JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
REPUBLIC OF TURKEY, MINISTRY OF ENVIRONMENT AND FORESTRY (MEF)

THE MASTER PLAN STUDY ON PARTICIPATORY WATERSHED REHABILITATION IN CORUH RIVER IN THE REPUBLIC OF TURKEY

FINAL REPORT

APPENDIX

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APPENDIX

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A. Natural Conditions and Soil Conservation

CONTENTS

A.ANNEXES:

A.1 INTRODUCTION

A.1.1 The Purpose of this Working Paper

This Working Paper presents and discusses information relevant to soil conservation in the Coruh River watershed (catchment). The natural conditions are first outlined (Section 2), leading to discussion of several significant issues and strategies for soil conservation in the catchment (Section 3). Section 4 presents some principles and practices for soil conservation which give useful guidelines when considering land management in relation to soil conservation (Section 5).

The Working Paper is not intended to be a comprehensive report on all aspects of soil conservation in the Coruh River catchment, but it provides passages of text suitable for inclusion in the Master Plan.

While the title of the Study is "The Master Plan Study on Participatory Watershed Rehabilitation in Coruh River in the Republic of Turkey", it should be noted that in this Working Paper the following usage of the terms 'watershed' and 'catchment' is preferred by this Consultant and by counterpart officers from Orman Bakanligi:

- a 'watershed' is, strictly speaking, the term used to denote the boundary of a catchment, and delineates the points or the line at which rain after falling may then flow either into the catchment under consideration, or into the adjacent catchment;
- the Coruh River watershed (Turkish: *Su Havzasi*) represents the boundary of the entire catchment for the Coruh River, which is approximately 2 million hectares in area;
- the Coruh River catchment has been divided into six Sub-Catchments (SCs) (Turkish: *Alt Havza*), ranging in area from about 180,000 to 652,000 hectares; and
- the Coruh River catchment has been divided into 63 Micro-Catchments (MCs) (Turkish: *Micro Havza*), ranging in area from about 12,000 to as much as 80,000 hectares, but averaging 25,000-38,000 in each MC.

A.1.2 Field Studies

The Consultant, together with members of the Study Team, undertook field inspections and village discussions for approximately 3 weeks in and around the Coruh River catchment from 20 October to 9 November 2002, and approximately 6 weeks from 10 June to 18 July 2003. Numerous discussions were held with staff of several State agencies, of course including many staff of the MEF in several centres. Staff of the NGO TEMA explained their activities with five villages in the Bayburt area. The Consultant is very grateful to all these respondents for their assistance in explaining numerous aspects of soil conservation in the Coruh River catchment.

During the first mission, perhaps two-thirds of the entire Coruh River catchment was viewed from main and subsidiary roads. Several forest villages were visited and some exploratory discussions held. Numerous examples of erosion control activities were inspected and assessed. During the second mission, attention focused on the natural conditions in the selected 6 MCs.

A.1.3 Data Collection

Data in the form of published and unpublished reports, maps and tabular material has been collected from numerous sources in Ankara, Erzurum, Artvin, Bayburt and elsewhere. A wide range of maps of catchment attributes was prepared for processing in the GIS. The GIS produced several maps of individual attributes superimposed on the agreed catchment base map with its MCs, together with computer-derived tabulations of the areas and percentage proportions of those attributes according to their distribution among MCs. Numerous discussions with many people in a wide range of agencies and in the villages provided facts, opinions and guidance on soil conservation and related topics. The quality of the data and other information has been assessed and cross-checked where possible.

A.1.4 Responsible State Agencies

The Study Team has been working with the participation and assistance of counterpart officers from the General Directorate for Reforestation and Erosion Control in the MEF (AGM). AGM is the main State agency responsible for assessing and treating soil erosion in areas under its management within the Coruh River catchment. The State Water Works (DSI: *Devlet Su Isleri*) has prepared comprehensive plans for the development of hydraulic engineering structures (dams, tunnels, intakes and other structures) on the Coruh River and some of its tributaries, and this agency is vitally concerned about the possibility that the functional lifespan of such structures may be greatly reduced by the accumulation of suspended sediments and bedloads in the Coruh River and its tributaries.

A.1.5 Forest Villages and Soil Conservation

Many parts of the Coruh River catchment exhibit extremely steep slopes, and erodible rocks and soils. The catchment is subjected to very harsh climates. In most of the catchment the annual rainfall is low (<500 mm) and the rain tends to fall in short storms of high intensity. Winters are intensely cold, with heavy snow. In Summer the temperatures are relatively high and humidities and rainfall low, while in Spring heavy snowpacks can melt quickly to produce rapid runoff from poorly-protected soils with low infiltration rates, and consequently severe torrent flows down steep slopes. Therefore, in most of the Coruh River catchment it will always be difficult to maintain a self-sustaining ground cover of grasses and trees for erosion prevention, even in the absence of grazing and other pressures.

Under the prevailing natural conditions of climate, slopes, geology and soils, the natural (geologic) rates of erosion have always been and will remain high in much of the catchment. However, the high rates of natural erosion have been exacerbated during the past decades by very high rates of accelerated erosion in many places.

Over many years, the forest villagers have cleared forests for fuelwood, animal fodder and timber, have over-grazed the rangelands and have converted rangelands to arable fields on steep slopes. They have been the major (but not the only) agents responsible for initiating and exacerbating accelerated soil erosion within many parts of the Coruh River catchment. In addition, the forest harvesting policies and practices of the Ministry may also have contributed to an unsustainable level of forest exploitation and consequent degradation of natural forest conditions and soils.

Villagers have cleared forests in an attempt to obtain desperately needed arable land, although it is often of poor quality and high erodibility. Rangelands have been treated as "a common good" which supplies free grazing, even if this eventually results in soil degradation and low pasture productivity which seriously affect all the participants. Villagers have been forced by their poverty and their urgent needs for pastures and new arable land to exploit the natural resources without restraint and with little regard to the sustainability of their actions. There are no effective penalties for over-grazing, and there are no effective rewards or incentives for any individual villager to refrain voluntarily from over-grazing. Therefore, economic pressures encourage each villager to seek to obtain the maximum personal advantage from the common natural resources every day, at least until the effort required to exploit the natural resources exceeds the value obtained from them. While the villagers can be blamed for these historical trends and consequences, the fact that these pressures occurred in the past and are still occurring is not very helpful in considering future rehabilitation of natural resources and maintenance of village livelihoods.

It must be recognized that, in reality, the villagers have always been the actual "managers" of the local natural resources, despite the efforts and intentions of the forestry and other Government agencies, and despite the legal status of the lands on which the resources occur. They will remain the real managers of the natural resources. Any strategies and tactics (project activities, or development instruments) for rehabilitation and natural resource management proposed in the Master Plan for sustainable rehabilitation and management of the Coruh River catchment will have to recognize the important managerial role of the villagers. Furthermore, the villagers will not cooperate in any meaningful way with any proposed tactics for rehabilitation and natural resource management unless they are convinced that this will be in their own best interests. Foremost among these interests is the need for immediate day-to-day income from income-generating activities, most of which will continue to be agriculturally-based. Therefore, the strategies and tactics proposed in the Master Plan must always include measures (activities) which take account of the villagers' needs for daily income. If it is proposed to limit or prohibit any agricultural activity, such as access to forests

or rangeland, then any consequent loss of income to villagers must be compensated for by some other activity which will produce equivalent (or better) income.

These considerations are highly relevant to the issues and strategies for soil conservation discussed in Section 3. The Master Plan must address the serious challenge of deciding how forest villagers can be encouraged to act as voluntary and responsible land managers in protecting and rehabilitating the natural resources of the catchment from which they derive their livelihoods. The task is far too big for any Government agency – the only solution which has any chance of success is to "recruit" the forest villagers as trained and concerned land managers.

A.2 NATURAL CONDITIONS IN THE CORUH RIVER CATCHMENT

A.2.1 Topography

(1) Introduction

Much of the Coruh River catchment is notable for its rugged topography and beautiful scenery which, combined with some areas of impressive forests and the potential for recreational use of parts of the Coruh River, have provided numerous venues for local and international tourism. Trekking, hunting, rafting, viewing wildlife and other recreations all possess development potential, largely based on the natural resources.

There have always been high rates of natural erosion in parts of the Coruh River catchment, which is partly why the area has such steep topography. However, the steep topography also exacerbates the serious potential for accelerated soil erosion if the land is mismanaged. Unfortunately, there has been considerable mismanagement over long periods, principally through over-grazing and poor forest management by villagers and other participants.

(2) Data

The available information about the topography of the Coruh River catchment is summarized in Figure 3.1-1, Table 2.1 and Annex 1. The data was derived from computerized analysis of remote-sensed images in the Study GIS. There are six slope classes. Information about the gentler slope classes is important for understanding the potential for small-scale irrigation, but is less important for understanding the topography of the broader landscape. In the discussion below, Slope Classes 1 to 4 (SC1 to SC4) are SC1 = 0-12%, SC2 = 12-30%, SC3 = 30-45% and SC4 = more than 45%.

(3) Discussion

Figure 3.1-1, Table 2.1 and Annex 1 clearly indicate the spatial distribution of different slope classes. Artvin Province is much more mountainous than the other two Provinces, although they also have some localized very steep areas. Table 2.1 includes the data for slope distribution in the six MCs (in five of the Sub-Catchments) which were selected for detailed study.

The Sub-Catchments and their Micro-Catchments (MCs) have the following characteristic topographic features:

- Berta Sub-Catchment. Most of the MCs have a mean slope of about 25%, with SC2 the most common. Five of the seven MCs have significant proportions of land in SC4, with BT-06 the most mountainous. Two of the 7 MCs have about 30% of flat (SC1) land (BT-03 and BT-04). The combined proportions of SC3 plus SC4 are about 40% on average, and about 75% in BT-06.
- Lower Coruh Sub-Catchment. Most of the MCs have a mean slope of about 33%, with SC3 the most common (about 40% of the area). Most of the 7 MCs have about 30% of SC4. There is very little flat land (SC1) in the Sub-Catchment (the mean is 7%). The combined proportions of SC3 plus SC4 are about 60% on average, with nearly 75% of LC-01 in the steepest lands.
- Middle Coruh Sub-Catchment. This Sub-Catchment is generally steep to very steep, with about 65% of the land in SC3 and SC4 on average. The proportion of SC4 in most MCs is about 30%, with one MC (MC-09) at 36.2%. Overall, there is only about 7% of flat land in the Sub-Catchment. Some MCs have about 70% of land in the two steepest classes.
- Oltu Sub-Catchment. This Sub-Catchment has 16 MCs, with a remarkably high proportion of flat land (averaging 35.1%). Conversely, there is only 6.5% of SC4 on average, although OL-13 has 29.4% in SC3 and 26.4% in SC4.
- Tortum Sub-Catchment. On average, the Sub-Catchment has about 62% of land less than 30% slope, and one MC (TR-02) has about 80% of this land. One MC (TR-06) is particularly steep, with about 58% in SC3 and SC4 combined.
- Upper Coruh Sub-Catchment. This Sub-Catchment has the least steep land, on average, with only about 23% in SC3 and SC4 combined. UC-17, on the northern border of the Sub-Catchment, has about 67% of its land in these two classes. The proportion of SC1 is 37% on average, with some MCs (UC-06 and UC-07) having about 70% and 61% respectively. Thirteen of the 17 MCs in this Sub-Catchment have more than 15% of their land at slopes less than 6%, which are probably suitable for irrigation. UC-06 has nearly 50% of this land, and UC-07, UC-08, UC-09 and UC-11 have more than 25% of these gentle slopes.

(4) Summary of Findings

1. The steepest land in the Coruh River catchment is concentrated in the three northeastern Sub-Catchments – Berta, Lower Coruh and Middle Coruh. The area around the Coruh River between Yusefeli and Artvin is particularly steep.
2. The most subdued topography is found in the south and west of the catchment, notably in Oltu, Tortum and Upper Coruh Sub-Catchments.
3. Upper Coruh Sub-Catchment has the least steep land, on average, in the Coruh River catchment, and many of the MCs have high proportions of land at slopes less than 6%, which are probably suitable for irrigation.

Table A.2.1 Distribution of slope classes by area (ha) and percentage in MCs

Sub-Catchment	Name of MC	Total Area (ha)	0-2% (ha)	2-6% (ha)	6-12% (ha)	12-30% (ha)	30-45% (ha)	over 45% (ha)	0-2% (%)	2-6% (%)	6-12% (%)	12-30% (%)	30-45% (%)	over 45% (%)
Berta	BT-04 (Savsat)	18,518	479	1,880	3,155	8,991	3,046	967	2.6	10.2	17.0	48.6	16.4	5.2
	Sub-total	228,030	3,426	12,867	24,281	91,347	62,905	33,204	1.5	5.6	10.6	40.1	27.6	14.6
Lower Coruh	**Sub-total**	**177,693**	**1,239**	**4,238**	**7,020**	**51,426**	**68,612**	**45,159**	**0.7**	**2.4**	**4.0**	**28.9**	**38.6**	**25.4**
Middle Coruh	MC-03 (Yusufeli)	21,554	186	656	1,188	8,288	6,976	4,260	0.9	3.0	5.5	38.5	32.4	19.8
	Sub-total	**259,022**	**1,353**	**6,028**	**10,364**	**69,142**	**99,952**	**72,184**	**0.5**	**2.3**	**4.0**	**26.7**	**38.6**	**27.9**
Oltu	OL-04 (Oltu)	38,463	2,003	3,989	5,112	16,318	8,296	2,745	5.2	10.4	13.3	42.4	21.6	7.1
	Sub-total	**501,260**	**31,444**	**56,598**	**87,846**	**215,319**	**77,706**	**32,347**	**6.3**	**11.3**	**17.5**	**43.0**	**15.5**	**6.5**
Tortum	TR-06 (Uzundere)	30,684	330	1,138	1,760	9,315	10,058	8,083	1.1	3.7	5.7	30.4	32.8	26.3
	Sub-total	**203,035**	**7,269**	**17,333**	**26,896**	**75,995**	**47,699**	**27,843**	**3.6**	**8.5**	**13.2**	**37.4**	**23.5**	**13.7**
Upper Coruh	UC-03 Bayburt)	21,873	1,286	1,867	2,372	8,953	5,540	1,855	5.9	8.5	10.8	40.9	25.3	8.5
	UC-14 (Ispir)	31,167	535	1,471	3,432	13,465	8,515	3,749	1.7	4.7	11.0	43.2	27.3	12.0
	Sub-total	651,814	65,739	77,627	92,556	262,065	115,965	37,862	10.1	11.9	14.2	40.2	17.8	5.8
Others	665													
	Total	**2,020,855**	**110,470**	**174,691**	**248,963**	**765,293**	**472,838**	**248,599**	**5.5**	**8.6**	**12.3**	**37.9**	**23.4**	**12.3**

Source: remote sensed data processed by the GIS

A.2.2 Climate

(1) Introduction

Some details of the climatic features of the Study Area are provided in this Section.

(2) Data

Table A.2.2 gives detailed climatic information for several stations within and just outside the Study Area. The stations are well distributed within the Study Area, and give representative information for most of the Sub-Catchments.

(3) Discussion

Major features of the climates at these stations include:

- Artvin. The lowest elevation station, and not as cold as the others, with only 18 days of frost per year. Artvin station records the highest rainfall of all stations, at 660 mm/year. The parts of the Study Area north and east of Artvin town, towards the Black Sea and the Georgian border, will have higher annual rainfall but there are few reliable records.
- Erzurum. The city is at high altitude, and is renowned for its very low temperatures. There are 154 days of frost/year and the mean annual temperature is only 6^0C. The minimum temperatures from November to March are around –30^{o}C. Conversely, from June to September the maximum temperature is about 34^{o}C. The average rainfall is 460 mm/yr, much of which falls as snow in winter on 112 days/yr.
- Bayburt. Even though it is only a little lower than Erzurum, the average minimum temperature is much higher than Erzurum, at –11.4^{o}C with 36 days of frost. The average annual rainfall is 426 mm.
- Yusufeli. This area has a very harsh climate. The annual rainfall is only about 300 mm, with very high temperatures from April to October and rather low temperatures in winter.
- Tortum. The average annual rainfall is 434.9 mm. The mean maximum and minimum temperatures are 35.4^{o}C and –20.8^{o}C respectively. There are 125 days of frost/yr.
- Oltu. The average annual rainfall is 382.3 mm. The average annual temperatures are very similar to those at Tortum.

Most of the Study Area has harsh climates, with generally very low temperatures and heavy snow in winter and rather high temperatures in summer, especially at Yusufeli. Except in the vicinity of Artvin, the rainfall is generally very low, again especially at Yusufeli. Except in the vicinity of Artvin, the climatic conditions are not conducive to the growth of highly productive forests. The conditions for pasture growth in the rangelands are obviously quite difficult, and the growing seasons will be short. The climatic conditions strongly influence soil erodibility and soil erosion in at least two ways:: firstly by discouraging (or at least not

encouraging) vigorous forest and pasture growth and the maintenance of the highest feasible vegetative cover; and secondly by producing occasional high intensity storms falling onto bare ground. When the rain falls on steep, gullied, bare terrain most of it will produce torrent runoff with very high erosive power.

(4) Summary of Findings

1. Most of the Coruh River catchment has harsh climates, with very low and high temperatures in winter and summer respectively, and low annual rainfalls with occasional high intensity storms which exacerbate soil erosion and torrents in steep gullies.
2. The area around Yusufeli has a particularly harsh climate. The annual rainfall is only about 300 mm, with very high temperatures from April to October and rather low temperatures in winter.
3. The harsh climates predispose to short growing seasons, and difficult conditions for plant growth and rehabilitation of forests and rangelands.

Table A.2.2 Detailed climatic information for several stations within and just outside the Study Area

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Period
ARTVIN	Observation period: 1932-1990				Latitude: 41 11'N			Longitude: 41 49'E			Elevation: 628 m			
Average temp. (°C)	2.7	3.8	7.1	12.0	15.9	18.6	20.5	20.6	17.9	13.8	9.2	4.6	12.2	42 yrs
Maximum temp. (°C)	6.2	8.2	12.4	18.0	22.0	24.2	25.5	25.9	23.7	19.5	13.6	7.9	25.9	42 yrs
Minimum temp. (°C)	-0.4	0.3	2.8	7.2	11.1	14.0	16.5	16.6	13.8	9.8	5.8	1.7	-0.4	42 yrs
Humidity (%)	64	64	62	61	65	68	72	71	70	66	65	65	66	42 yrs
Rainfall (mm)	85.1	71.4	55.6	53.1	50.3	46.8	27.0	25.8	35.1	55.6	70.0	87.1	662.9	42 yrs
Evaporation (mm)	-	-	89.4	100.5	116.0	116.8	122.0	121.4	107.9	85.0	49.6	65.9	974.5	26 yrs
Sunshine hours (min)	137	187	250	352	366	407	360	413	383	273	179	120	286	6 yrs
Solar rad. (cal/cm^2/min)	141.7	238.1	316.7	401.3	450.1	487.7	453.8	441.8	363.8	246.9	158.9	118.7	318	6 yrs
Days of frost	3.7	2.4	3.3	0.6	0.0	-	-	-	-	0.4	2.6	5.4	18.4	42 yrs
ERZURUM (1869 m)	:				:									
Average temp. (°C)	-8.3	-7.0	-3.0	5.1	10.9	15.0	19.1	19.6	14.9	8.6	2.0	-5.1	6.0	42 yrs
Maximum temp. (°C)	8.0	10.6	17.8	23.5	29.6	32.2	34.0	34.0	31.4	26.0	20.7	12.3	34.0	42 yrs
Minimum temp. (°C)	-30.1	-27.5	-24.8	-18.5	-6.4	-3.2	1.8	1.2	-3.8	-12.0	-25.6	-28.0	-30.1	42 yrs
Rainfall (mm)	25.7	30.2	40.0	53.5	75.8	53.7	29.7	18.6	27.1	46.7	35.9	23.6	460.5	42 yrs
10mm<Rainfall day (days)	0.3	0.4	0.8	1.4	2.4	1.7	0.9	0.5	0.8	1.5	0.9	0.3	11.9	42 yrs
Daily Max.Rainfall (mm)	40.3	23.4	35.6	39.5	34.3	43.8	42.1	44.6	39.2	46.3	33.5	35.4	46.3	42 yrs
Hourly Max.Rainfall(mm)													21.5	
Evaporation (mm)	76	75	74	65	60	56	50	46	49	60	71	75	63	41yrs
Sunshine hours (min)	185	253	308	377	483	616	681	663	558	423	271	187	423	50 yrs
Days of snowfall	29.4	26.5	21.5	4.0	0.2				0.0	0.9	6.4	23.2	112.2	70 yrs
Days of frost	30.7	27.8	28.2	11.9	1.1	0.1			0.3	5.5	18.4	29.8	153.9	42yrs
10 (°C)> days				4.5	18.3	27.9	30.8	30.9	26.9	9.5			148.9	15yrs
BAYBURT	Observation period: 1929-1990				Latitude: 40 15'N			Longitude: 40 14'E			Elevation: 1584 m			
Average temp. (°C)	-7.1	-5.4	-3.0	6.8	11.6	15.0	18.8	18.4	14.5	8.8	2.6	-3.4	6.5	30 yrs
Maximum temp. (°C)	-1.9	0.1	5.0	12.6	17.8	21.9	26.4	26.7	23.0	16.1	8.5	1.3	26.7	30 yrs
Minimum temp. (°C)	-11.4	-9.8	-4.6	1.7	5.6	8.2	10.9	10.4	7.0	3.1	-1.8	-7.3	-11.4	30 yrs
Humidity (%)	74	74	71	64	61	59	53	51	52	62	71	74	64	30 yrs
Rainfall (mm)	24.8	27.1	36.6	57.8	67.6	53.4	21.2	14.6	20.9	39.7	35.0	27.5	426.2	62 yrs
Evaporation (mm)	-	-	-	-	98.1	139.8	179.1	170.8	128.6	61.0	26.8	-	804.2	14 yrs
Days of frost	3.5	3.1	4.4	2.8	0.8	0.2	0.0	0.0	0.9	6.0	9.6	4.8	36.0	57 yrs

YUSUFELI (611 m)														
Average temp. (°C)	3.8	5.2	10.0	14.8	19.3	23.4	26.0	26.3	21.7	14.6	9.5	4.8	15.0	
Maximum temp. (°C)	16.8	22.2	24.0	34.0	36.1	40.0	42.0	42.5	38.5	31.5	25.2	17.6	42.5	
Rainfall (mm)	19.4	18.5	24.1	33.0	39.3	34.7	26.3	15.6	16.4	19.0	25.0	24.6	295.8	
Days of frost	18.0	15.4	8.2	0.8						0.1	1.9	12.6	57.0	
TORTUM	Observation period: 1954-1970				Latitude: 40 18'N			Longitude: 40 34'E			Elevation: 1550 m			
Average temp. (°C)	-3.4	-2.2	1.6	7.2	12.4	16.1	19.6	19.5	15.3	9.5	5.0	-0.6	8.3	18yrs
Maximum temp. (°C)	10.0	11.4	16.0	25.1	28.1	32.0	35.4	35.0	30.5	26.4	20.0	12.2	35.4	18yrs
Minimum temp. (°C)	-18.5	-20.8	-19.0	-12.7	-3.0	-3.3	5.5	6.0	-0.6	-8.0	-15.3	-19.0	-20.8	18yrs
Humidity (%)	67	64	66	59	58	55	52	50	51	56	62	68	59	18yrs
Rainfall (mm)	28.4	23.6	39.5	50.1	66.6	62.1	34.6	24.5	19.2	32.0	29.8	24.4	434.9	18yrs
10mm<Rainfall day (days)	0.6	0.4	1.1	1.2	1.9	1.8	0.9	0.8	0.4	0.9	0.7	0.4	11.1	18yrs
Daily Max.Rainfall (mm)	30.8	30.3	26.8	59.7	43.0	36.0	50.0	30.3	16.9	37.0	32.2	27.0	59.7	18yrs
10 (°C)> days			0.4	8.3	24.8	29.3	31.0	31.0	29.1	15.7	2.4		172.1	18yrs
Days of frost	28.0	25.7	21.6	8.3	0.8	0.1			0.1	4.0	11.0	25.6	125.3	18yrs
OLTU (1275 m)														
Average temp. (°C)	-1.7	-1.6	-4.0	10.3	14.9	18.3	22.0	22.8	16.9	11.3	6.1	0.4	10.2	5 yrs
Maximum temp. (°C)	11.5	16.8	19.0	30.0	30.7	36.5	36.6	36.3	32.6	26.8	19.6	12.0	36.6	5 yrs
Minimum temp. (°C)	-18.7	-20.1	-16.2	-4.0	-1.3	-0.4	8.0	8.7	1.5	-4.2	-15.2	-14.7	-20.1	5 yrs
Humidity (%)	65	63	54	57	51	52	51	53	60	66	69	58	58	20 yrs
Rainfall (mm)	20.4	23.0	27.2	40.7	45.6	49.6	42.8	23.7	20.2	28.8	20.8	19.5	382.3	20 yrs
10mm<Rainfall day (days)	0.3	0.4	0.6	0.9	2.0	1.3	1.4	0.8	0.6	1.0	0.6	0.4	10.2	5yrs
Daily Max.Rainfall (mm)	40.1	29.9	19.7	41.7	27.9	27.3	42.1	42.5	45.0	48.6	21.4	21.5	48.6	20yrs
Hourly Max.Rainfall(mm)													31.2	
10 (°C)> days			0.4	8.3	24.8	29.3	31.0	31.0	29.1	15.7	2.4		172.1	7yrs
Days of frost	28.0	25.7	21.6	8.3	3.0	0.1		0.0	0.1	4.0	11.0	25.6	125.3	10 yrs

Sources: Reports on soil fertility and fertilizer requirements in the Study Area, GDRS
Statistical Yearbook of Turkey, 2001
OGM (Artvin, Erzurum)

A.2.3 Geology

(1) Introduction

The geological features of an area are important because they influence the topography, the types and fertilities of the soils which are developed from the weathering rocks, and the natural rates of weathering and landscape change.

(2) Data

The map showing the geology of the Coruh River catchment (Figure 3.2-2) was derived by the Study GIS from three geological maps prepared in the 1960s by MTA at scales of 1:500,000. These had been prepared from more detailed maps at 1:100,000 scale. However, late in the second period of field work the Consultant learned that the MTA has recently revised this map. The new (2002) geological map at 1:500,000 scale is much better, both in presentation and the Legend, than the earlier one from which Figure 3.2-2 was prepared. It has not been possible to amend the original data, but the new map has been studied and some observations drawn from it are presented below.

The Legends of the original maps contained numerous classes of rock types. Several of these, especially the less common types, have been combined into a total of about 24 classes for relative ease of mapping and comprehension. Nevertheless, the geological picture is still rather complicated.

Two other publications give authoritative information about the geology of the Study Area: Ali Gunduz (2001), *Coruh Havzasi ve Artvin*, and Atalay, I., Tetlik, M., Yilmaz, O., (1985) *The Ecosystems of Northeastern Turkey*, Ormancilik Arastirma Ensititusu Yayinlari Teknik Bulten Serisi No. 141.

Tables 2.3 and 2.4 and Annexes 2 and 3 show the geological types by both area (km^2) and percentage in each MC. They were derived by the GIS from the basic data set, as depicted in the map.

(3) Discussion

In summary, the Eastern Black Sea Mountains have Paleozoic basement rocks, mostly micaceous quartz, granites and schists. These are overlain by younger (Cretacous to Eocene) rocks, mostly undifferentiated volcanics, basalts and limestones. The whole Coruh River catchment was subject to tectonic and volcanic deformations in the Triassic and Jurassic. Many of the rocks are densely faulted and folded, brittle and unstable, which promotes natural erosion at rapid rates. There are small scattered areas of alluvia and colluvia.

Atalay *et al.* (1985) (p.33) give a simplified Legend for the rocks of the Study Area:

Geological Period	Approximate Age (m years ago)	Rock Types
Quaternary (Pleistocene)	Present – 1.8	Alluvia, colluvia, slope debris
Pliocene-Quaternary	Present - 5	Clay, marl, sand, gravel
Miocene-Pliocene	1.8-24	Marly limestones
Neogene	1.8 – 15	Conglomerates and breccia with volcanic materials
Oligocene	24 – 34	Deposits containing gypsum, salt and alkali
Eocene	34 – 55	Flysches containing basalts and gabbro. Flysches with sand and conglomerates
Upper Cretaceous	65 - 98	Flysches containing volcanic rocks
Cretaceous-Jurassic	65 – 205	Limestones
Lower Mesozoic	Various ages, since about 205	Ophiolites (peridotites, serpentines, gabbro, basalts
Paleozoic	251 – 545	Quartzites, crystalline limestones, schists

At various times, granites, andesites, trachytes and basalt tuffs have been laid down.

In geomorphological terms, Atalay *et al.* (1985) list the features exhibited in various parts of the Coruh River catchment. They include very rugged and high mountainous terrains, undulating areas and basalt plateaux. There are Neogene volcanic plateaux and slightly undulating surfaces (now seen as the *yayla* rangelands), and volcanic cones. Other geologically recent features include dissected gullies, fault scarps, fossil surfaces, landslides, cuesta, flood and sedimentation areas, alluvia of many ages, swamps and meadows, fluvial terraces, dejection cones and fans, cliffs, incised valleys, epigenetic and antecedent valleys and numerous glacial features such as cirque lakes, valleys, knobs and moraines. Faults, anticlines, synclines and overthrusts may be commonly observed.

As stated above, the geological structure of the Coruh Rover catchment is very complicated, and becomes even more complicated at the scale of the MCs. Some of the general observations about the whole catchment which can be drawn from the Figure 3.2-2, Tables 2.3 and 2.4 and Annexes 2 and 3 include:

- The Study Area is dominated by volcanic rocks of various types, mostly of Cretaceous age (65 to 141 million years of age). There is a large area of granite and granodiorite in the northern section of the catchment, with related volcanic rocks west of Artvin.
- Most of the middle course of the Coruh River, from near Bayburt to Yusufeli, has Eocene volcanics (34 to 55 million years). Downstream from Yusufeli the river runs through Palaeozoic (older than 250 million years) metamorphic rocks.
- Another prominent area northwest of Tortum and also extending to parts of the eastern and northern boundaries of the catchment contains basalts and related rock types.
- There are some areas of serpentines (ultrabasic rocks with high manganese contents) around Yusufeli and Narman.
- The Oligocene-Miocene (5 to 55 million years) gypsiferous facies (rock types) around Narman are notable for their extremely eroded bare slopes.

- There are some reasonably extensive Quaternary (less than 1.8 million years) deposits on flat or gently undulating plains west of Bayburt, for example near Aydintepe.

With respect to the individual MCs, specific observations drawn from a study of the new map include:

Area	Map symbols	Rock Types
Berta Sub-Catchment (SC), Savsat Micro-Catchment (MC)	Pn	The eroded hills behind Kirecli are Paleocene clastic and carbonate rocks
	e 2-3	All the NW side of the MC is Upper Eocene volcanic and sedimentary rocks
	k2	The west side of the MC has Upper Cretaceous volanics, clastic and carbonate rocks
	m3plv	Upper Miocene volcanic and sedimentary rocks
Middle Coruh SC, Yusufeli MC	k2	Almost all the MC is Upper Cretaceous clastic and carbonate rocks
	pn, e2-3, e1-2	The Alanbasi area has very complex geology, with Paleozoic clastic and carbonate rocks underlying Lower and Middle Eocene clastic rocks (continental in places) and in turn underlying Middle and Upper Miocene volcanic and sedimentary rocks
Oltu SC, Oltu MC	jk	N of Tutmac the eroded hills are Jurassic-Cretaceous basic volcanic and sedimentary rocks.
	j1-2B, ev, e1-2	Between Ozdere and Tutmac the oldest rocks are Lower and Middle Jurassic basalts, andesites and spilites, overlain by Eocene undifferentiated volcanic and clastic rocks.
	j3-k1, e1-2, olv	E of Basakli there are Upper Jurassic and Lower Cretaceous clastic and carbonate rocks. Along the stream there are younger Lower-Middle Eocene clastics. To the W of the village are Oligocene undifferentiated volcanics.
	jk, k3, e1-2, olm1	The geology of the area around Ballica, and especially around and W of Orcuk, is extremely complex. There are many different types of rocks and much faulting, which explains the instability of the area. A complex of volcanics, clastics, carbonate rocks and sedimentary rocks from Jurassic to Miocene ages is present.
	Q, olm1	Near Oltu town there are extremely eroded Quaternary alluvial fans and slope debris, together with Oligocene/Miocene evaporates and rocks.
Tortum SC, Uzundere MC	j3k1, k, pnv	Most of the MC, at least around the selected Forest Villages, has Upper Jurassic to Lower Cretaceous clastic and carbonate rocks and considerable pelagic limestone. Just E of Uzundere town there is an area of Paleocene (or Lower Eocene) undifferentiated acidic volcanic rocks.
Upper Coruh SC, Bayburt MC	k, j3m1	Gezkoy, Heybetepe and Masat have Lower Cretaceous pelagic limestones. Most the rest of the MC has Upper Jurassic/Lower Cretaceous pelagic limestones.
Upper Coruh SC, Ispir MC	y2, m1-2, j3ki, k	The road to Gockoy passes through Carboniferous granitoids. The rolling rangelands around Numanpasa are on Lower/Middle Miocene evaporates and sedimentary rocks. The Durukoy and Kockoy areas have complicated geology, but are mostly UpperJurassic and Lower Cretaceous clastic and carbonate rocks, with volcanics in places. Korpukoy is nearly all Lower Cretaceous pelagic limestones.

As previously stated, the geological features of an area are likely to influence:

- the susceptibility of the area to weathering and natural erosion;
- the formation of soils from the different rocks;
- the fertility of the soils; and
- the rates of accelerated erosion.

In the case of the Coruh River catchment, the major control of natural rates of weathering and production of sediments and bedloads appears to be largely related to the types of rocks, the amount of faulting and the degree of stratification of the rocks. In the field numerous cases were seen where the exposed ends of steeply-dipping strata were providing copious debris to colluvial fans, while the faces of the strata were less weathered. These effects produce a characteristic jagged topography and different bedloads to the streams and rivers.

Any apparent correlations between the different rock types and the soils which are formed from them, and their susceptibility to soil erosion, are examined in Section 2.8. Soils formed from basalt are likely to be deeper, more fertile and to possess structures which are more resistant to erosion than would be soils formed from acidic rocks such as granites. Quaternary alluvial deposits will form soils which are generally more fertile than soils from granites, granodiorites and most metamorphic rocks.

(4) Summary of Findings

1. In the case of the Coruh River catchment, the major control of natural rates of weathering and production of sediments and bedloads appears to be largely related to the types of rocks, the amount of faulting and the degree of stratification of the rocks.
2. A wide variety of rock types is found in the Coruh River catchment, although the area is dominated by volcanic rocks of different types and ages.
3. Extensive areas near Tortum and also extending to parts of the eastern and northern boundaries of the catchment contain basalts and related rock types.
4. There are some areas of serpentines (ultrabasic rocks with high manganese contents) around Yusufeli and Narman.
5. The gypsiferous rocks around Narman are notable for their extremely eroded bare slopes.
6. The only reasonably large extensive deposits of recent alluvia in the catchment are found on flat or gently undulating plains west of Bayburt.

Table A.2.3 Geological types, by area (km^2) in each MC

SC		Total Area	A	Eoc., Flysch	Eoc., Volc. Facies	Juras.-Cret.	K	Lias	Lower Cret.	Lower Cret., Flysch	Malm	Mesoz. (Ophiol. Series), Mainly Cret.	Neog., Volc. Facies	Neog., Cont, Undif.	Oligo-Mioc., Gypsif. Facies	Paleoz., Metam.,	Q	Upper Cret.	Upper Cret., Flysch	Upper Cret., Volc. Facies	Upper Mioc.	Y	Others
Berta	Sub-total	2,280	670	53	33	27	3	0	0	0	0	0	0	0	42	75	3	18	0	1,356	0	0	0
Lower Coruh	Sub-total	1,777	190	0	470	7	10	0	0	0	0	0	0	0	0	140	0	0	0	960	0	0	0
Middle Coruh	Sub-total	2,590	66	106	426	66	925	27	0	25	105	0	0	0	0	227	40	59	7	364	0	147	0
Oltu	Sub-total	5,013	1,636	306	63	0	38	30	0	360	309	285	5	273	618	283	57	256	344	69	0	72	8
Tortum	Sub-total	2,030	686	16	99	0	62	23	0	336	450	0	139	0	9	0	0	4	182	0	0	24	0
Upper Coruh	Sub-total	6,518	134	548	1,006	4	1,000	782	738	197	767	58	0	0	0	302	475	118	4	196	144	22	24
Others	7																						
Total		**20,209**	**3,383**	**1,028**	**2,097**	**104**	**2,039**	**862**	**738**	**918**	**1,632**	**343**	**145**	**273**	**669**	**1,025**	**574**	**456**	**536**	**2,945**	**144**	**265**	**32**

Note: Others include Cretaceous, undifferentiated with 8km^2, Permo-Carboniferous with 14 km^2 and Pliocene, Continental with 10 km^2.
Source: JICA Study Team calculation using GIS based on old (1960s) geological maps (scale 1:500,000) by MTA.

Table A.2.4 Geological types, by percentage of each MC

SC		Total	A	Eoc., Flysch	Eoc., Volc. Facies	Juras.-Cret.	K	Lias	Lower Cret.	Lower Cret., Flysch	Malm	Mesoz. (Ophiol. Series), Mainly Cret.	Neog., Volc. Facies	Neog., Cont, Undif.	Oligo-Mioc., Gypsif. Facies	Paleoz., Metam.,	Q	Upper Cret.	Upper Cret., Flysch	Upper Cret., Volc. Facies	Upper Mioc.	Y	Others
Berta	Sub-total	100.0	29.4	2.3	1.5	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	3.3	0.1	0.8	0.0	59.5	0.0	0.0	0.0
Lower Coruh	Sub-total	100.0	10.7	0.0	26.4	0.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.9	0.0	0.0	0.0	54.0	0.0	0.0	0.0
Middle Coruh	Sub-total	100.0	2.6	4.1	16.5	2.6	35.7	1.0	0.0	1.0	4.1	0.0	0.0	0.0	0.0	8.7	1.5	2.3	0.3	14.0	0.0	5.7	0.0
Oltu	Sub-total	100.0	32.6	6.1	1.3	0.0	0.8	0.6	0.0	7.2	6.2	5.7	0.1	5.5	12.3	5.6	1.1	5.1	6.9	1.4	0.0	1.4	0.2
Turtum	Sub-total	100.0	33.8	0.8	4.9	0.0	3.1	1.1	0.0	16.5	22.2	0.0	6.8	0.0	0.5	0.0	0.0	0.2	8.9	0.0	0.0	1.2	0.0
Upper Coruh	Sub-total	100.0	2.1	8.4	15.4	0.1	15.3	12.0	11.3	3.0	11.8	0.9	0.0	0.0	0.0	4.6	7.3	1.8	0.1	3.0	2.2	0.3	0.4
Others																							
Total		**100.0**	**16.7**	**5.1**	**10.4**	**0.5**	**10.1**	**4.3**	**3.7**	**4.5**	**8.1**	**1.7**	**0.7**	**1.4**	**3.3**	**5.1**	**2.8**	**2.3**	**2.7**	**14.6**	**0.7**	**1.3**	**0.2**

Note: Others include Cretaceous, undifferentiated, Permocarboniferous and Pliocene, Continental.

Source: MTA old (1960s) geological maos for Trabzon, Erzurum and Kars (1:500,000), processed by Study GIS

A.2.4 Hydrology

(1) Introduction

The Coruh River and its tributaries rise in the western part of the catchment west and south of Bayburt at altitudes of about 2000 m and flow about 300 km to the Black Sea, crossing the Turkish border into Georgia for the last few kilometers. The river and its tributaries are notable for their rapid flows, especially when the snow melts. The Coruh River is already being used for recreational activities such as rafting between Ispir, Yusufeli and Artvin. The River and tributaries are the main sources of water for irrigation and drinking for villages along their banks, and carry some of the wastes from those villages and from agricultural activities. They transport suspended sediments and bedloads from the landscapes and roads which will affect the future dams. The sediments ultimately flow to the Black Sea, unless trapped by the dams, and the quality of the water which enters the Black Sea is important to the biological health of that body of water.

(2) Data

The Study Team prepared a River Drainage Map, which is attached. DSI provided a map showing the locations of the hydrological measuring stations in the Coruh River catchment (numbered No. 23), which is also attached. There are approximately 40 stations in the catchment, but not all are measured with the same frequency. The stations are mostly concentrated along the Coruh River downstream of Bayburt, with several on the Tortum, Berta and Oltu streams, and there are no stations within the extreme western and southern areas of the catchment. Information on the discharges of water and sediment for nine selected stations is presented in Table 2.5. The Study Team has little reliable information on the water quality of the Coruh River and its tributaries.

(3) Discussion

The information in Table 2.5 is derived from very detailed records of many measurements throughout the year and over many years at most stations. The hydrological characteristics demonstrated in the table include:

- The Coruh River, and especially its tributaries, demonstrate extreme ranges between maximum and minimum discharges throughout the year. They are very “flashy” streams, subject to extreme storm events which will produce rapid, massive, very erosive flows.
- As might be expected, the within-year variations in discharge demonstrate a clear seasonal pattern, with the highest discharges during the snow melt within the period March to June approximately, very low discharges in Summer and generally low flows in Autumn and Winter.

- The coefficients (R^2) for the regressions of log daily average suspended sediment (t/day) on log daily average discharge in m^3/second (cumecs) demonstrate a close relationship between these parameters. In other words, the larger the discharge the faster the water velocity and the greater the transport of suspended sediment. Murgul Cayi is the exception, with a very low coefficient, due solely to four aberrant readings when sediment discharge was much lower than expected for the water discharge. Apart from those four readings, all other readings would conform to the close relationship measured at the other stations.
- The average sediment discharges in t/km^2/yr range from as low as 61 to as high as 653 in different Sub-Catchments. There is no obvious relationship between catchment size and sediment discharge. Other possible relationships between some catchment characteristics and sediment discharge will be examined in Section 2.8.
- Sediment composition (%sand:%silt+clay) mostly varies from about 40:60 to 60:40, with one striking exception (Station 2331, Deviskel Deresi) at 20:80. The available data is insufficient to provide an explanation for this exception.
- The data on sediment discharge will be further discussed in Section 2.9, in relation to the effects of sediment on the dams to be built on the Lower Coruh River.

(4) Summary of Findings

- The Coruh River, and especially its tributaries, demonstrate extreme ranges between maximum and minimum discharges throughout the year. They are very “flashy” streams, subject to extreme storm events which will produce rapid, massive, very erosive flows.
- The within-year variations in discharge demonstrate a clear seasonal pattern, with the highest discharges during the snow melt within the period March to June approximately, very low discharges in Summer and generally low flows in Autumn and Winter.
- The larger the average daily water discharge the faster the water velocity and the greater the average daily transport of suspended sediment.
- The average sediment discharges in t/km^2/yr range from as low as 61 to as high as 653 in different Sub-Catchments.

Table A.2.5 Some features of the hydrology of the Coruh River at selected measuring stations (figures rounded)

R^2 of regression of log daily average suspended sediment (t/day) on log daily average discharge (m^3/sec)	Area of Catchment (km^2)	Mean Discharge (m^3/second) (maximum) (minimum)	Suspended Sediment (t/yr)	Average Sediment Discharge ($t/km^2/yr$)	Average Sediment Composition	
					Sand (%)	Silt + Clay (%)
Station 2315, Coruh Nehri, Karsikoy. 57m elevation. Years of record, 32						
0.67	19,654	209 (1211) (38)	7,146,900	401	53	47
Station 2316, Coruh Nehri, Ispir Bridge. 1170 m elevation. Years of record, 32						
0.78	5,505	44 (350) (7)	505,800	92	43	57
Station2322, Coruh Nehri, Altinsu. 201 m elevation. Years of record, 15						
0.85	18,326	160 (994) (26)	6,962,100	422	59	41
Station 2325, Oltu Suyu, Asagikumlu. 1129 m elevation. Years of record, 22						
0.77	1,762	7 (67) (0.3)	854,700	485	62	38
Station 2327, Berta Suyu, Ciftehanlar. 570 m elevation. Years of record, 3						
0.82	1,216	22 (84) (4)	73,700	61	45	55
Station 2329, Oltu Suyu, Coskunlar. 1004 m elevation. Years of record, 8						
0.79	3,539	17 (182) (1.3)	1,531,800	433	60	40
Station 2331, Deviskel Deresi, Gundogdu. 500 m elevation. Years of record, 11						
0.71	100	5 (19) (0.5)	6,400	65	21	79
Station 2334, Berta Suyu, Baglik, 366 m elevation. Years of record, 4						
0.81	1,473	26 (99) (5)	161,150	109	49	51
Station 2339, Murgul Cayi, Erenkoy, 213 m elevation. Years of record, 10						
0.11	298	12 (59) 1.5)	1,944,300	653	47	53

Sources. DSI records

A.2.5 Soils

(1) Introduction

The types of soils occurring in an area are obviously important for several reasons:

- Firstly, they are the media in which trees, pastures and crops grow, whether naturally or under agricultural systems. The productivity of the vegetation depends strongly upon the nature and distribution of soils, and upon the constraints on plant growth (such as nutrient levels, water relations and compacted layers) presented by the different types of soils. The productivity of the vegetation also depends on the climate of the area, largely acting through the mediating influence of the soils.
- The types and distributions of soils on a landscape are related in complex ways to the topography, climate, geology and land capability of the area. In turn, the types of soils will affect the land capability. These relationships will be examined in Section 2.8.
- The types of soils on a landscape will strongly influence the infiltration rates and erodibility of the soils, and thus (in conjunction with the topography and climate) will affect the extent and severity of soil erosion and the output of suspended sediments from the catchments.

(2) Data

The basic data on soils which was used to prepare the GIS for the Study was supplied by GDRS. The original data included information on 26 so-called “Great Soil Groups”. For ease of mapping and comprehension some similar soils were combined, making 13 classes, and in Tables 2.6 and 2.7 have been further grouped into 11 classes, plus a column for areas for which there was ‘No Data’.

In addition, some detailed information was supplied by GDRS for various combinations of soil characteristics. These included relationships between: the Great Soil Groups and slope and soil depth; Alluvial Soils and drainage and texture combinations; Hydromorphic Alluvial Soils and combinations of texture, salt-alkali content and drainage; and Colluvial Soils and slope, texture and soil depth. Three other tables gave information on Saline-Alkaline Soils, Organic Soils and Other Soil Characteristics. This detailed information has not been used to compile the GIS. The soil surveys would have been undertaken at reconnaissance level over areas which are mostly very difficult to access, and by different surveyors over a lengthy period of time. The distribution of soil types shown in Figure 3.2-3 is therefore only indicative.

Two other publications give authoritative information about the soils of the Study Area: Ali Gunduz (2001), *Coruh Havzasi ve Artvin*, and Atalay, I., Tetlik, M., Yilmaz, O., (1985) *The*

Ecosystems of Northeastern Turkey, Ormancilik Arastirma Ensititusu Yayinlari Teknik Bulten Serisi No. 141.

The main soil classes identified by Atalay *et al*. (1985) are:

Zonal Soils: (those soils developed under the predominant influence of the local climatic zones)
Brown Soils; Non-Calcic Brown Soils; Chestnut Soils; Chernozems; Red-Yellow Podzolics; Brown Forest Soils; Podzolised Brown Forest Soils; Non-Calcic Brown Forest Soils.

Azonal Soils: (generally, young soils developed under the predominant influence of geomorphological factors, such as slope or impeded drainage)
Alluvial Soils; Hydromorphic Alluvial Soils; Colluvial Soils; Lithosols (on basalts and andesites); Regosols.

Intrazonal Soils: (those soils developed under the predominating influence of unusual parent materials)
Organic Soils; High Meadow and Pasture Soils; Sandy and Gravelly Soils on flysches; Limey Sandy and Gravelly Soils on fysches and limestones; Rocky and Gravelly Soils on granites, quartzites, crystalline limestone and schists; Stony and Alkaline Soils (peridotite and serpentine); Gravelly and Stony Soils on volcanics; Gypsum, Saly and Alkaline Soils on Oligocene deposits.

The information provided by Gunduz (2001) and Atalay *et al.* (1985) has been used in preparing this Section and Tables 2.8 and 2.9.

(3) Discussion

Figure 3.2-3, Tables 2.6 and 2.7 and Annexes 4 and 5 illustrate the most common soils in the Study Area. Only five types of soils cover about 77% of the whole catchment, with all the other soils combined covering only about 13% of the catchment. There is no data on the soils in about 8.4% of the catchment. However, some of the less common soils may be locally important – a good example being the Alluvial Soils whose importance is considerable for individual villages.

Table 2.8 sets out some details of the most significant features of soil distribution in the whole catchment and in the Sub-Catchments.

Table 2.9 briefly describes the most important soils mentioned in Table 2.8, and includes some comments on the fertility, erodibility and constraining factors for plant productivity of each of these soils. Possible correlations and relationships between soils, slopes, geology, land capability and soil erosion in the Coruh River catchment are examined in Section 2.8.

Detailed information about the distribution, areas and percentage coverage of the most common soils in the six selected MCs – Savsat (BT-04), Yusufeli (MC-03), Oltu (OL-04), Uzundere (TR-03), Bayburt (UC-03) and Ispir (UC-14) – will be found in Annexes 4 and 5.

(4) Summary of Findings

1. The most common soils in the Study Area are the Basaltic Soils, Brown Forest Soils, Brown Soils, Chestnut Soils and High Mountain Pasture Soils. Together, these five types of soils cover about 77% of the whole catchment, with all the other soils combined covering only about 13% of the catchment. Some Sub-Catchments have locally high occurrences of particular soils.
2. The Alluvial Soils are not common in terms of area or percentage occurrence, but are very important to villagers where they occur as they are highly productive.
3. Most of the soils are moderately or strongly erodible, especially where present on steep slopes.
4. Most of the soils possess only moderate fertility, and present severe constraints of shallowness, poor fertility, stony subsoils and high erodibility, especially where present on steep slopes.

Table A.2.6 Main soil classes, areas (km^2)

SC	Alluvial Soils	Basaltic Soils	Brown Forest Soils	Brown Soils	Chestnut Soils	Colluvium Soils	High Mountain Pasture Soils	Non-calcic Brown Forest Soils	Non-calcic Brown Soils	Red-Yellow Podzolic Soils	Others	No data	Sub-total
Berta	1	0	1,717	0	3	2	351	0	0	40	0	165	2,280
Lower Coruh	1	0	393	0	0	1	100	518	0	675	0	76	1,765
Middle Coruh	12	39	1,584	0	13	0	307	220	0	1	0	419	2,596
Oltu	2	1,857	1,084	869	384	178	137	94	0	0	0	457	5,063
Tortum	2	898	497	274	177	49	20	0	0	0	4	107	2,029
Upper Coruh	575	162	280	2,401	1,505	101	630	67	320	0	2	469	6,512
Total	**593**	**2,956**	**5,555**	**3,545**	**2,082**	**333**	**1,545**	**900**	**320**	**717**	**6**	**1,694**	**20,244**

Note: Others include Gray Brown Podzolic soils with 4 km^2 and Saline-Alkaline and Mixture soils with 2 km^2.

Source: JICA Study Team based on GIS data by GDRS.

Table A.2.7 Main soil classes, (percentage of area)

SC	Alluvial Soils	Basaltic Soils	Brown Forest Soils	Brown Soils	Chestnut Soils	Colluvium Soils	High Mountain Pasture Soils	Non-calcic Brown Forest Soils	Non-calcic Brown Soils	Red-Yellow Podzolic Soils	Others	No data	Total
Berta	0.0%	0.0%	75.3%	0.0%	0.1%	0.1%	15.4%	0.0%	0.0%	1.8%	0.0%	7.3%	100.0%
Lower Coruh	0.1%	0.0%	22.3%	0.0%	0.0%	0.1%	5.6%	29.4%	0.0%	38.2%	0.0%	4.3%	100.0%
Middle Coruh	0.5%	1.5%	61.0%	0.0%	0.5%	0.0%	11.8%	8.5%	0.0%	0.1%	0.0%	16.1%	100.0%
Oltu	0.0%	36.7%	21.4%	17.2%	7.6%	3.5%	2.7%	1.9%	0.0%	0.0%	0.0%	9.0%	100.0%
Tortum	0.1%	44.3%	24.5%	13.5%	8.7%	2.4%	1.0%	0.0%	0.0%	0.0%	0.2%	5.3%	100.0%
Upper Coruh	8.8%	2.5%	4.3%	36.9%	23.1%	1.6%	9.7%	1.0%	4.9%	0.0%	0.0%	7.2%	100.0%
Total	**2.9%**	**14.6%**	**27.4%**	**17.5%**	**10.3%**	**1.6%**	**7.6%**	**4.4%**	**1.6%**	**3.5%**	**0.0%**	**8.4%**	**100.0%**

Note: Others include Gray Brown Podzolic soils and Saline-Alkaline and Mixture soils.

Source: JICA Study Team based on GIS data by GDRS.

Table A.2.8 Significant features of soil distribution in the whole catchment and in the Sub-Catchments.

Type of Soil	Area in Whole Catchment (km^2)	Percentage in Whole Catchment (%)	Comments on Distribution within Sub-Catchments (SCs)
Basaltic Soils	2,956	14.6	Found only in Oltu (36.7%) and Tortum (44.3%) SCs, with 2.5% in Upper Coruh.
Brown Forest Soils	5,555	27.4	Common in all SCs except Upper Coruh, where they cover only 4.3%.
Brown Soils	3,545	17.5	Common only in Oltu, Tortum and Upper Coruh SCs. About 37% of Upper Coruh has Brown Soils, with some MCs having more than 80% coverage
Chestnut Soils	2,082	10.3	Found only in Oltu, Tortum and Upper Coruh SCs. Some MCs in Oltu have 20-30% coverage, and some MCs in Upper Coruh have 30-90% coverage.
High Mountain Pasture Soils	1,545	7.6	Most common in Berta and Middle Coruh SCs. Nearly all the MCs in Berta have 10-20% coverage, and half the MCs in Middle Coruh have 13-45%. Five MCs in Upper Coruh have 15-37% coverage, with the remaining 12 MCs having virtually no coverage.
Alluvial Soils	593	2.9	Virtually absent at this scale of mapping in all SCs except Middle Coruh (0.5%) and Upper Coruh (8.8%). Some MCs in Upper Coruh have as much as 15% coverage, with MC-15 at 37%. However, even very small areas of these soils are extremely important to villagers where they occur.
Colluvial Soils	333	1.6	Not common in any SC, although some MCs in Oltu have up to 10% coverage, and some in Tortum and Upper Coruh have up to 4%.
Non-Calcic Brown Forest Soils and Non-Calcic Brown Soils	1,220	6	Only common in Lower Coruh and Middle Coruh, where some MCs have as much as 20-50% coverage and one MC (LC-06) has 90%.
Red-Yellow Podzolic Soils	717	3.5	Found only in Berta SC (BT-01 has 10%) and Lower Coruh, where LC-03, LC-04 and LC-07 have 75-90% coverage.

Sources: Study GIS

Table A.2.9 Brief soil descriptions, and comments on fertility, erodibility and constraining factors for plant productivity

Soil Type	Comments on Soil Fertility	Comments on Soil Erodibility	Comments on Constraints on Plant Productivity
Alluvial Soils. Usually on gentle slopes near streams. Usually deep, friable, well drained but water-retentive.	Quite fertile, and very important to villagers where they occur even if in very small areas.	Alluvial soils by definition are water-deposited, and therefore are subject to removal by bank erosion. Apart from this factor, their gentle slopes will generally not predispose to erosion.	Few constraints. Especially when irrigated alluvial soils can be very productive for human and animal food crops.
Basaltic Soils. These soils are not strictly in a Great Soil Group. They will generally be reasonably deep and well structured, with moderate organic matter contents. They will be well drained but moisture retentive.	Moderately fertile, although with high phosphorus-fixing capacity.	Generally will be moderately resistant to erosion, due to well developed structures.	Few constraints. These soils are moderately productive, and rarely have any compacted layers in the subsoils. They may have stony subsoils with poorly weathered stones and boulders.
Brown Forest Soils. Generally found under broadleaved forests, or where such forests used to occur. Contain significant amounts of lime in the subsoils. Well-drained.	Reasonably fertile, due to development under the previous broadleaved forest and high pH due to high lime content.	Generally quite erodible, especially on steeper slopes.	Few constraints, unless on steep slopes with shallow stony subsoils.
Brown Soils. Generally similar to Brown Forest Soils, but developed under poorer vegetation. Well-drained, and may have stony subsoils.	Fertility will be similar to Brown Forest Soils. Neutral to alkaline, especially in the subsoils.	Will generally be quite erodible, as these soils are usually found on steep slopes and rarely have strong structures.	Some constraints, especially where they occur on steep slopes. Will generally have stony subsoils.
Chestnut Soils. Are dark coloured soils developed under semi-arid and sub-humid grasslands. Will be reasonably deep where slopes are not steep.	Can be quite fertile, with high organic matter contents.	Will be quite erodible, especially on steep slopes.	Some constraints, especially where they occur on steep slopes.
High Mountain Pasture Soils. Strictly, these soils are not a distinct Great Soil Group. These soils will generally be acidic, shallow and have stony subsoils. They support rangeland pastures and are favoured for summer grazing.	Moderately fertile, but will not support high rates of pasture growth if exploited heavily and if not fertilized.	These soils generally occur on relatively gentle slopes and may have a satisfactory plant cover, which will guard against erosion. However, if the plant cover declines due to over-grazing, these soils can erode rapidly.	These soils are generally shallow over stony subsoils. The climatic conditions are harsh. A high plant cover percentage must be maintained to avoid soil erosion.

Non-Calcic Brown Forest Soils and Non-Calcic Brown Soils. Are generally shallow soils on steep slopes.	Only moderate fertility, and may be acidic in topsoils and subsoils.	May be easily eroded, due to poorer plant cover and steep slopes.	These soils present constraints to rangeland development, due to shallowness, steep slopes and moderate to poor fertility.
Red-Yellow Podzolic Soils. Well-drained, acidic soils, often with a poorly-permeable subsoil. Will usually be shallow, with stony subsoils. Are not common in the Study Area.	Poor fertility, acidic and with low organic matter contents.	Are highly erodible, especially on steep slopes.	These soils present constraints to rangeland and forest development, due to shallowness, poor fertility and acidity. They are generally used for tea and hazelnut production.

Sources: DOKAP Study. FAO-UNESCO Soil Map of the World (Revised Legend, 1990). World Soil Resources Reports 60 and 66. Atalay *et al.* (1985). Gunduz (2001)

A.2.6 Land Capability

(1) Introduction

The Land Capability Classification used in Turkey closely resembles the original system devised by the United States Department of Agriculture. It has eight Classes (I to VIII), which broadly integrate the soil and site factors affecting suitability for cultivation. These are the slope of the land, the degree of erosion, various soil properties such as soil depth and chemical composition, and other limiting factors such as wetness and potential for flooding. In general, Land Capability Classes I to IV are suitable for most intensive crops (including horticulture and pastures) provided appropriate management practices are followed. Class I has few limitations of any kind, while Classes II, III and IV have increasingly severe limitations for intensive agriculture, horticulture and pastures. Class V is a special Class, generally denoting areas which would be within Classes I to IV were it not for some severe limitation on cultivation, such as extreme rockiness or very poor drainage. Classes VI, VII and VIII are not cultivable, and have increasingly severe limitations on agriculture, and even limitations on extensive grazing on rangelands with native pastures. Lands under Classes VII and VIII would normally be used only for limited commercial (production) forestry or protection forestry, and rangelands.

(2) Data

The basic data was supplied by GDRS. It has been processed by the GIS to produce Figure 3.2-4, Tables 2.10 and 2.11, and Annexes 6 and 7. It should be noted that the GDRS data does not include any assessments of Class V land. There is no data for about 21,000 ha, or 1.1%, of land in the catchment. The original field surveys would have been undertaken by teams of surveyors over a lengthy period of time and the criteria for classification may not have been carefully standardized among the teams. The distribution of Land Capability Classes in Figure 3.2-4 is therefore only indicative.

(3) Discussion

Figure 3.2-4 clearly demonstrates that most of the Coruh River catchment falls into Land Capability Classes VI, VII and VIII, reflecting the harsh topography. Apart from areas in the western end of the catchment, the small proportion of land within Classes I, II and III indicates the generally limited potential for intensive agriculture and horticulture. There are some reasonably extensive areas of Class IV land in the south and east of the catchment.

Detailed information about the distribution, areas and percentage coverage of the Land Capability Classes in the six selected MCs – Savsat (BT-04), Yusufeli (MC-03), Oltu (OL-04), Uzundere (TR-03), Bayburt (UC-03) and Ispir (UC-14) – will be found in Annexes 6 and 7.

Conclusions which may be drawn from Figure 3.2-4, Tables 2.10 and 2.11 and Annexes 6 and 7 include:

- In the catchment as a whole, only about 15% of the land is in Classes I to IV. Conversely, about 85% is in Classes VI to VII, with Class VII predominating at 59%.
- There is virtually no Class I land anywhere in the catchment, except for about 3% in each of OL-02 and OL-03, and 11.4% in UC-07. The total area of Class I land is only about 11,300 ha, or 1.7% of the whole catchment.
- Class II land is also scarce, except in a few MCs in Oltu and Tortum SCs and significant areas in Upper Coruh (17.7% in UC-05, 11 to 13% in UC-08 and UC-09, and 37.5% [about 17,300 ha] in UC-15).
- Class III land is likewise scarce, except in three MCs in Oltu SC.
- Class IV land occupies about 7.5% of the whole catchment, principally within three MCs in Berta SC (11-17%), in Oltu SC (11.2% overall, with OL-09 having 31%), in Tortum (3 MCs from 19-29%) and some of the MCs in Upper Coruh with up to about 13%.
- Class VI land occurs over 17% of the whole catchment, with high proportions within Berta SC (27%), and about 12-17% in each of the other SCs.
- Class VII land dominates all SCs – at least 50% of the land is within this Class in every SC. Lower Coruh SC has 82% overall, with LC-01 at 91.4%.
- Class VIII land occupies 8.4% of the whole catchment and is particularly common in Middle Coruh SC (24.1%). MC-02 has about 77% of its land in this Class. UC-15 is an unusual MC, having virtually all its land in either Class II (37.3%) or Classes VII and VIII (55.2%).

(4) Summary of Findings

1. Most of the Coruh River catchment falls into Land Capability Classes VI, VII and VIII, reflecting the harsh topography. Apart from areas in the western end of the catchment, the small proportion of land within Classes I, II and III indicates the generally limited potential for intensive agriculture and horticulture. There are some reasonably extensive areas of Class IV land in the south and east of the catchment.
2. In the catchment as a whole, only about 15% of the land is in Classes I to IV. Conversely, about 85% is in Classes VI to VII, with Class VII predominating at 59%.
3. The total area of Class I land is only about 11,300 ha, or 1.7% of the whole catchment. Class II and Class III land is also scarce. Class IV land occupies about 7.5% of the whole catchment.
4. Class VI land occurs over 17% of the whole catchment.
5. Class VII land dominates all SCs – at least 50% of the land is within this Class in every SC. About 82% of Lower Coruh SC is in Class VII.
6. Class VIII land occupies 8.4% of the whole catchment

Table A.2.10 Land Capability by area (hectares)

	I	II	III	IV	VI	VII	VIII	No data	Sub-total
Berta	0	141	4,368	18,596	61,356	127,026	15,991	547	228,025
Lower Coruh	75	24	43	1,877	22,021	144,780	6,619	1,027	176,466
Middle Coruh	0	876	349	5,275	40,977	148,387	62,529	1,159	259,552
Oltu	2,774	6,791	26,332	56,858	73,388	294,445	32,487	13,245	506,322
Tortum	0	4,062	4,998	27,146	28,995	126,980	10,128	579	202,889
Upper Coruh	11,344	58,272	24,574	42,827	116,593	350,687	41,905	4,968	651,171
Totals	**14,194**	**70,166**	**60,664**	**152,580**	**343,331**	**1,192,305**	**169,659**	**21,525**	**2,024,424**

Sources: GDRS data processed by the Study GIS

Table A.2.11 Land capability by percentage of each MC

	I	II	III	IV	VI	VII	VIII	No data	Sub-total
Berta	0.0	0.1	1.9	8.2	26.9	55.7	7.0	0.2	228,025
Lower Coruh	0.0	0.0	0.0	1.1	12.5	82.0	3.8	0.6	176,466
Middle Coruh	0.0	0.3	0.1	2.0	15.8	57.2	24.1	0.4	259,552
Oltu	0.5	1.3	5.2	11.2	14.5	58.2	6.4	2.6	506,322
Tortum	0.0	2.0	2.5	13.4	14.3	62.6	5.0	0.3	202,889
Upper Coruh	1.7	8.9	3.8	6.6	17.9	53.9	6.4	0.8	651,171
Totals	**0.7**	**3.5**	**3.0**	**7.5**	**17.0**	**58.9**	**8.4**	**1.1**	**2,024,424**

Sources: GDRS data processed by the Study GIS

A.2.7 Soil Erosion

(1) Introduction

It is well known that soil erosion is very severe in almost all parts of Turkey. Some estimates indicate that the status of soil erosion is:

- No soil erosion: 5.2 m ha, or 6.6% of the country;
- Slight soil erosion: 5.6 m ha, or 7.2% of the country;
- Medium severity of soil erosion: 15.6 m ha, or 20.0% of the country;
- Intensive severity of soil erosion: 28.3 m ha, or 36.4% of the country;
- Most severe soil erosion: 17.4 ma ha, or 22.3% of the country;
- Bare rocky areas: 2.9 m ha, or 3.8% of the country; and
- Areas affected by wind erosion: 0.5 m ha, or 0.6% of the country.

The Turkey Forestry Sector Review (World Bank Report No. 22458-TU, June 27 2001) states *(para. 10)* that serious soil erosion occurs on about 75 percent of the country, and is one of the most serious environmental problems of Turkey. The amount of soil carried off by erosion may be as much as 500 million tonnes annually, of which some 350 million tonnes is

deposited in the reservoirs behind dams. The damage from frequent floods and torrents which take lives and degrade farmlands and infrastructure is also severe.

These generalised statements of the obvious problem in most parts of Turkey also apply to the Coruh River catchment. Soil erosion is important because it:

- degrades soil productivity for intensive and extensive agriculture, and forestry, and therefore seriously limits the livelihoods of all those villagers dependent on agricultural activities in the rural areas;
- destroys perhaps the most important natural resource in Turkey, and therefore must be rehabilitated, arrested and controlled;
- affects the potential for rehabilitation, or the reversibility of land degradation; and
- produces suspended sediments and stream bedloads which eventually move to the tributaries of the Coruh River and are deposited in dams, thus reducing their effective lifespans.

(2) Data

The Classes for water-caused soil erosion have been assigned by GDRS:

- Erosion Class 1: None, or very little
- Erosion Class 2: Moderate
- Erosion Class 3: Severe
- Erosion Class 4: Extreme

It is important to note that the assignment of an Erosion Class is largely subjective, is heavily dependent on the personal approach of the assessor and is probably not exactly replicable by another assessor. The criteria for assigning an Erosion Class do not appear to be quantified in any way, for example by a statement such as “more than 25% of the topsoil has been lost”. It should also be noted that even the “Moderate” Class (2) probably indicates a rather high degree of soil erosion which will already be affecting the productivity of the site. Likewise, the distinctions between Classes 3 and 4 (“Severe” and “Extreme”) are probably hard to judge. It would seem best to amalgamate the two so that, in reality, there would be two broad classes of soil erosion: Classes 1 plus 2, and Classes 3 plus 4.

The original field surveys would have been undertaken by teams of surveyors over a lengthy period of time and the criteria for classification may not have been carefully standardized among the teams. The distribution of Soil Erosion Classes in Figure 3.2-5 is therefore only indicative.

All the MCs in Table 2.12 have considerable areas for which there is 'No Data'. This category averages 8.4% over the whole catchment, and in some MCs can range up to as much as 20-35%.

Detailed information about the distribution, areas and percentage coverage of the Soil Erosion Classes in the six selected MCs – Savsat (BT-04), Yusufeli (MC-03), Oltu (OL-04), Uzundere (TR-03), Bayburt (UC-03) and Ispir (UC-14) – will be found in Annex 8.

In addition, a selection of recent colour aerial photographs (approximately 1:15,000 scale) of the Oltu MC was inspected at the Photogrammetry Department of OGM in Ankara. The erosion "hotspots" were clearly visible in stereoscopic view and each could have been delineated on the photographs and the area measured with a dot grid or planimeter. A small trial indicated that this procedure would take approximately 15 minutes for each square kilometer of interest, which could mean a total of 3-5 days' work for each MC, depending on the intensity of visible erosion. There was insufficient time and opportunity to undertake this task during this mission, even for one MC let alone six. It is strongly recommended that the detailed studies of each MC which will have to be undertaken during the planning phase of the implementation project should include this activity, either by contract with OGM or by a team member, in order to supplement the field observations of "hotspots" prior to planning the most vital rehabilitation activities.

(3) Discussion

The map of Soil Erosion Classes prepared by the GIS (Figure 3.2-5) broadly resembles the Land Capability map, which is not surprising considering that assessments of land capability depend heavily upon the status of soil erosion at a site.

Figure 3.2-5, Table 2.12 and Annex 8 clearly indicate the very large proportion of the catchment which has suffered severe and extreme degrees of soil erosion. Over the whole catchment, the proportion of Erosion Class 1 is only 3.8% and of Class 2 is 25.3%. Given that Class 2 is "moderate" erosion, the Coruh River catchment in fact has, on average, only about 4% of its land (about 77,000 ha) in a satisfactory state as far as soil erosion is concerned. Other observations include:

- With the exception of Upper Coruh SC, with 9.7% of its land (63,000 ha) in Class 1, all the SCs have virtually no land within Class 1. Oltu and Tortum SC have around2% in this Class. Upper Coruh has one MC (UC-15) with 37% in this Class.
- Erosion Class 2 is common in all SCs, with Berta SC having the greatest proportion (33.8%), ranging up to nearly 50% in one MC. UC-14 has no Class 1 but 50.8% in Class 2.
- Erosion Class 3 occupies about 51% of the whole catchment, ranging from about 30% in Tortum SC to about 82% in Lower Coruh SC.

- All SCs have between about 56% and 82% of their land in the severely and extremely eroded Classes 3 and 4. TR-04 has the highest proportion of Class 4 eroded land, at 50.4%.

During the second half of the 1970s, Mr Mahir Keskin and Mr Ekrem Taftali prepared at least twelve comprehensive reports on surface soil erosion and gully formation in the Erzurum Forest Conservancy. Their criteria for different degrees of erosion are not strictly comparable with the recent GDRS surveys, but are interesting because they specify the degrees of loss of different amounts of topsoil and subsoil which characterize the different classes. The other factor which makes their survey difficult to compare with the GDRS data reported in this Working Paper is that they included areas of "bare rock" as 'no or slight erosion' – the reasoning being that such areas have no soil and therefore cannot contribute to discharge of suspended sediments. Nevertheless, Table 2.13 summarises their survey results for parts of the Coruh River catchment.

Table A.2.13 Summarised results of percentage areas of soil erosion classes (rounded), from surveys in Coruh River Sub-Catchments within the Erzurum Forest Conservancy by M. Keskin and E. Taftali in the 1970s

Catchment (*havzasi*) (area in ha)	Class e1 None or Slight (%)	Class e2 Moderate (%)	Class e3 Severe (%)	Class e4 Very Severe (%)
Senkaya (162,495)	20	40	40	nil
Oltu Cayi (I) (159,611). Considerable areas of gully erosion were also evident.	21	24	54	2
Oltu Cayi (II) (146,602)	52	17	30	1
Ispir-Coruh (106,751)	63	7	25	4
Tortum Lake (122,376)	34	34	22	10
Coruh-Camlikaya (119,173)	47	10	41	1

Source: Reports held at the Erzurum Forest Conservancy

The office of the Erzurum AGM Chief Engineer has, to date, completed a total of 11,558 ha of erosion control works within a total project area of 57,124 ha. During the last five years erosion control planting has included about 1,460 ha of *Pinus sylvestris*, about 95 ha of *Robinia pseudoacacia*, about 670 ha of almond trees, 24 ha of oak trees and about 110 ha of other tree species. Table 2.14 lists the work achieved during the last five years by the Erzurum AGM office in both erosion control and afforestation. In addition, about 750 ha of rangeland rehabilitation was accomplished during this period.

Table A.2.14 Erosion control activities and afforestation undertaken by the AGM office in Erzurum for the period 1997-2001

Year	Erosion Control Works			Afforestation		
	Planning	Planting	Maintenance	Planning	Planting	Maintenance
1997	742	221	950	545	498	740
1998	350	640	680	610	515	1200
1999	320	257	320	560	565	880
2000	660	355	300	660	520	587
2001	1050	615	400	102	61	257

Source: AGM Chief Engineer, Erzurum

Details of the field methods used for soil erosion control, and some information about the current costs, are described in Section 5 of this Working Paper.

The costs of erosion control works to rehabilitate badly degraded areas on steep slopes in the Coruh River catchment are very high. Restricted funding will always ensure that there will never be any hope of rehabilitating any significant proportion of the whole catchment. AGM is continually looking for methods of reducing the per-hectare costs of erosion control and afforestation activities. However, it is very difficult to assess the technical effectiveness (and cost-effectiveness) of previous erosion control activities: a problem which is discussed in Sections 3.1 and 4.5. It is very unfortunate that currently there are no objective measures of the success, or otherwise, of these activities, which have been undertaken at considerable cost to the Turkish taxpayer.

Therefore it is necessary, given the limited financial resources, to create frameworks of policies, strategies and tactics for rational decision-making about the locations and amounts of erosion control work to be done. Obviously, "prevention is better than cure" with soil erosion, which means that rangeland rehabilitation and management must be allocated adequate funds and attention. However, although successful rangeland rehabilitation (combined with effective grazing control) may minimise further soil erosion on the rangelands and may even rehabilitate some of the current erosion, it cannot be expected to rehabilitate the severe and extreme levels of soil erosion which are so common in most parts of the Coruh River catchment. Therefore, erosion control activities and afforestation are also necessary to complement rangeland management.

The simplest method of allocating limited resources of money and manpower to erosion control and rehabilitation would be to set up a *"triage"* system, whereby any area of degraded land would be allocated to one of three categories which might be labelled: (i) 'reversible'; (ii) 'possibly reversible'; and (iii) 'irreversible'. Resources would then be allocated cost-effectively and firstly to category (i), and later to category (ii), on the principle that any resources allocated to category (iii) would be a gross waste of money.

However, it might be better to allocate resources according to an administrative assessment of the priorities of the various groups of stakeholders, perhaps as set out below.

Stakeholder group 1: priorities of the farmers who graze livestock on the rangelands. These stakeholders would probably prefer considerable resources to be spent on rangeland rehabilitation to produce as much animal feed as possible. Some of the resources would have to be spent on training farmers and shepherds in improved grazing management.
Stakeholder group 2: priorities of the villagers living below flood and torrent-prone valleys. Section 3.2 discusses this strategy, which is certainly understandable from the humanitarian viewpoint but may need to be examined carefully. AGM has to reach a balance between treating these "hot-spots" at very high cost, treating the "mini-catchments" containing the "hot-spots", doing nothing or persuading villagers to move to less dangerous sites.
Stakeholder group 3: priorities of the State forestry agencies. These agencies would probably prefer to treat some of the worst "hot-spots" while also establishing large areas of afforestation.
Stakeholder group 4: priorities of State agricultural agencies, including the Treasury and its rangelands. These agencies would probably prefer to rehabilitate and improve as much of the rangelands as possible, while simultaneously improving irrigation and agricultural practices on the arable areas.
Stakeholder group 5: priorities of DSI as a builder of dams in the lower Coruh River catchment. DSI would be interested in any forms of erosion control which minimized the discharge of suspended sediments and bedloads. This would mean concentrating on the "hot-spots", almost regardless of the cost.

These are matters to be decided with the stakeholders in relation to the policies, strategies and tactics for the management and rehabilitation of the selected MCs within the Coruh River catchment.

In addition, a new "Decision-Making Methodology for Rehabilitating Soil Erosion in the Coruh River Catchment" is presented and discussed in Chapter 5 of this Working Paper. It is a method for rationally allocating limited funds to future activities according to a logical and standardized set of field procedures.

(4) Summary of Findings

1. The map of soil erosion prepared by the GIS broadly resembles the Land Capability map, which is not surprising considering that assessments of land capability depend heavily upon the status of soil erosion at a site.
2. The map clearly indicates the very large proportion of the catchment which has suffered severe and extreme degrees of soil erosion. Over the whole catchment, the proportion of Class 1 is only 3.8% and of Class 2 is 25.3%. Given that Class 2 is "moderate" erosion, the Coruh River catchment in fact has, on average, only about 4% of its land (about 77,000 ha) in a satisfactory state as far as soil erosion is concerned.

3. With the exception of Upper Coruh SC, with 9.7% of its land (63,000 ha) in Class 1, all the SCs have virtually no land within Class 1.
4. Erosion Class 2 is common in all SCs, with Berta SC having the greatest proportion (33.8%), ranging up to nearly 50% in one MC.
5. Erosion Class 3 occupies about 51% of the whole catchment, ranging from about 30% in Tortum SC to about 82% in Lower Coruh SC.
6. All SCs have between about 56% and 82% of their land in the severely and extremely eroded Classes 3 and 4.
7. The costs of erosion control works to rehabilitate badly degraded areas on steep slopes in the Coruh River catchment are very high. Restricted funding will always ensure that there will never be any hope of rehabilitating even a small proportion of the whole catchment.
8. Currently there are no objective measures of the success, or otherwise, of erosion control activities, which have been undertaken at considerable cost to the Turkish taxpayer.
9. Therefore it is necessary, given the limited financial resources, to create frameworks of policies, strategies and tactics for rational decision-making about the locations and amounts of erosion control work to be done.
10. Obviously, "prevention is better than cure" with soil erosion, which means that rangeland rehabilitation and management must be allocated adequate funds and attention. However, although successful rangeland rehabilitation (combined with effective grazing control) may minimise further soil erosion on the rangelands and may even rehabilitate some of the current erosion, it cannot be expected to rehabilitate the severe and extreme levels of soil erosion which are so common in most parts of the Coruh River catchment.
11. The simplest method of allocating limited resources of money and manpower to erosion control and rehabilitation would be to set up a *"triage"* system, whereby any area of degraded land would be allocated to one of three categories which might be labelled: (i) 'reversible'; (ii) 'possibly reversible'; and (iii) 'irreversible'. Resources would then be allocated cost-effectively and firstly to category (i), and later to category (ii), on the principle that any resources allocated to category (iii) would be a gross waste of money.
12. However, it might be better to allocate resources according to an administrative assessment of the priorities of the various groups of stakeholders, which might include:
13. **Stakeholder group 1:** priorities of the farmers who graze livestock on the rangelands. These stakeholders would probably prefer considerable resources to be spent on rangeland rehabilitation to produce as much animal feed as possible. Some of the resources would have to be spent on training farmers and shepherds in improved grazing management.
14. **Stakeholder group 2:** priorities of the villagers living below flood and torrent-prone valleys. Section 3.2 discussed this strategy, which is certainly understandable from the humanitarian viewpoint but may need to be examined carefully. AGM has to reach a balance between treating these "hot-spots" at very high cost, treating the "mini-catchments" containing the "hot-spots", doing nothing or persuading villagers to move to less dangerous sites.

15. **Stakeholder group 3:** priorities of the State forestry agencies. These agencies would probably prefer to treat some of the worst "hot-spots" while also establishing large areas of afforestation.
16. **Stakeholder group 4:** priorities of State agricultural agencies, including the Treasury and its rangelands. These agencies would probably prefer to rehabilitate and improve as much of the rangelands as possible, while simultaneously improving irrigation and agricultural practices on the arable areas.
17. **Stakeholder group 5:** priorities of DSI as a builder of dams in the lower Coruh River catchment. DSI would be interested in any forms of erosion control which minimized the discharge of suspended sediments and bedloads. This would mean concentrating on the "hot-spots", almost regardless of the cost. DSI has, in fact, provided funds to AGM for this type of activity.
18. These are matters to be decided with the stakeholders in relation to the policies, strategies and tactics for the management and rehabilitation of the selected MCs within the Coruh River catchment.
19. **A new "Decision-Making Methodology for Rehabilitating Soil Erosion in the Coruh River Catchment" is presented and discussed in Chapter 5 of this Working Paper. It is a method for rationally allocating limited funds to future activities according to a logical and standardized set of field procedures.**

Table A.2.12 Soil erosion, areas (ha) and percentage of each MC in the four erosion classes

SC		Total Area (ha)	Erosion Class 1 (ha)	Erosion Class 2 (ha)	Erosion Class 3 (ha)	Erosion Class 4 (ha)	No Data	Erosion Class 1 (%)	Erosion Class 2 (%)	Erosion Class 3 (%)	Erosion Class 4 (%)	No Data
Berta	subtotal	228,025	92	76,968	128,420	6,006	16,538	0.0	33.8	56.3	2.6	7.3
Lower Coruh	subtotal	176,466	99	22,701	143,908	2,111	7,646	0.1	12.9	81.6	1.2	4.3
Middle Coruh	subtotal	259,552	969	46,793	157,834	12,070	41,886	0.4	18.0	60.8	4.7	16.1
Oltu	subtotal	506,322	8,553	137,406	244,775	69,856	45,733	1.7	27.1	48.3	13.8	9.0
Tortum	subtotal	202,889	4,303	57,255	61,698	68,926	10,707	2.1	28.2	30.4	34.0	5.3
Upper Coruh	subtotal	651,170	62,880	171,120	299,538	70,760	46,873	9.7	26.3	46.0	10.9	7.2
Totals		**2,024,424**	**76,897**	**512,243**	**1,036,174**	**229,729**	**169,382**	**3.8**	**25.3**	**51.2**	**11.3**	**8.4**

Source: GDRS data manipulated by the Study GIS

A.2.8 Correlations between Slopes, Geology, Soils, Land Capability and Soil Erosion in the Coruh River Catchment

(1) Introduction

It would be helpful in understanding the occurrence and severity of soil erosion in the Coruh River catchment if there were some clear correlations between the observed occurrence and severity of soil erosion and the observed slopes, geology, soils and land capability.

In order to examine such correlations, it would be necessary to examine relevant data for each MC to see if a relatively high proportion of one attribute (such as geological rock type) matches a relatively high proportion of some other attribute (such as Erosion Class). However, even if this process yields apparent positive correlations in any MC, the correlations are not necessarily proven, because the two attributes may be commonest in completely different parts of the MC. For example, a MC might have a relatively high proportion of a particular rock type and a relatively high proportion of a particular Soil Erosion Class, but the rock type may occur at one end of the MC and the erosion at the other end.

The only way to resolve the problem is for the Study GIS to map the two attributes on one image so that both the areal extents and locations of the two attributes can be seen to be coincident, or not. This data is not available at the time of writing. In due course, the Study GIS will examine the following possible correlations by overlaying one or two attribute layers on the slope map:

- Slopes and soil erosion
- Soils and soil erosion and geology
- Slopes and soil erosion and soil types
- Slopes and soil erosion and land capability

However, it must not be assumed that any strong positive correlation between two attributes implies causality between them.

(2) Data

The available tabular data allows examination of apparent correlations between:

- Soils and Soil Erosion Class;
- Soils and Land Capability;
- Slopes and Soil Erosion Class; and
- Geological Type and Soil Erosion Class.

(3) Discussion

Soils and Soil Erosion Class. Possible correlations between these attributes were examined for only the most common soils: Basaltic Soils, Brown Forest Soils, Brown Soils, Chestnut Soils and High Mountain Pasture Soils. Although they are common in only one Sub-Catchment, Red-Yellow Podzolic Soils were included, as they appear to be particularly erodible.

- Basaltic Soils: there appear to be some weak inverse correlations, with less erosion in Oltu and Tortum on these soils.
- Brown Forest Soils: there appear to be weak positive correlations in Berta and Lower Coruh Sub-Catchments, with more erosion (Erosion Classes 2 and 3) on these soils.
- Brown Soils and Chestnut Soils: no clear correlations are evident.
- High Mountain Pasture Soils: in all Sub-Catchments except Tortum there is a clear association of these soils with Soil Erosion Classes 2 and 3.
- Red-Yellow Podzolic Soils: these soils occur only in Lower Coruh Sub-Catchment, and are strongly positively correlated with Erosion Class 3.

Soils and Land Capability. Possible correlations between these attributes were examined for only the most common soils: Basaltic Soils, Brown Forest Soils, Brown Soils, Chestnut Soils and High Mountain Pasture Soils. Correlations between Land Capability and Alluvial Soils were examined in Upper Coruh Sub-Catchment, where they are most common. Although they are common in only one Sub-Catchment, Red-Yellow Podzolic Soils were included, as they appear to be particularly erodible.

- Alluvial Soils: there is a strong correlation with Capability Classes I to III in Upper Coruh Sub-Catchment.
- Basaltic Soils: there appears to be a strong correlation between these soils and Capability Classes VI and VII, mostly in Oltu and Tortum Sub-Catchments.
- Brown Forest Soils and Brown Soils: there appear to be strong correlations between these soils and Capability Classes VI and VII.
- Chestnut Soils: these soils are not very common, but in Upper Coruh Sub-Catchment there appears to be a clear correlation with Capability Classes VI and VII.
- High Mountain Pasture Soils: there appear to be weak correlations between these soils and Capability Class VII.
- Red-Yellow Podzolic Soils: these soils are found only in Lower Coruh Sub-Catchment, and there is a strong association with Capability Classes VII and VIII.

Slopes and Soil Erosion Class. Possible correlations include:

- Berta Sub-Catchment: there appears to be a moderately strong positive correlation between slopes and Soil Erosion Class.

- Lower Coruh Sub-Catchment: on average, and in most of the MCs, there is a strong positive correlation between slopes and Soil Erosion Class.
- Middle Coruh Sub-Catchment: on average, about 65% of the Sub-Catchment is in Erosion Class 3 and about 70% is steeper than 30%, so a moderately strong positive correlation can be assumed.
- Oltu Sub-Catchment: on average, about 65% of the Sub-Catchment is in Erosion Classes 3 and 4 and about 60% has slopes of 12-30%. The correlations between slopes and Soil Erosion Class, if any, are weakly inverse.
- Tortum Sub-Catchment: on average, about 65% of the Sub-Catchment is in Erosion Classes 3 and 4, and there appear to be weak positive correlations between slopes and Soil Erosion Class.
- Upper Coruh Sub-Catchment: most MCs (especially UC-06, UC-15 and UC-16) have large proportions of Erosion Classes 1 and 2 correlated with large proportions of gentle slopes less than 30%.

Geological Type and Soil Erosion Class. Possible correlations include:

- The most common geological types are Alluvia, Upper Cretaceous Volcanic Facies, Eocene Volcanic Facies, Lower Cretaceous Flysch and Malm. The data for each Sub-Catchment has been examined and no strong correlations are evident, except there may be a weak positive correlation between the occurrence of Upper Cretaceous Volcanic Facies and Soil Erosion Class 3 in Berta and Lower Coruh Sub-Catchments.
- However, the discussion in Section 2.3 above, based on a recent careful examination of the geology in each MC as shown in the new and more detailed 1:500,000 scale geological map and on field observations, indicates that the major control of natural rates of weathering and production of sediments and bedloads appears to be largely related to the complexity of the geological types and structures, the amount of faulting and the degree of stratification of the rocks.

(4) Summary of Findings

1. Soils and Soil Erosion Class. In general, from the available data there appear to be few strong positive or inverse correlations between the occurrence of particular soils and the Soil Erosion Class. High Mountain Pasture Soils in all Sub-Catchments except Tortum are clearly associated with Soil Erosion Classes 2 and 3, and Red-Yellow Podzolic Soils are strongly positively correlated with Erosion Class 3.
2. Soils and Land Capability. There is a strong correlation between Alluvial Soils and Capability Classes I to III in Upper Coruh Sub-Catchment. With some exceptions in some Sub-Catchments, there appear to be strong correlations between Basaltic Soils, Brown Forest Soils, Brown Soils and Chestnut Soils with Capability Classes VI and VII.
3. Slopes and Soil Erosion Class. In all Sub-Catchments except Oltu there appear to be moderately strong positive correlation between slopes and Soil Erosion Class. In Oltu the

correlations between slopes and Soil Erosion Class, if any, are weakly inverse. In Upper Coruh Sub-Catchment: most MCs have large proportions of Erosion Classes 1 and 2 correlated with large proportions of gentle slopes less than 30%.

4. Geological Type and Soil Erosion Class. It appears that no strong correlations between the common rock types and soil erosion are evident, except there may be a weak positive correlation between the occurrence of Upper Cretaceous Volcanic Facies and Soil Erosion Class 3 in Berta and Lower Coruh Sub-Catchments. However, recent careful examination of the geology in each MC as shown in the new and more detailed 1:500,000 scale geological map and on field observations indicates that the major control of natural rates of weathering and production of sediments and bedloads appears to be largely related to the complexity of the geological types and structures, the amount of faulting and the degree of stratification of the rocks.

A.2.9 Dams and Sedimentation

(1) Introduction

The discharges of suspended sediments and bedloads which move down the Coruh River and its tributaries will inevitably influence the effective operation and lifespans of the planned hydroelectric dams. Each dam is designed to have a specified volume of "dead storage" at the bottom of the lake behind the dam, from which the water will not normally be used for power generation. The variable volume of water above the "dead storage" is called the "active storage", and may be used for power generation, irrigation and discharge of surplus water downstream to the next dam. The volume occupied by "dead storage" may thus be filled with sediments and bedloads over an uncertain period of time without great harm to the operation of the dam. When this volume is filled, sediments will then start to reduce the available volume of "active storage". The operation of the dam, and its effective lifespan, will then be progressively affected.

The Government of Turkey may eventually construct as many as 15 major dams on the Coruh River and some of its tributaries (Tables 2.15, 2.16, 2.17 and the two attached Figures), together with a large number of other hydraulic engineering structures such as tunnels, sediment basins, pipelines and small weirs. The dam at the highest altitude will be Laleli, with a top water level at 1,480 m above sea level, and the lowest Muratli, at 96 m above sea level, the whole sequence therefore utilizing a combined fall of 1,384 m. Approximately 10.474 billion kWh of energy will be produced from 3,189 MW of generating capacity. At the present time, the three lowest altitude dams (Muratli, Borcka and Deriner) are being constructed, and planning is proceeding for some of the others.

According to information from the Artvin Municipality, the dams being constructed or planned on the lower reaches of the Coruh River will affect one District, 79 villages and two Mahalessi. Approximately 20% of the total population of the Province is currently living in

the areas which will be directly affected by the dams and their lakes. Some 40% of the land which produces fruit and vegetables will eventually be under water which, among other effects, is strongly discouraging new investments in horticultural production.

(2) Data

Some hydrological data, also relevant to this Section, has been presented in Table 2.5 in Section 2.4. The average sediment discharges at nine measuring stations ranged from as low as 61 t/km^2/yr to as high as 653 t/km^2/yr in different Sub-Catchments. Additional information from DSI has been summarized in Tables 2.15 and 2.16. Some additional information about sediment discharges was presented by Gunduz (2001) in his book *Coruh Havzasi ve Artvin* (p.70), and has been reproduced here in Table 2.17.

(3) Discussion

The average annual sediment inputs shown in Tables 2.16 and 2.17 probably do not include bedloads, as these are extremely difficult to measure. Dividing the "dead storage" volume by the average annual sediment input does not provide a reliable estimate of the lifespan of the dam, as all upstream dams will trap the sediment from that portion of the catchment which directly contributes to that dam. For example, Tortum Golu (which formed naturally behind a huge landslide) is trapping a large volume of sediments which would otherwise ultimately be deposited in the next downstream dam. In Table 2.16 the catchment areas attributable to the three dams are calculated as the total area above the dam, rather than the area above the dam but below the next upstream dam.

Nevertheless, it is clear from Tables 2.5 (in Section 2.4) and 2.16 and 2.17 that some of the Sub-Catchments are discharging very large amounts of sediment, measured as both t/km^2/yr or m^3/km^2/yr and as absolute annual amounts at the damsites in m^3/yr. The catchment above Station 2322 on the Coruh River at Altinsu includes most of the Coruh catchment and is discharging about 7 million tonnes of sediment annually at 422 t/km^2/yr. The Oltu Suyu at Coskunlar has a much smaller catchment but discharges about 1.5 million tonnes annually at a similar rate. The Murgul Cayi at Erenkoy (Station 2339) is discharging about 200,000 tonnes annually from a very small catchment (298 km^2) at a rate of 653 t/km^2/yr. The rocks in this catchment (LC-03) are mainly Eocene Volcanic Facies and Flysch, and the soils are Red-Yellow Podzolic Soils – almost the only occurrence of these soils in the Coruh River catchment. The Soil Erosion Classes are 2 (20.2% of the catchment) and 3 (72.1% of the catchment). The Land Capability Class is VI or VII. It is probable that a major cause of the extremely high measured rate of sediment discharge is rapid erosion of the Red-Yellow Podzolic soils.

In addition to sheet and gully erosion, other sources of suspended sediment include bank erosion, mass movements (landslides) and erosion from roadside banks and fills. Every effort should be made to control discharge of sediments from roadworks.

Finally, in relation to soil conservation and discharges of sediments, it is relevant to consider the "ownership" of the dams. The Study Team does not have sufficient information about whether the dams will be owned solely by DSI, or whether some forms of "Build-Operate-Transfer" (BOT), "Build-Operate-Own-Transfer" (BOOT), or other arrangements, will apply in different ways for different periods to the different dams. The matter is relevant because it affects the incentives for the (permanent or temporary, and State or private) owner of the dams to participate in catchment protection and erosion control during the period of "ownership". After the period of private "ownership", if any, will DSI inherit a partly sedimented dam with reduced "dead and active storage"? There may be a case for considering a suite of incentives, disincentives, rewards and penalties for the company, if any, during the period of ownership and control of the dam. Does ownership and control also carry responsibilities for soil conservation and erosion control of the catchment above the dam? If so, in what ways and for how long a period?

(4) Summary of Findings

1. The Government of Turkey may eventually construct as many as 15 major dams on the Coruh River and some of its tributaries, together with a large number of other hydraulic engineering structures. Approximately 10.474 billion kWh of energy will be produced from 3,189 MW of generating capacity. The three lowest altitude dams (Muratli, Borcka and Deriner) are now being constructed, and planning is proceeding for most of the others.
2. The dams on the lower reaches of the Coruh River will affect one District, 79 villages and two mahalessi. Approximately 20% of the total population of the Province is currently living in the areas which will be directly affected by the dams and their lakes. Some 40% of the land which produces fruit and vegetables will eventually be under water.
3. The discharges of suspended sediments and bedloads which move down the Coruh River and its tributaries will inevitably influence the effective operation and lifespans of the planned hydroelectric dams.
4. Some of the Sub-Catchments are discharging very large amounts of sediment. Some measured amounts are: 7 million tonnes of sediment annually at 422 t/km^2/yr from the catchment above Altinsu on the Coruh River; about 1.5 million tonnes annually at a similar rate from the Oltu Suyu at Coskunlar; and about 200,000 tonnes annually from the small catchment (LC-03) of the Murgul Cayi at Erenkoy at a rate of 653 t/km^2/yr. It is probable that a major cause of this extremely high measured rate of sediment discharge from this MC is rapid erosion of the Red-Yellow Podzolic soils.
5. In addition to sheet and gully erosion, other sources of suspended sediment include bank erosion, mass movements (landslides) and erosion from roadside banks and fills. Every effort should be made to control discharge of sediments from roadworks.

6. Finally, in relation to soil conservation and discharges of sediments, it is relevant to consider the "ownership" of the dams, because it affects the incentives for the (permanent or temporary, and State or private) owner of the dams to participate in catchment protection and erosion control during the period of "ownership". There may be a case for considering a suite of incentives, disincentives, rewards and penalties for the company, if any, during the period of ownership and control of the dam, if ownership and control also carries responsibilities for soil conservation and erosion control of the catchment above the dam for some period of time.

Table A.2.15 General information on the proposed dams on the Coruh River and its tributaries

River or Stream	Name of Dam	Base Level (m above sea level)	Top Water Level (m above sea level)	Lake Volume (million m^3)	Average Discharge of River or Stream (m^3/second)
Coruh	Muratli	56	96	75	192
Coruh	Borcka	103	185	419	179
Coruh	Deriner	190	392	1969	154
Coruh	Artvin	380	500	167	122
Coruh	Yusufeli	496	710	2130	120
Coruh	Arkun	811	935	283	57
Coruh	Aksu	933	1042	184	48
Coruh	Gullubag	1090	1147	20	42
Coruh	Ispir	1262	1342	367	28
Coruh	Laleli	1363	1480	969	28
Oltu	Ayvali	810	930	355	26
Oltu	Olur	1025	1105	294	21
Berta	Baglik	467	530	7.3	25
Berta	Bayram	635	740	133	19
Barhal	Altiparmak	1090	1150	8	7

Source: DSI

Table A.2.16 Detailed information for three dams on the Coruh River, in order downstream from Artvin to the Turkish border.

Name of Dam	Thalweg Height (m above sea level)	Crest Height (m above sea level)	Catchment Area (km^2)	Passive Volume (million m^3)	Active Volume (million m^3)	Average Annual Sediment Yield 1965-81 ($t/yr/km^2$)	Damsite Average Annual Sediment Yield ($m^3/yr/km^2$)	Average Annual Sediment Input (m^3/yr)
Deriner	207	397	18,369	882.05	1,197.4	553	462	7,655,340
Borcka	86	189	19,255	81.42	150.78	553	473	8,247,322
Muratli	56	100	19,748	17.83	56.95	553	462	8,480,417

Source: DSI

Table A.2.17 Sediment discharges at the planned damsites (from Gunduz, 2001)

Dam, and Top Water Level (m a.s.l.)	Annual Total Sediment Yield ($m^3/km^2/yr$ from catchment)	Average Annual Sediment Yield at Damsite (m^3/yr)
Laleli (1480)	153	728,280
Ispir (1342)	173	882,404
Gullubag (1147)	187	1,106,180
Aksu-Yenivan (1042)	201	1,278,159
Cetinbogaz	201	1,329,695
Karakale	205	1,404,865
Yusufeli, Inali (710)	402	6,132,108
Zeytinlik	413	6,432,888
Artvin (Deriner?) (392)	470	8,642,830
Borcka (185)	479	9,050,705
Muratli (96)	509	10,051,732

A.3 ISSUES, POLICIES, STRATEGIES, MEASURES AND OPPORTUNITIES FOR SOIL CONSERVATION IN THE CORUH RIVER CATCHMENT

A.3.1 Issues and Policies

The first question to be asked about natural resource management in the Coruh River catchment with respect to soil conservation must be:

> "Does the catchment exhibit soil erosion which is of so severe a nature and so extensive in its effects as to require considerable attention to natural resource rehabilitation and continuing management, using the best available soil conservation techniques and sufficient funds to achieve this?"

The answer, judging by the information in Chapter 2, is obviously in the affirmative. The second question must then be:

> "Is it possible to rehabilitate and to arrest all or most of the mild, moderate and severe soil erosion using improved soil conservation techniques?"

The answer in relation to work in the Coruh River catchment must be qualified, in that while appropriate techniques are available and have been applied for many years, their success has been somewhat mixed and there are some doubts whether cost-effective methods can be applied by both the relevant State agencies and by the other "land managers" – the villagers. A rigorous assessment of the past achievements in the work on soil conservation, control of soil erosion and afforestation which have been undertaken by the State agencies is needed.

In this respect, it is very unfortunate that there has been virtually no applied scientific research by any institution in Turkey on assessing the real effectiveness of all the time, money and effort which has been expended on controlling soil erosion in all the forest lands in Turkey.

The baseline status of sediment discharge, and the impacts of erosion control measures on reducing continuing discharge below the baseline level, are largely unknown in any reliable scientific sense.

The **Key Issues** in relation to soil conservation then become:

1. Whether erosion control measures and soil conservation can be both technically-effective and cost-effective in reducing both the degradation of soil qualities and the output of suspended sediments, and in improving soil productivity.
2. Whether it will be possible to devise rational, effective and cost-effective scales of erosion control, natural resource rehabilitation and continuing natural resource management for use in the Coruh River catchment.
3. Whether active participation by villagers in the effective use of soil conservation measures, combined with other land management measures, can rehabilitate and improve natural conditions and the productivity of forests, rangelands and arable lands in the Coruh River catchment.

Several subsidiary issues in relation to soil erosion and soil conservation in the catchment are listed below. The first four have been highlighted by the World Bank in its recent Forestry Sector Review (Report No. 22458-TU; June 27, 2001).

1. The ways in which measures for ensuring institutional cooperation and villager participation can be introduced to achieve effective soil conservation. This issue includes consideration of the working methods and institutional arrangements employed by AGM and OGM (and, to a lesser extent, ORKOY and MPG), and also ways of ensuring that some other agencies (such as MARA) are also participating.
2. The legislative, regulatory and administrative environment required to ensure that cooperative activities and participatory management do in fact occur and are embedded permanently into operational methods.
3. Whether it is possible to realize the opportunities for combining measures for poverty alleviation with effective measures for soil conservation, and possibly also to involve the private sector. To date there has been very little involvement of the private sector in natural resource management, even though some legislative, administrative and financial support measures have been introduced by the State.
4. With respect to controlling resource degradation, the challenge is to: (i) realize the economic benefits of sustainable forest management; and (ii) realize the benefits to forest villagers of association with efforts to promote sustainable management of the lands from which they too draw their living.
5. DSI is currently planning and constructing five large dams on the River and some of its tributaries, some of which will eventually flood a large number of villages and the riparian arable lands from which they currently derive a high proportion of their livelihoods. This is an immediate impact, but will also have the effect of forcing these

people (assuming they continue to live in their current locations, but at a higher altitude) into greater relative dependence on the higher altitude rangelands and forests. This is likely to exacerbate landscape degradation, including soil erosion, on those sites.

6. The load of suspended sediments and coarser bedloads resulting from soil erosion and mass land movements (landslides) that are currently carried by the tributaries of the Coruh River downstream into lakes formed behind the new dams. The sediments will decrease the volume of the "dead storage" in the lakes, and might in due course diminish the "active storage" volume upon which power generation depends. The effective lifespans of the dams, and their hydroelectric potential, largely depend upon the rates of sedimentation.
7. It has been tacitly assumed by most soil conservationists that there are positive correlations between improved village and household livelihoods and improved soil conservation in adjacent catchments. In other words, if villagers are helped to achieve better livelihoods they will automatically manage the adjacent lands better so that there is less degradation. This assertion has probably been proved in a limited number of recent projects in Turkey, but cannot be assumed to be correct in all cases.
8. The sustainability of soil conservation interventions has not been tested in any soil conservation project in Turkey. This may be because most such activities (whether or not they have been undertaken within an externally-supported development project) are mostly quite recent.
9. The environmental impacts of most soil conservation activities, assuming they are properly planned and executed, must presumably be largely benign and beneficial, and without serious detrimental environmental impacts. After all, this is why they are undertaken. However, these assertions should be examined and proven.
10. The new Pastures Law is supposed to improve rangeland management by delineation of cadastral boundaries, followed by annual assessment at selected sites of pasture productivities, calculation of carrying capacities, and allocation of carrying capacities to livestock owners in villages. Fees are payable by the village, from which 25% is returned to the village and the balance retained by MARA. The technical basis for these determinations is suspect. Pasture productivity at a site is assessed only once a year during a period of 15 days near the start of the grazing period. Grazing is excluded from a small site by using a cage, and the amount of plant material which grows in this period is clipped, dried and weighed. From this single estimate it is then assumed that the pastures will produce a calculated amount of plant material throughout the grazing season. This is obviously incorrect, because the plant growth during this period may not be representative of the usual conditions at that site (the weather conditions may be more or less typical) and because pasture growth will always vary greatly from week to week according to the seasonal conditions and grazing intensities. Because the calculation of pasture productivity is suspect, the calculation of carrying capacity will also be incorrect.
11. Currently the Government is supporting the agricultural sector with direct income supports, partly financed by the World Bank. The farmers are receiving TL 135 million for every hectare that they claim to be "using" up to a limit of 50 ha, regardless of the

ownership status. Those who claim to have used a plot of land receive the payment, even if they do not have ownership title. This new system has had two extremely deleterious effects on soil erosion. Firstly, marginal plots of land which were abandoned (possibly because the farmers out-migrated from the village) and have rehabilitated themselves naturally over the last decade or so are now being utilised to receive the subsidy. A second unintended consequence of the new subsidy arrangements is that farmers who convert pastures to ploughed land, thus potentially exacerbating soil erosion, produce witnesses to state that the land has been continuously farmed. The Commissions which were set up to verify such claims are not able or willing to do so.

(Some of the information in Items 10 and 11 above is by courtesy of Dr Hasan Gencaga, Team Member)

Therefore, an **Operational Policy** which can be derived from these issues is:

That soil conservation activities which attempt to alleviate and rehabilitate current levels of soil erosion and other forms of soil degradation should be undertaken within the Coruh River catchment to the greatest feasible extent, using the best available field techniques, and effective participatory planning and cooperation between State agencies and the villagers. These activities should be planned and implemented where erosion is assessed as threatening, severe, active and reversible, and where the villagers are willing to help implement the proposed activities.

A.3.2 Strategies

The strategies for implementing this policy, in order to address the issues described above, include:

1. Change the economic dependence of villagers on their adjacent forests and rangelands.
2. Arrest the cycle of landscape degradation through improved, participatory, rangeland management.
3. Use an approach to erosion control and rehabilitation of degraded soils which addresses a "total mini-catchment" within any selected MC. This implies studying all of the mini-catchment (a catchment on, say, a sixth-order stream, perhaps including 200 to 1,000 hectares) and then planning integrated and comprehensive soil conservation measures for the whole mini-catchment.
4. An alternative approach is to employ a "hotspot" approach. In other words, attention is devoted to rehabilitating only the very worst places. These would include the very steepest gullies and would include advanced and expensive methods of torrent control. It assumes that soil erosion in the "hotspots" is reversible, which is a questionable assumption.

5. Another alternative is to attempt to rehabilitate only the areas which are not so badly eroded that their status can fairly easily be reversed.
6. The new Decision-Making Methodology described in Section 5.1 of this Working Paper will greatly assist in determining whether any given "hotspot", of whatever size, requires rehabilitation and is able to be rehabilitated.
7. It is important to devise technical instruments which can be undertaken at low cost per hectare (lower than present methods), and thus treat more hectares for the same amount of money.
8. Some attention could be devoted to assessing the severity of mass earth movements, and their contribution to suspended sediments and bedloads.
9. Some of the past and current activities in erosion control have been initiated largely as a result of public concern about flood control, often only after deaths by drowning have occurred. While this might be understandable from the point of view of politicians and the public, this approach should be examined to determine whether it is the most rational way of allocating scarce resources to soil conservation.
10. Likewise, the severity and extent of riverbank erosion, its contribution to suspended sediments and bedloads, and the effectiveness of attempts to arrest riverbank erosion with engineering structures and bankside plantings should be examined.
11. It is very important to start well-planned scientific research to measure the long-term impact of erosion control and rehabilitation on the actual output of suspended sediments from catchments in which these expensive activities have been undertaken.

A.3.3 Measures for Implementation

Implementing any of these strategies will generally require various measures, which might include all or some of the following:

1. Closing up areas of land (such as the delineated forest areas and their included rangelands) in such ways as to effectively exclude villagers from entering and using the land. The feasibility of these measures is problematical. The acceptability of these measures to the villagers will also be problematical in most cases, unless the villagers are encouraged to examine such measures in the light of their own best interests, and if indeed such measures are recognized by the villagers as being in their own best interests.
2. In this respect, it is always important to recognize that villagers must be actively supported to develop compensatory income-generating activities if any conventional (current) source of income from forests and rangelands is threatened by permanent closure or by limiting access. Such compensatory mechanisms could include intensification of arable land use close to the village, promotion of new crops, more attention to marketing of current and new crops, better veterinary care, assistance with better animal husbandry for existing types and breeds of livestock, and promotion of other income-generating activities such as apiculture, horticulture, plastic greenhouses and aquaculture. However, before any of these activities can be promoted and adopted,

each must be shown to be economically viable and sustainable in the long term. They must also be acceptable to villagers on other grounds, such as labour availability and integration with the current farming systems and practices. This will require applied research and field demonstrations.

3. Changing the economic dependence of villagers on adjacent forests and rangelands is an important strategy. Increasing village incomes from improved agriculture, forestry and land management have been assumed to improve villager management of the adjacent natural resources, as discussed above. This strategy assumes that the participation of villagers in improved soil conservation (both by involvement in soil erosion control and in better management of rangelands and forests through better livestock management) can be improved through convincing them that their own best interests would be served if cooperation and participation were increased. This is not easy and will, among other measures, require considerable education and training of village administrators, and farmers and shepherds.
4. Regardless of whether the cooperation and participation of villagers in the above measures can be assured, it will still be important to promote rehabilitation of large areas of certain types of rangelands whose condition is probably reversible. In fact, villagers are likely to welcome this activity, but only if they are convinced that they will directly and rapidly benefit from the better pasture resources.
5. All proposed strategies and instruments for soil conservation require monitoring and evaluation against objective baseline conditions to ensure that they are in fact effective in achieving benefits (above the baseline) in relation to soil conservation, among any other benefits they might provide.

A.3.4 Constraints and Opportunities for Soil Conservation

The constraints on improved soil conservation in the Coruh River catchment include physical (ecological) constraints, socio-economic constraints and legal/administrative constraints.

Physical constraints may include:

- bare soils, with virtually no vegetative cover;
- shallow soils;
- generally, soils of poor fertility;
- generally, soils of high erodibility;
- steep to very steep slopes;
- extensive gully erosion;
- severe torrents in gullies;
- harsh climates, in terms of low rainfall, high rainfall intensity in storms, poor absorption of rainfall and rapid runoff, poor water retention in shallow soils, and poor retention of snowmelt; and

- harsh climates, in terms of intensely cold winters and hot dry summers, which impose very short growing seasons.

Socio-economic constraints may include:

- conservative and suspicious attitudes of villagers to proposed soil conservation activities;
- the economic dependence of villagers on continued exploitation of the forests and rangelands, despite the continued degradation of these resources and the apparent irrationality of the exploitation;
- the lack of viable, sustainable, income-generating alternatives to current land use practices;
- the lack of initiative and self-reliance often exhibited by villagers;
- the continued expectations by villagers that the State will assist them to overcome their problems; and
- financial constraints on field activities in soil conservation faced by State agencies.

Legal/administrative constraints may include:

- lack of clarity in legal boundaries of various types of lands;
- continued conflicts over these boundaries, and the consequent protracted legal actions;
- lack of acceptance of any legal boundaries;
- lack of effective means of enforcing legal boundaries and of enforcing compliance with legal restraints on entry and use of various types of lands;
- lack of cooperation between and within State agencies;
- the need for capacity-building in relation to the principles and practices of effective soil conservation among both staff of State agencies and among villagers; and
- the need for effective methods of participatory planning and encouragement of cooperative soil conservation in the field.

The opportunities for mitigating and (if possible) overcoming these constraints depend on addressing each constraint to the greatest feasible extent. The aim must always be to attempt to improve:

- participatory planning and cooperation;
- the technical methods and measures;
- the cost-effectiveness of technical methods and measures;
- the legal instruments for soil conservation;
- the administrative methods and cooperation between and within State agencies; and
- the levels of trust and cooperation between State agencies and the villagers.

A.3.5 Soil Conservation and Landscape Rehabilitation

Table 3.1 describes all the types of landscapes and soil erosion problems present in the Study Area. It does not include descriptions of forested areas or of various types of Protected Areas.

Table 3.1 first classifies landscapes into those subject to high rates of natural (geological) erosion and those subject to high rates of accelerated (man-made) erosion. The former include: steep bare rocky areas; mass earth movements; floods; mudslides; and coarse rocky debris in streams and as deposits on arable land. The latter include: high and lower rangelands (*yayla* and *mer'a*, in four classes of seriously degraded, poor rangelands, average rangelands and good rangelands); meadows; streambanks; and arable lands (in three classes of non-active erosion, but potentially erodible, active erosion and discharging suspended sediments, and lands buried by coarse rocky debris). Table 3.1 also describes the impacts of road construction and maintenance on soil erosion.

It is important to recognize that in many parts of the Coruh River catchment very high rates of natural erosion are occurring, which might in some places be hard to distinguish from high rates of accelerated erosion. The two may, of course, occur on the same site and will thus be mutually even more destructive.

Table 3.1 also describes the causes and trends of soil erosion observable in each landscape type, proposes various solutions to alleviate the causes and mentions some of the techniques which could be used to implement the solutions. The agencies responsible for implementing the techniques are mentioned, with strong emphasis on the role of the villagers as the real land managers.

A.3.6 The Status of Soil Erosion in the Six Selected Micro-Catchments

The Study Team has assessed the status of soil erosion and degradation of natural resources in the six selected MCs. The assessments represent the summarized observations from (i) field inspections by the Study Team; and (ii) discussions with villagers, MEF staff and other stakeholders. They have been reported as Annex 2 in each of the six MC Plans.

Each Annex 2 is reproduced in this Working Paper, collected together as Table 3.2, to illustrate the actual conditions in the field. Table 3.2 therefore provides specific examples of the more generalized trends and descriptions in Table 3.1.

Table A.3.1 Soil Conservation, Landscape Rehabilitation and Natural Resource Management

SOIL CONSERVATION, LANDSCAPE REHABILITATION AND NATURAL RESOURCE MANAGEMENT

1: LANDSCAPES WITH HIGH RATES OF NATURAL EROSION

PROBLEM/ SITUATION	CAUSES/TRENDS (Why is the problem occurring, and what is the trend?)	SOLUTIONS (What should be done, when and where?)	TECHNIQUES/AGENCIES (How should it be done, and who is responsible for doing it?)
Steep bare rocky areas (For example, Uzundere and Yusufeli)	These are a result of natural geomorphological processes. If overgrazing and deforestation continues, the trend is towards increasing the area of these slopes.	Little can be done to change the process itself, but the trend can be reversed if overgrazing and deforestation are arrested or mitigated.	The only useful techniques to rehabilitate these areas are to minimize the removal of adjacent vegetation and to encourage natural regeneration, particularly of *Populus tremula*.
Mass earth movements (landslides and soil slumping) (For example,Ispir, Upper Oltu and Upper Yusufeli)	Large rock landslides are a result of natural geomorphological processes, such as earthquakes and rock weathering. Localised soil slumping is generally the result of saturation of some types of susceptible soil profiles during and after heavy rain. In both cases the trends are neither better nor worse. Any naturally unstable area will threaten any infrastructures lower on the slope.	Nothing can be done to minimize large rock landslides. Soil slumping might be minimized by maintaining a dense stand of trees with strong roots. It may be necessary to move infrastructures out of the danger zone. Expensive civil engineering structures may be effective in mitigating the effects of mass earth movements on humans, but only if the problem is not too massive.	Both MEF and villagers can assist by encouraging and maintaining dense stands of trees. GDRS and DSI may be able to build civil engineering structures which might have some benefit in localized cases. Where villagers are already utilizing these areas, the possibility of loss of land and infrastructures must be recognized.
Floods (For example, Tutmac and Ballica [Oltu], and Celtikduzu [Yusufeli])	Floods are the result of high rainfalls at high intensities falling on steep bare rocky areas and producing immediate flashy runoff. The trends may be better or worse, depending on the success of land management in maintaining a high percentage cover of trees, shrubs and pastures and absorbent soil profiles. Damage to streambanks and infrastructures from floods, usually lower in the catchment, is getting worse in some sub-catchments in the Study area.	Floods can be minimized, but not completely eliminated, by maintaining a high percentage cover of trees, shrubs and pastures and absorbent soil profiles. The aim is to slow the runoff as much as possible and encourage slow release of water. The treatments are most effective if first applied high in the catchment, and then working down the catchment. Physical damage to streambanks and infrastructures can be alleviated to some extent by appropriate civil engineering structures on streams, and by streambank planting.	Any interventions which maintain a high percentage cover of trees, shrubs and pastures high in the catchment, and elsewhere, will help to minimize rapid runoff. Terracing might be effective in slowing the runoff, increasing infiltration and retaining higher soil moisture contents. For maximum effectiveness, all or most of the upper and middle catchment must be treated. The responsibility lies with the villagers, AGM and OGM. AGM may also be able to establish streambank plantations which may stabilize erodible areas. GDRS and DSI may be able to build civil engineering structures which might have some benefit in localized cases.

PROBLEM/ SITUATION	CAUSES/TRENDS (Why is the problem occurring, and what is the trend?)	SOLUTIONS (What should be done, when and where?)	TECHNIQUES/AGENCIES (How should it be done, and who is responsible for doing it?)
Mudslides (For example, Yenikoy [Yusufeli])	Mudslides are the result of high rainfalls at high intensities falling on unstable fine sedimentary rocks such as mudstones and sandstones (and colluvial deposits from them) and unstable fine-textured soils, producing immediate runoff which carries a massive amount of mud. The trends may be better or worse, depending on the success of land management in maintaining a high percentage cover of trees, shrubs and pastures, especially on unstable types of rocks and soils.	Mudslides can be minimized only by improving the stability of the vulnerable parts of the catchment, by maintaining a high percentage cover of trees, shrubs and pastures. In some localized cases it may be possible to divert mudslides into less harmful places with civil engineering structures, but the best action is to treat the cause of the problem rather than trying to minimize the effects of the problem.	Any interventions which maintain a high percentage cover of trees, shrubs and pastures on the vulnerable areas will help to minimize rapid runoff. The responsibility lies with the villagers, AGM and OGM. While OGM implements appropriate forest conservation and improvement techniques, AGM may also be able to establish plantations which should stabilize erodible areas. GDRS and DSI may be able to build civil engineering structures which might have some benefit in localized cases.
Coarse rocky debris in streams and as deposits on arable land (For example, Kirazli and Altincanak [Uzundere] and Orcuk [Oltu])	These are the result of high rainfalls at high intensities falling on unstable rocks and producing immediate flashy runoff with very high velocities and power. Floods cover arable lands and deposit debris. The trends may be better or worse, depending on the success of land management in maintaining a high percentage cover of trees, shrubs and pastures. Much of the coarse rocky debris seen in the streams is being re-mobilised and transported from debris already in the streambeds and streambanks, especially where the stream is eroding old colluvial fans.	Deposits of coarse rocky debris are important to villagers in two ways: (i) they raise streambeds above surrounding arable land and exacerbate flooding, which then (ii) deposits additional debris outside the stream channel. This problem can only be alleviated by addressing the causes of the high discharge floods, by maintaining a high percentage cover of trees, shrubs and pastures in the uplands. The treatments are most effective if first applied high in the catchment, and then working down the catchment. Burial of arable land can be alleviated to some extent by appropriate civil engineering structures on streams, and by streambank planting. Bulldozing of deposits back into the streambed may be required, but there will always be some damage to the arable land.	Any interventions which maintain a high percentage cover of trees, shrubs and pastures on the vulnerable areas will help to minimize rapid and powerful runoff. The responsibility lies with the villagers, AGM and OGM. AGM may be able to establish plantations which should stabilize erodible streambanks and stream beds. GDRS and DSI may be able to build civil engineering structures which might have some benefit in localized cases. GDRS may be able to bulldoze deposits back into the streambed and at the same time improve the channel to minimize future damage to adjacent arable land.

2: LANDSCAPES WITH HIGH RATES OF ACCELERATED EROSION

(Use the Decision-Making Methodology to classify the severity of the problem, and to decide whether the erosion is active or non-active, whether the erosion is reversible and whether the proposed solutions are acceptable to the villagers.)

PROBLEM/ SITUATION	CAUSES/TRENDS (Why is the problem occurring, and what is the trend?)	SOLUTIONS (What should be done, when and where?)	TECHNIQUES/AGENCIES (How should it be done, and who is responsible for doing it?)
High and lower rangelands (yayla and mer'a)			
Seriously degraded rangelands on difficult sites. These areas may also be called "hotspots". The estimated dry matter production at present is virtually zero.	These areas may resemble the steep bare rocky areas described above. Sheet and gully erosion will be severe, and unless mitigating action is taken the trend will be towards even more serious degraded conditions. Many of these areas can be permanently maintained in their degraded condition by occasional grazing by even one animal for a week or two. If it is decided (after using the Decision-Making Methodology) that any "hotspot" has some potential for rehabilitation then appropriate actions should be taken, as specified in the Methodology.	The only feasible solution is to fence the area and remove the stock permanently, hopefully allowing some natural regeneration to establish and start to rehabilitate the area. These areas produce so little feed that their removal from grazing has no economic consequences anyway. The solutions are entirely the responsibility of the villagers. If the "hotspots" are treatable, then a range of solutions, including fencing, elimination of grazing and soil conservation, can be implemented.	Fencing and closing from grazing for many years. This is the responsibility of the villagers. The applicable techniques include participatory assessment of the state of the natural resources by villagers and AGM staff, and enforceable village agreements on land use. MARA will probably become involved, through the operations of the Pastures Law. Alternatively, the "hotspots" might be treated with terracing and/or planting with species of grasses, herbs, shrubs and trees chosen by the villagers. Some gully plugging can be done.
Poor rangelands (40% of area). The estimated dry matter production at present is about 300 kg/ha/an.	Severely degraded pastures due to long continued over-grazing. The trends are generally stable or getting worse if over-grazing is continuing, but in places where grazing intensities have decreased slightly over the last decade some of these pastures are recovering to an average level of productivity. These areas are either already exhibiting moderate sheet erosion and some gully erosion, or are potentially erodible if grazing intensities do not decrease.	Controlled grazing is essential, probably combined with closure of the land with or without fences. It is possible to re-seed and apply fertilizers, using the species of plants preferred by the livestock, which have disappeared from the pasture due to over-grazing. However, local experience with this solution has been disappointing, with rapid loss of the introduced species, probably due to limited root development in seasonal droughts. Unsuitable (non-local) species and varieties have also failed in trials. It is necessary to close the land to grazing while the new seedlings are establishing, and this is generally not acceptable to farmers. Gully plugging can be done. If these solutions are successful, fodder productivity might increase to as much as 1,500 kgDM/ha/an.	If improvements are planned, agreement with villagers is essential. It may be possible to re-seed and apply fertilizers, but experience appears to show that this is not cost-effective. Use the species of plants which have disappeared from the pasture due to over-grazing. It may also be necessary to break the ground surface with light hand or mechanical cultivation. This technique can only be used on suitable slopes and soils, and certainly not on unstable sites. In this case, close the site if possible and allow it to regenerate naturally for many years, or at the least persuade the villagers to severely restrict grazing, with or without fences. Some gully plugging can be done. AGM is responsible for rangelands within, near and above forests as well as for OT areas, but in the future (under the Pastures Law) MARA will be responsible for improvement of most of the rangeland in OT areas.

PROBLEM/ SITUATION	CAUSES/TRENDS (Why is the problem occurring, and what is the trend?)	SOLUTIONS (What should be done, when and where?)	TECHNIQUES/AGENCIES (How should it be done, and who is responsible for doing it?)
Average rangelands (50% of area). The estimated dry matter production at present is about 1,200 kg/ha/an.	The main cause of the relatively low productivity is over-grazing, and grazing too early, too late and for too long a period each year. The pasture plants are rarely able to establish strong root systems, nor to set seed. The trends are generally stable or getting worse if over-grazing is continuing, but in places where grazing intensities have decreased slightly over the last decade some of these pastures are recovering to a higher level of productivity. There may be slight sheet erosion and some gully erosion, but generally the current erosion is relatively slight. Potentially, the sites are still erodible.	The most important solution is to alleviate the cause of the problem by controlled grazing, using two main interventions: rotational grazing (perhaps 10 out of every 30 days, or even one out of every three years) and reducing the grazing period each year down to about 120 days. The critical period is in the Spring, when pastures must not be grazed for at least a month after the snow melts. If the grazing period is to be reduced from 6 or 7 (or even more) months each year to only 4 months, then a complementary program of increased forage production on the lowlands must be introduced. It is possible to improve pasture productivity: some fertilizers and re-seeding with local species can improve pasture productivity considerably. Fodder productivity might increase to as much as 2,700 kgDM/ha/an.	Work closely with the farmers to implement a mutually-acceptable program of controlled grazing – both rotational grazing and limiting the grazing period. Water troughs might assist in better distribution of grazing pressures. Establish small demonstrations of the benefits of fertilizing and re-seeding with local species on suitable slopes and sites. The responsibility of working with the villagers to establish better grazing practices rests with AGM and MARA. Methods for increasing fodder production from rangeland pastures, and also for improving forage production from lowlands, will generally be the responsibility of MARA, but in the Forest Villages and high rangelands AGM can be the most appropriate agency unless MARA is directly involved in the project. Stall feeding should be encouraged, especially for cattle, but if large flocks of sheep are present it is unrealistic to expect that they will be kept and fed inside for up to 8 months.
Good rangelands (10% of area). The estimated dry matter production at present is about 2,500 kg/ha/an.	These rangelands are not common, and are probably the result of rational grazing patterns employed over many years by sensible farmers and villagers. There is some field evidence that the area of good rangelands may be increasing, but they are still not common. Such rangelands will probably not exhibit much sheet or gully erosion.	The main intervention is to reduce the length of the grazing period to no more than 120 days/year, with particular attention to stopping grazing in early Spring. It could be difficult to convince villagers to refrain from early grazing in Spring if they observe apparently high pasture production, but if they give in to the temptation of grazing they risk setting the pastures back to only average quality. Surplus pastures should be harvested by hand or simple machines where possible (cut-and-carry). Complementary improvement of forage production on low lands will be necessary. Fodder productivity might increase to as much as 4,000 kgDM/ha/an.	Work closely with the farmers to implement a mutually-acceptable program of controlled grazing – both rotational grazing and limiting the grazing period. The responsibility of working with the villagers to establish better grazing practices rests with AGM and MARA. Methods for increasing fodder production from rangeland pastures, and also for improving forage production from lowlands, will generally be the responsibility of MARA. Stall feeding should be encouraged, especially for cattle, but if large flocks of sheep are present it is unrealistic to expect that they will be kept and fed inside for up to 8 months.

PROBLEM/ SITUATION	CAUSES/TRENDS (Why is the problem occurring, and what is the trend?)	SOLUTIONS (What should be done, when and where?)	TECHNIQUES/AGENCIES (How should it be done, and who is responsible for doing it?)
Meadows	These areas are generally almost flat and exhibit very little erosion. They are intensively used for production of pasture fodder (hay) and forage crops. If they are near streams they may be subject to streambank erosion. If cultivation is up and down the slopes, sheet erosion can be serious. The general trend will be towards improvement, and irrigation is generally installed to improve plant production.	The solutions for increased plant production include better seeds, the use of fertilizers and manures to maintain soil fertility, cultivation, disease control and appropriate harvesting methods and timing. Higher plant production should allow more cuts of hay each season at the best times for maximum nutrient content. Mechanisation of hay cutting is helpful. Cultivation up and down slopes must be discouraged – use contour tillage and possibly terracing if feasible. Streambank protection (by poplars, willows and possibly by levy banks or gabions) may be required.	MARA should be able to assist farmers with advice on better seeds, fertilizers, cultivation methods, disease control and havesting methods. GDRS is responsible for irrigation design, installation and operation. Villagers are responsible for channel maintenance. AGM is generally responsible for streambank erosion control, usually by planting poplars and willows.
Streambanks	Streambanks generally have fertile alluvial soils which are valuable and productive, but erodible. If the upper catchments have been degraded and are producing large amounts of coarse rocky debris, the streambeds will fill with debris and will rise, floods will overtop the streambanks and sediments and debris will be deposited on adjacent land.	The solutions lie in implementing any erosion control methods in the upper catchments which will reduce the amount and power of the runoff from intense storms, and the coarse rocky debris which it carries. Stream bank protection with poplars and willows can be very effective in minimizing bank erosion.	AGM is responsible for planning and implementing streambank erosion control using trees. GDRS and DSI are responsible for any civil engineering works along streams.
Arable lands			
Non-active erosion, but potentially erodible	This situation occurs on fields which are not frequently cultivated. Most of the arable soils in the Coruh River catchment are erodible if cultivated and if plant cover is removed.	These fields should continue to be cultivated as little as possible. If cultivated, it should if feasible be done on the contour and not up and down the slope. The period of exposure of bare soils should be as short as possible. Terracing should be considered as a method of reducing the slopes of cultivated land.	The responsibility for soil conservation tillage rests with the farmers. MARA should be able assist by training farmers in responsible soil conservation practices such as mimimum tillage, contour tillage and other protective techniques.
Active erosion, discharging suspended sediments	Fields on even gentle slopes can easily generate sheet, rill and gully erosion if badly cultivated and left bare for long periods.	The solutions lie in proper cultivation methods and reducing the length of time the fields are left bare (fallow reduction). If sheet and rill erosion are already evident, cultivation will probably partly repair the damage. If gullies have developed, gully plugging and filling the gullies with unwanted tree branches may slow the water and allow deposition of sediments.	The responsibility for soil conservation tillage rests with the farmers. MARA should be able to assist by training farmers in responsible soil conservation practices such as minimum tillage, contour tillage and other protective techniques.

PROBLEM/ SITUATION	CAUSES/TRENDS (Why is the problem occurring, and what is the trend?)	SOLUTIONS (What should be done, when and where?)	TECHNIQUES/AGENCIES (How should it be done, and who is responsible for doing it?)
Buried by coarse rocky debris	Large proportions of the limited areas of village arable lands are often covered by coarse rocky debris from floods. The trends depend on the state of the upper catchments, and the effectiveness of any erosion control measures which might have been taken.	The solutions lie in implementing all the measures for flood control described above, to minimize the amount and velocity of the runoff from severe storms and thus reduce the frequency and severity of floods. Arable lands buried under rocky debris may be cleared by bulldozing, but there will always be some degradation of their quality following this treatment.	GDRS is responsible for any physical removal of the rocky debris, and re-forming and re-grading the stream channels. AGM is responsible for all measures in the upper catchment which will minimize the amount and velocity of the runoff from severe storms and thus reduce the frequency and severity of floods.

3: ROAD CONSTRUCTION

Erosion due to road construction and maintenance	Even though roads occupy a very small proportion of the area of each catchment they are often responsible for a disproportionately high contribution of suspended sediments and coarse rocky debris. High intensity rain falls on non-absorbent gravelly and clayey road surfaces and immediately runs off, is concentrated at high velocity into road gutters and the large volumes of water then erode the gutters and eventually the downslope soils. Poor road construction and maintenance exacerbate the problems and the trend is towards further degradation.	By design, roads are impervious surfaces which must shed water. It will never be possible to eliminate the problem of rapid runoff, but it is possible to use the best available civil engineering practices in design, construction and maintenance to minimize the destructive effects of large amounts of water moving rapidly along gutters and then downslope. Gutters and culverts must be designed for the probable worst-case storms and must dispose of the water downslope in the slowest possible, least concentrated, streams flowing in protected beds and banks.	GDRS is responsible for general village road construction and maintenance, and OGM for forest roads. DSI is responsible for roads which service hydroelectric developments. All agencies must use the best available civil engineering practices in design, construction and maintenance to minimize the destructive effects of large amounts of water moving rapidly along gutters and then downslope.

Table A.3.2 The Status of Soil Erosion in the Six Selected Micro-Catchments

Berta Sub-Catchment, Savsat MC (BT-04)

VILLAGE	COMMENTS
Kirecli (on the Anadali Dere)	The view of the MC from the MC boundary above Duzenli indicates very well many of the eroded areas in the MC. Generally, the high yayla is in reasonable condition. The pastures around the saddle could produce hay, using small mechanisation. The hill at the NW end of the saddle is moderately eroded and actively eroding, and could be fenced and protected if villagers allow this. The long ridge to the W and S of the village is eroding and needs attention, together with an area to the N.
Hanli (on the Anadali-Hanli Dere	The oak regeneration W of Camlica needs attention by encouraging a program of oak coppice treatment. The ridge to the NW of Hanli is very steep and subject to landslides, but little can be done here. The yayla above Hanli is generally in good condition at current grazing intensities. AGM has established a reforestation and erosion control area W of Karaagac which does not seem to be really essential and is only partly successful.
Ciftlik (on the Cavdarli Dere)	This village has a large area of undulating pasture lands from which hay is produced. There are few problems with soil erosion, apart from a few limited areas on steeper slopes S or E of the village.
Savas (on the Cavdarli Dere)	On the MC boundary. Apparently a recognized area for illicit cutting, outside the MC boundary. No need for erosion control around the village within the MC.
Cavdarli (on the Cavdarli Dere)	There are 55 households, only 3 of which have sheep. There appear to be few erosion problems around the village.

General comments from forestry agencies:

- The most important problem in the general area is fuelwood. The forest management plans do not take account of any other output from the forests except timber. The planning procedures and instructions must be changed to take account of the other outputs from the forest, such as subsistence fuelwood, biological conservation, water, grazing etc. The forests are not currently providing for the needs of the villagers, including employment.
- It is likely that virtually all (90%?) of the Normal Forests (now totaling 4,059 ha) will become conservation forests in the near future. The direct costs of felling and transporting are at least TL 50 m/m^3, and the selling price is about TL 80 m/m^3, but this does not take into account the considerable overhead costs. Timber production is becoming quite uneconomic in this area. Present production is about 10,000 m^3/annum, of which 90% goes to sawmills outside the area, so there will be little impact on the local mills if timber production ceases.
- There are also 1,463 ha of Bozuk (degraded) Forest and 8,100 ha of Cok Bozuk (highly degraded) Forest.
- The inflexible forest management policies and practices lead to conflicts and contradictions in forest management with respect to villager attitudes. The relations with villagers are generally poor. There is widespread illicit cutting, which might be minimized if the management practices were more sensitive to local needs.
- The population is out-migrating and/or is becoming much older, with passive attitudes. There is limited labour available for forest operations.
- If these new attitudes and practices in regard to multi-purpose land management (and holistic, basin-wide planning and management) are to become widely accepted, it will be essential to have better cooperation between Government agencies, especially MEF and MARA.
- There are poor capabilities for Protected Area planning and management in MEF, which become especially important in the Artvin Province. Villagers are usually strongly opposed to establishment of Protected Areas.
- Savsat has considerable areas of rangelands of various qualities, which appear to under-utilised at present. Apart from some localized areas, soil erosion is not particularly serious at present. The yayla above the timberline will probably in due course become the responsibility of MARA under the Pastures Law. It is becoming more obvious that MARA will become the

major management agency of areas previously considered the responsibility of MEF. But MARA is not our counterpart agency.

- There are some nomadic grazers, mostly from Hopa, who tend to travel through to the Ardanuc area and beyond.
- The most fertile land in the Artvin area will soon be under the Deriner and other dams. This will have a severe effect on the productivity of the area, and also on the investment climate. The displaced villagers will have to move further up the inhospitable slopes, which has serious consequences for soil erosion, or will move to town. Research is needed on suitable horticultural and other crops for the higher altitudes and different soils.
- The areas of the forests are not decreasing very much at the moment, but the quality and growing stock are deteriorating due to selective illicit cutting, especially for fuelwood. It is thought that some 60,000 steres of fuelwood are cut annually by 66 villages, or perhaps 500 stere/forest village annually. The demand is probably about 20 steres.household, or say 12 m^3/household. Better house insulation might reduce fuelwood demand. The existing forests should be closed and treated as "maintenance forests", with minor thnning to maintain forest vigour and standing volume at about 250 m^3/ha. But there may be opposition to this, and the availability of labour at the offered piece rates may be low.

The Main Problems:

- Illicit cutting for fuelwood.
- Poor availability of labour for maintenance forest operations, at the current offered piece rates for work.
- Poor planning for Protected Areas and Forest Management Plans, especially in respect of recognizing village needs.
- Need for better cooperation with MARA in relation to rangeland management.
- Some limited areas need erosion control and afforestation, and other areas need fencing and protection.

Constraints:

- Poor relationships between villagers and MEF.
- Poor cooperation with MARA.
- Poor planning of forest management and Protected Areas.

Potential for Rehabilitation:

- Most areas needing rehabilitation have good potential.
- The potential for better maintenance of standing coniferous forests and oak coppice forests depends on cooperation by villagers.
- The potential for better rangeland management will depend on MARA, and on cooperation between MARA, MEF and villagers.

Middle Coruh Sub-Catchment, Yusufeli MC (MC-03)

VILLAGE (in order of AGM priority)	COMMENTS
1. Yenikoy (not in MC)	Regarded as a serious problem because three mudslides cover the main road every time there is heavy rain, disrupting traffic for long periods and requiring expensive maintenance. The catchment is relatively small, but obviously unstable. Needs comprehensive study, followed by preparation of an integrated erosion control plan with the villagers. This will only work if the villagers eventually understand the relationship between causes and effects.
2. Koprugoren (not in MC)	Subject to serious flash flooding from this long steep catchment. The whole long catchment (from above Yamacuslu to the Coruh River) should be studied and planned as one integrated erosion control project. There are numerous areas which could be treated to rehabilitate hotspots, but the catchment is naturally unstable. Lessons learned will be applicable to Alanbasi.
3. Yamacuslu (not in MC)	This area was not inspected during the Study, but any effective treatments around this village will benefit Koprugoren lower in the catchment if they minimize flash runoff.
4. Alanbasi (in MC). (On the Hapishar Dere)	The village area is extremely steep and is subject to high rates of natural erosion which are not treatable. On the few suitable sites terracing, reforestation, gully plugging and grazing control should be planned if villagers are willing to participate. Some oak coppicing could be useful. The boundaries to Bakirtepe are not clear and there is much overlapping of grazing between the two villages, which is potentially destructive.
5. Celtikduzu (in MC). (On the Selcisal, Balsuyu Dere, and on the bank of the Coruh River)	This village will be flooded by the Yusufeli Dam within two decades. Investment in agriculture has virtually ceased, and interest in erosion control and better land management is low among the villagers. The area high above the village needs protection, especially from goats, in order to stimulate some improvement in pastures and natural regeneration. Oak coppice needs treatment. This might alleviate flooding, at least to a small extent. There is a large area of extreme erosion about 2 km downstream on the right bank of the Coruh River. There are dense stands of poplars on the colluvial fan on which the village is situated.
6. Ilmakyani (in MC, but not a chosen village)	The land high above the village is extremely steep and rocky, and little can be done to minimize natural erosion and rapid runoff. The are immediately above the village (top of the colluvial fan) shows moderately active sheet erosion and appears to threaten the village. The area should be fenced, terraced and grazing eliminated to minimize runoff. Dense planting of useful species such as Rosa, Kapari and wild pomegranate should be considered. Immediately S of the village, but not so threatening, is another small colluvial fan which should be fenced, grazing prohibited, planted and natural regeneration encouraged.
7. Kilickaya (in MC). (On the Kilickaya Dere)	The pollarded oak coppice on the steep slopes NW and SE of the village need treatment to improve productivity and erosion control. There are numerous individual eroded areas all around the village, and the area obviously suffers heavy and unsustainable grazing and harvesting of fuelwood. The villagers are reputed to resist any activities which interfere with their unimpeded abuse of the land., but they might slowly be convinced by demonstrations that the oak stands could be improved.
8. Bakirtepe (in MC). (On the Hapishar Dere)	The village has a few isolated areas of moderate erosion, and there is ample evidence of minor landslides which appear to revegetate naturally. The Normal and Degraded Forest above the village should be improved by simple maintenance silviculture. Grazing control is needed for the rangeland pastures. The land below the village, down to Alanbasi, is steep and rocky, with considerable erosion which is probably not reversible.

General comments from forestry agencies:

- The AGM office in Artvin specified 8 “hotspots” in and around the MC which they regard as being important, in this order of priority: 1. Yenikoy (adjacent to MC); 2. Koprugoren (adjacent to MC); 3. Yamacuslu (adjacent to MC); 4. Alanbasi; 5. Celtikduzu; 6. Ilmakyani; 7. Kilickaya; 8. Bakirtepe. It is significant that the three highest priority sites are just outside the MC. All 8 sites are described in the table above.

- The real problem in the MC and local area is fuelwood, while protection of Normal Forest is also important. There is virtually no production forestry in the MC. MEF is now allowing some branch pruning to provide fuelwood, in an effort to minimize illicit cutting, and is trying to persuade villagers to convert to coal as the common fuel.
- An estimate of illicit cutting in Celtikduzu is a relatively small 4 steres/household/annum, but this village has large areas of poplars. In more remote villages with smaller (or no) areas of poplars, the rate of illicit felling is probably around 10 steres/household/annum. The average over the MC is probably about 7 steres/household/annum.
- Recent erosion control (brush terracing, planting) of 145 ha W of the road to Cevreli was inspected across the valley. Appears to be potentially very successful. The cost was TL 73 billion (about TL 500 m/ha).
- The quality of the initial work and maintenance on erosion control and planting is likely to be higher than that done by contractors. The villagers are likely to have more interest in sustainable land improvement. One problem with villager involvement is the requirement that a professional forester has to "sign off" on work done on any area over 50 ha. The high costs of this (maybe TL 2 billion) eliminate any profit the villagers might have made, for no benefit whatsoever. It is a severe disincentive to the villagers.

The Main Problems:

- Extremely steep and unstable slopes, especially in the gorge of the Coruh River.
- Severe scarcity of fuelwood, and the consequent high level of illicit cutting.
- Shallow soils and very dry climates, but occasional severe thunderstorms producing floods from immediate runoff from steep slopes.
- Generally severe accelerated gully and soil erosion on the slopes of the numerous colluvial fans along tributaries of the Coruh River.
- The cost to the villagers of involvement in erosion control work on areas greater than 50 ha.

Constraints:

- Extremely steep and unstable slopes, especially in the gorge of the Coruh River.
- Shallow soils and very dry climates, but occasional severe thunderstorms producing floods from immediate runoff from steep slopes.
- Variable, but often severe, village opposition to involvement in erosion control work.
- Erosion control by revegetation is very difficult under the harsh climates, and different methods are needed.

Potential for Rehabilitation:

- Outside the MC, important work could be done by studying (i) the catchment from Yamacuslu to Korugoren, and (ii) the catchment above Yenikoy, as integrated whole-of-catchment erosion control projects.
- Within the MC, the potential for rehabilitation is restricted by the extremely harsh conditions and by opposition from villagers, particularly in Celtikduzu. However, there is some potential for oak coppice treatments around Kilickaya, improved grazing control around all villages, and limited terracing and planting in a few places.

Oltu Sub-Catchment, Oltu MC (OL-04)

VILLAGE	COMMENTS
Orcuk (on the Dagin Dere)	The major problem (the worst in the whole MC) is the frequent flooding and re-activation of the very large colluvial fan along the stream through and below the village. At least 250 ha of arable land has been covered by coarse rocky debris. The total area around the village which should be rehabilitated is at least 2,000 ha, but much of this is irreversible erosion. The undifferentiated volcanic rock types and unconsolidated sandstones and mudstones immediately above the village appear to be particularly unstable and would be difficult to treat with terraces and planting. The stream bed contains a very wide variety of rock types. It might be possible to reduce the flash flooding from above by better grazing systems to reduce runoff. The village appears to be internally conflicting, but small, successful, demonstrations of erosion control are important to convince villagers.
Ballica (on the Kadaagac Dere)	The village is said to have lost about 200 ha of arable land under deposits of coarse rocky debris from the flooding stream. There is an obvious need for flood control. The village appears to have an active, aware and enthusiastic Muhtar. It would be a good village for model demonstration of integrated rehabilitation and development.
Tutmac (on the Sivri Dere)	The large eroded area (500 ha?) to N and W of village could be rehabilitated by conventional methods if it is a problem. Afforestation and erosion control area between Tutmac and Yarbasi is reasonably successful, but was probably not necessary. Conspicuous successful natural regeneration of *Populus tremula*. Needs grazing control of rangelands to SW. The springs upstream of the village are important for irrigation water and need some protection by revetments and streambank protection.
Ozdere (on the Sekincukur Dere)	There is mostly small gully erosion, but not very extensive. Successful use of korunga, *Robinia* and other species (*Eleagnus angustifolia*) for erosion control, also using brush terraces.
Basakli (on the Igdelinun Dere)	There is generally good pasture on rangelands high above village (2450 m) on MC boundary. AGM implemented a conventionally terraced and planted area, but this was of little real value as there was no particular problem on the site allowed by the villagers. Dekmonstrates the importance of discussing fencing and grazing control with specific rangeland users. Some extensive areas of erosion and bare rock along the steep stream from this site down to the village.
Igdeli (not a selected village)	Igdeli is not a forest village, although it should be. It is very small, with only 6 conservative and obstinate households. Very limited land area, and numerous continuing conflicts with the adjacent Orcuk. The villagers have refused to allow any erosion control activities, even though the Governor has applied pressure. There is a lot of degraded forest above the village, which is contributing to erosion and stream debris through and below Igdeli.

General comments from forestry agencies:

- The disproportionate influence of a small group of stakeholders is well demonstrated in the case of Aksu village (just outside the MC), where only three households are said to possess a total of 1,500 goats. These have created serious erosion and still continue to degrade the area. It will be impossible to rehabilitate any part of this area unless these stakeholders change the composition and size of their herds, and their grazing patterns.
- The effect of aspect on soil erosion is very well illustrated in the Aksu area. South-facing slopes are much harder to rehabilitate than the less harsh north-facing slopes.
- There is considerable evidence of landslides and soil slumping on the higher slopes at the head of the MC, but most disturbed areas appear to rehabilitate themselves with grass naturally in time.
- There is often great difficulty getting permission from villagers for erosion control activities on specific sites.
- Utilise native species for erosion control, although obtaining seed or seedlings is difficult. Some of the areas around Ballica would be good sites.
- The Muhtar of Orcuk may offer some 250 ha for an erosion control demonstration site.

The Main Problems:

- Severe flooding and deposition of bedload sediments on stream banks and over arable lands, especially at Orcuk and Ballica.
- Poor cooperation by villagers – need for considerable awareness training and much discussion. In particular considerable difficulty getting permission from villagers for proposed erosion control.
- Need to identify livestock herders and discuss rangeland grazing control.
- The rangeland pastures generally appear to be in reasonable condition, but are potentially subject to severe erosion if over-grazed.

Constraints:

- Unstable rocks and soils.
- Generally poor villager cooperation.
- Need to protect the limited areas of arable and mer'a from flooding and deposition of coarse rocky debris.
- Need to improve lowland productivity to relieve pressure on uplands.

Potential for Rehabilitation:

- Most areas are probably reversible, except in and around Orcuk. Removal of coarse rocky debris, as frequently requested by villagers, would be extremely expensive.
- There is a need for civil works to prevent stream bank erosion in selected areas..
- Potential for use of *P. tremula* in natural regeneration.

Tortum Sub-Catchment, Uzundere MC (TR-06)

VILLAGE	COMMENTS
Caglayan (on the Cevizli Dere)	Very steep bare rocky slopes to the S of the village, with lesser slopes to the N. In addition to the bare rocky slopes, there has been severe erosion of any areas which might at one time have had moderately deep soils under forests or rangelands.
Cevizli (on the Cevizli Dere)	Both sides of the river through the village have extremely steep bare rocky slopes. Landslides are common after heavy rain. The riverbed and any tributaries are choked with coarse rocky debris, and several check dams have been completely filled. The soils are very shallow and unstable. The village has some walnut and poplar trees, but the slopes have only sparse Sari Cam woodland. There have been no effective erosion control projects.
Kirazli (on the Kilizli Dere)	Both sides of the river through the village have extremely steep bare rocky slopes. Landslides are common after heavy rain. The riverbed and any tributaries are choked with coarse rocky debris. The soils are very shallow and unstable. Some erosion control measures by AGM high on the left bank slopes have produced a sparse cover which has been moderately effective in erosion control.
Sapaca (on the Sapaca Dere)	Both sides of the river through the village have extremely steep bare rocky slopes. Landslides are common after heavy rain. The riverbed and any tributaries are choked with coarse rocky debris. The soils are very shallow and unstable. The river has been used for successful aquaculture, but the venture is always subject to damage by floods and deposition of sediments.
Altincanak (on the Kilizli Dere)	The village is situated at the mouth of the Kilizli River downstream from Kirazli village, and has steep bare rocky slopes to its N, S and E, and open flats to the W at the head of the Tortum Lake. The village uses some parts of the large area of alluvial sediments at head of Tortum Lake for agriculture. The River has large quantities of coarse rocky debris and is an unstable channel.

General comments from forestry agencies:

- Implementation of any erosion control and afforestation activities is very difficult due to the extremely steep slopes, and shallow unstable soils.

The Main Problems:

- Extremely steep bare rocky slopes with active natural erosion and landslides.
- Overgrazing of the limited areas of rangeland, and poor percentage cover of vegetation.
- Overcutting of the limited forest resources.
- Frequent severe flash floods, and considerable movement of coarse rocky debris in streambeds.

Constraints:

- Extremely steep bare rocky slopes with active natural erosion and landslides.
- Shallow unstable soils.
- Frequent severe flash floods, and considerable movement of coarse rocky debris.

Potential for Rehabilitation:

- Generally poor, due to the severe constraints.
- Erosion control by any means, including afforestation, is very difficult.
- In places where villages and infrastructures are under serious treat from high rates of natural erosion, such as landslides and streambank erosion by flooding, expensive civil engineering structures may be needed.

Upper Coruh Sub-Catchment, Bayburt MC (UC-03)

VILLAGE	COMMENTS
Maden (on the Mitibey Dere)	Area 3 km W of Maden applied for erosion control work on the S-facing long ridge parallel to the main road. Cadastral surveys under the Pastures Law have been completed, but it is not clear who can do any erosion control work. The soils are shallow and potentially unstable, and terracing would not be a satisfactory method. Better to fence and control grazing, and perhaps plant individuals of species such as *Berberis* and *Rosa*. Gullies could be brush terraced. Just above Madan a few wide terraces have been constructed, presumably to protect the village from downslope flow. It is not known who constructed them.
Masat (on the Buyuk Dere)	The N-facing slopes to the S, outside the MC, has regenerated well after removal of goats. Strong aspect effects on natural regeneration are demonstrated on the ridge E of Masat parallel to the main road. The valley NE of Masat has considerable coppice oak and juniper regeneration, protecting and rehabilitating some moderately eroded slopes. Nomadic grazers with some 6,000 sheep on rangeland pastures which are only just reasonable.
Yaylapinar (on the Kuru, Latrans Dere)	AGM afforestation area (400 ha) established in 2000 on W side of Latrans Dere) E of Yaylarpinar, about 4 km N of the main road. The site is not particularly severely eroded, except for gullies which have mostly been plugged with drystone walls. The rangelands around the village are said to be in much better condition than 10-20 years ago due to recent much lower grazing intensities. Unlike Masat, the village does not allow nomadic grazing.
Heybetepe (on the Ahsuniclar Dere)	The ridge to the N of the village (on the MC boundary) is rocky but not eroding. The rangeland below the ridge is in reasonable condition, apart from some gullies, but is potentially erodible if cultivated. Considerable natural regeneration of *P. tremula* and juniper W of the village.
Gezkoy (on the Gez Dere)	Some eroding gullies W of village. Some reasonably satisfactory pastures on S-facing aspects W and E of the village.

General comments from forestry agencies:

- No comments, as there is no AGM officer in Bayburt.

The Main Problems:

- The main problems relate to the over-grazing of rangeland pastures, especially on S-facing slopes. Grazing control and possibly fencing are needed.

- Generally shallow soils.
- The presence of large flocks of sheep owned by nomads for four months in summer, whose grazing intensities cannot be controlled by the village once the agreements have been made.

Constraints:

- A predominance of South-facing slopes and shallow soils.
- The large flocks of sheep owned by nomads.

Potential for Rehabilitation:

- Mostly very good, provided villagers are interested and able to be active.
- The nomadic grazing must be better controlled.
- The out-migration appears to have had positive effects on the intensity of erosion, and the apparent success of natural regeneration in many places.
- The potential for natural regeneration of *P. tremula* and other species is excellent.

Upper Coruh Sub-Catcment, Ispir MC (UC-14)

VILLAGE	COMMENTS
Koprukoy	About 200 ha being terraced and planted conventionally by a village group under a direct contract of approximately TL 130 billion. The only AGM work in this MC was done 15 years ago on an area to the W and N of the village, but tree growth is not very successful. Village has suffered badly from annual flooding, but flooding seems less severe now. S of the village on the left bank of the Koprudere, opposite Mezua mahalle there are steep slopes with frequent landslides. A little N and W of the village the same problem is evident. There is a need for erosion control SE of the village. Village is very cohesive and cooperative. Potential for natural regeneration by *P. tremula*, among other species.
Gockoy	Very rocky terrain on approach to village, with very high rates of natural erosion. Reputedly, the village has an excellent conservation ethic, forbids goats and encourages profuse natural regeneration of *P. tremula* and other species. There is a very large ancient landslide behind the village, which is still potentially unstable.
Numanpasa	The village has extensive gently rolling rangelands with excellent pastures. There is very little sheet or gully erosion. Beekeeping based on the pasture resource is common.
Durukoy	Erosion of the (mostly) Chestnut Soils is not currently very severe overall, except for a few limited areas, mostly on limestone. However, intensive cultivation will expose these soils to serious erosion.
Kockoy	The area to the SE, high on the ridge, has large areas of severe mass movements. There are other scattered areas of sheet and gully erosion.

General comments from forestry agencies:

- Encountered an example of extreme villager opposition to any erosion control work at Kirik village, outside the MC. Closely tied to village politics, and the influence of non-residents. Large areas of potentially-erodible rangeland – just on the edge of severe sheet and gully erosion if further over-grazed. Under the Pastures Law this type of rangeland will probably come under the responsibility of MARA. A delegation of villagers later came to AGM to apologise for the conduct of this person, and expressed awareness of soil erosion and their willingness to cooperate.
- The factors which distinguish villagers from each other in terms of their "conservation ethic" appear to include: (i) experiences of erosion, severe flooding and catastrophic mass earth movements; (ii) a strong and committed Muhtar; (iii) the level of education and awareness of the outside world; (iv) the presence of disruptive elements in the village (often those who live in other towns and only visit briefly) who for political reasons try to undermine the authority of the Muhtar; and (v) a high proportion of conservative older people in the village who are not receptive to new ideas and cannot physically implement new activities.

The Main Problems:

- The worst areas of soil erosion are below, around and above Koprukoy. Landslides are also common. This village is also subject to serious flooding.
- The Numanpasa area demonstrates the value of effective pasture management and low grazing intensities.
- There is ample evidence almost everywhere of severe mass movements in the past and potentially in the future.

Constraints:

- Extremely steep land around most villages, except the rolling rangelands at Numanpasa.
- Very little can be done to avoid or mitigate mass movements, except to avoid building under potentially unstable zones.
- Generally erodible soils if badly managed.

Potential for Rehabilitation:

- Quite promising, except on steep slopes.
- Effective grazing control can certainly mitigate erosion on moderate and even steep slopes.

A.4 PRINCIPLES AND PRACTICES OF EFFECTIVE SOIL CONSERVATION

A.4.1 Causes and Impacts of Natural and Accelerated Soil Erosion

Natural soil erosion occurs continuously and at all places in all countries. It is in fact the main process whereby the Continental landscapes are worn down over geological time and the products eventually moved by rivers to the sea. In time they may be reconstituted into new sedimentary rocks and again uplifted to form new landscapes. The rates of geological, or natural, erosion vary widely from place to place and time to time, depending on rock types and the orientation of their strata, weathering rates, climates, earthquakes and other natural catastrophes, vegetation cover, the transporting power of the streams and rivers and many other factors. Mass movements (such as the old landslide which dammed the Tortum River to form Tortum Lake) are also a feature of natural erosion and can rarely be prevented by any human intervention, although their impacts can sometimes be mitigated by engineering structures.

However, accelerated soil erosion is generally the result of human interventions. Many experimental measurements in many countries have confirmed that accelerated soil erosion is negligible when the landscape has a dense cover of grass or closed forest, when a high proportion of the rainfall infiltrates into the soil and when runoff moves slowly in shallow layers over the surface. Rates of soil loss might range from almost zero to 1-3 tonnes per hectare per annum (t/ha/an.).

When pastures are grazed, especially if over-grazed in relation to the type of pasture and the prevailing climate, rates of soil erosion might double or triple to as much as 10 t/ha/an. When soils are cultivated, even using the best practices of cultivation tillage, even larger rates of soil loss usually occur. Severe over-grazing, poor cultivation practices on arable land, poor

harvesting practices in forests and other forms of poor soil management will produce increasingly greater losses of topsoil by sheet erosion. If the amounts and proportions of runoff increase because a smaller proportion of the rainfall is absorbed (infiltrated) into the topsoil, it generally concentrates into small channels. Its velocity then increases and its erosive power increases with the cube of the velocity. Small shallow rills first appear on the surface, and these eventually combine and deepen into gullies which remove both topsoils and subsoils.

Table A.3.1 describes many of these factors, influences, consequences and problems, and some of the solutions which may be employed to alleviate or rehabilitate the problems.

The first, essential, step in the processes of sheet, rill, gully or wind erosion is detachment of soil particles (single grains, or soil aggregates) from the surrounding soil particles. The forces which bind one soil particle to its neighbours must be broken. There will be no, or very little, soil erosion unless and until detachment first occurs. Detachment occurs when the particle is exposed to high velocity winds, the direct impacts of raindrops or to the force of water moving rapidly over the surface, with a level of energy which exceeds the forces binding the soil particle to the adjacent particles. Once detached, the particle exposes other particles to detachment, and may itself assist in detaching other particles. The processes of water erosion accelerate as more particles detach and start to move downslope. The process is more destructive if the slopes are steep, the water velocities are high, the binding power of plant roots is low and the soils less cohesive.

Factors which limit detachment (and therefore tend to limit rates of soil erosion) include: a well developed complete plant cover of foliage; profuse and strong plant roots; high soil organic matter contents; well developed medium granular and blocky soil structures; non-compacted topsoils; medium soil textures such as silty clay loams; and high infiltration rates. It is worth noting that when rainfall intensity greatly exceeds topsoil infiltration rates for several hours, and when soils become saturated after considerable rain, runoff increases greatly and even the most erosion-resistant soils become more prone to sheet and gully erosion.

High rates of sheet erosion are serious, even on very deep fertile soils, because they will, in time, lead to loss of topsoil organic matter, loss of topsoil nutrients, breakdown of soil structures and decreasing soil depths. The output of suspended sediments from the catchment increases. Compacted infertile stony subsoils will be closer to the surface. The area of land occupied by gullies impedes cultivation, removes land from productive uses and produces a great deal of sediment. If the soil is initially shallow, infertile, has poorly developed structures and infertile subsoils, the impacts of accelerated soil erosion will be very serious and will occur very quickly. The productivity of the vegetation, whether crops, pastures or trees, will rapidly decline. Livestock and humans dependent on the vegetation will suffer commensurately.

It is not possible to calculate tolerable soil loss rates for the soils of the Coruh River catchment with the limited information available at this time. Methods for such calculations have been devised: for example, as described in "A Case Study on Kenya", Agro-Ecological Land Resources Assessment for Agricultural Development Planning, Technical Annex 2, Institute for Applied Systems Analysis, FAO World Soil Resources Reports 71/2, 1992.

Lastly, road construction and maintenance is likely to produce large amounts of suspended sediments and coarse rocky debris when high–intensity rains fall on bare road surfaces and concentrate into swift torrents in road gutters, and thence into rapid streams downslope of the road. Many observations in Turkey and elsewhere in the world have demonstrated that poorly-constructed roads with poor drainage often contribute very high proportions of the total discharge of suspended sediment from the catchment, even though the roads themselves occupy a very small area and proportion of the catchment. These matters have been described in Table 3.1 above.

A.4.2 Soil Conservation Strategies: Control of Water Movement and Control of Plant Cover

Therefore, two important Strategies for Soil Conservation are immediately apparent:

1. Maintain the highest feasible percentage foliage cover of grasses or closed forest over each area of soil, especially on steep slopes.
2. To the greatest feasible extent, maintain wide, shallow and slow surface water flows instead of narrow, deep and fast flows.

If these strategies are followed to the greatest feasible extent, rates of soil erosion will be minimized for the prevailing site conditions.

Strategy 1 is highly dependent upon the methods used for land management. Excessive forest harvesting for commercial timbers, excessive harvesting of oak forests for fuelwood, allowing cultivated arable land to lie exposed for long periods and over-grazing of pastures are some of the activities which will exacerbate soil erosion. These activities can all be modified by human interventions.

Strategy 2 is firstly dependent on Strategy 1, in that a dense vegetation cover will tend to maintain shallow surface water flows at relatively low velocities, even on quite steep slopes. This desirable situation can also be assisted by interrupting downslope surface water flows with contour terraces spaced at appropriate intervals across the slope, provided that they do not channel water along the terrace to their ends where it will become concentrated and move at high velocity. Ripping along terraces may improve the rates of infiltration of water moving downslope to the terrace. A dense cover of inter-terrace vegetation (such as pastures or

forage crops) will assist in slowing surface water flows, as will trees planted along the terraces. These activities can all be assisted by human intervention.

If runoff water does become concentrated into narrow, deep, fast flows it will inevitably form torrents which will excavate gullies. The steeper the slope the worse the situation. The only way to avoid (or minimize) gully formation is to avoid concentrating overland flow into narrow and deep flows at high velocity. Deep and steep gullies will deliver large quantities of suspended sediments to watercourses, and large amounts of coarse debris (gravels, stones and boulders) to colluvial fans and thence into the rivers as bedloads. Colluvial fans and mudslides may block roads after torrential rain, which imposes severe costs on local governments. Once a gully has formed it can only be rehabilitated by (i) physically re-shaping and re-contouring the land by hand or machine; and/or (ii) by plugging the gully with small dams and/or (iii) by planting trees or shrubs in the gully to slow the flow of water. These methods will only be sustainable if strong efforts are made to minimize and control the amounts and velocities of runoff before they enter the gully.

Lastly, sediments moved from uplands, along small and large streams, may be deposited (even if temporarily) as alluvial terraces along major rivers. Alluvial terraces are usually prized for their fertility and suitability for intensive agriculture and horticulture, even if there is some risk of flooding. Alluvial terraces are highly prone to bank erosion, especially during floods, although bank erosion might be prevented by gabions or impervious walls, or minimised by planting riparian vegetation such as poplars and willows.

Implementation of both Strategies for Soil Conservation will be influenced at any given site by the physical, socio-economic and legal/administrative constraints described in Section 3.3.

A.4.3 Participation in Soil Conservation by Villagers

It is clear from the above discussion that human interventions can do a great deal to prevent and/or mitigate and/or rehabilitate soil erosion. The State agencies which have responsibility for controlling and rehabilitating soil erosion (such as AGM) will be able to undertake limited amounts of these interventions, as they have done in various parts of the Coruh River catchment. Other agencies, such as TEMA, can likewise have some impact. However, there is never enough money to accomplish all the necessary tasks, and the prime responsibility for accomplishing successful, sustainable, soil conservation must rest with the villagers whose livelihoods largely depend upon maintaining healthy and productive forests and rangelands. They will therefore remain the major “land managers” and “soil conservationists” in the catchment for a long time into the future.

The villagers can become effective land managers and agents for effective soil conservation in many ways, including:

- Protecting rangelands by adopting appropriate grazing strategies for different types of herds at different times and at different intensities of grazing. The grazing strategies will differ from place to place and time to time, and they must increasingly be soundly based in better scientific understanding of the different types of rangelands. The new Pastures Law may help in this respect, although its efficacy is yet to be proved. Changing the composition of the herds, especially by reducing the numbers of extremely destructive goats and increasing the proportion of cattle fed near the village on improved pastures and forage crops, will help to reduce grazing intensities. As discussed above, these changes may require some external assistance to improve forage production and income-generating opportunities in and around the village.
- In addition to improving rangelands by changing grazing practices, villagers can assist in soil conservation by actively participating in measures which improve certain types of rangelands, such as seeding and fertilizing. Improved rangeland pastures must then be better managed, principally by improving grazing practices, so that they are not preferentially grazed and then degraded into a condition worse than before improvement.
- Any measures which help to reduce the dependence of villagers on the adjacent forest resources should be helpful in minimizing degradation of these resources and in rehabilitating them.
- If transhumant (nomadic) grazing is a problem, villagers must recognize the problem and attempt to minimize it. This will not be easy as, firstly, these temporary visitors may provide some income to the village from rental of grazing rights and, secondly, they may not respect the rights and decisions of the resident villagers.
- In addition, it is not always possible for the village authorities to gain consensus among the villagers for better grazing practices, nor to enforce them upon some of the villagers. External authorities can do little to influence these matters – they are the responsibility of the villagers themselves.
- If the villagers persist in destructive behaviour which exacerbates soil erosion, despite all the evidence of degrading environments around the village which will ultimately destroy much of their livelihoods, then the authorities have little choice but to attempt to enforce better soil conservation strategies. This could be contentious and divisive, and may not be very successful. However, coercive measures will be better accepted if the authorities have developed at least some level of trust and goodwill with the villagers.

The primary long-term aim of any project undertaken in the Coruh River catchment is the rehabilitation and more effective management of the natural resources in and near the village - soils, rangelands, arable lands and forests. In the past, this was attempted by Government agencies alone, but at high cost and with limited effectiveness. It was rarely sustainable without continuing large inputs from the Government, mainly because it was done without the understanding and willing participation of the villages who depend upon and use the forests, rangelands and arable lands.

As discussed in the “Community Forestry Operations Manual” which was prepared for the project named “Development of Appropriate Methods for Community Forestry in Turkey” (FAO-Government of Switzerland-Government of Turkey project GCP/TUR/045/SWI), the only effective way in which these natural resources can be sustainably and permanently improved is by engaging the interest and involvement of the villagers in "Co-Management Partnerships" for land management.

They will only be interested in long-term improved landscape management if they believe that any short-term sacrifices and changes to their current land management practices will be ultimately justified in terms of better lives for themselves and their children.

Therefore, if the villagers understand that continuation of their present land management practices will ultimately destroy their environments and their chances of achieving satisfactory lifestyles, they will be more interested in the linkages between improved animal husbandry, arable land and rangeland management, reduced fuelwood use and establishment of fruit, nut and timber trees, and the long-term improvement of the forests and rangelands.

However, improvement of the economic and social conditions of the villagers by income-generating and communal activities will not in itself automatically lead to improved environmental conditions around the villages. It is only when clear connections are made by the villagers between their economic and social conditions and the environmental conditions around them they they will realise they have a stake in improving their natural resources.

The key lies in demonstrating, with the villagers, the linkages between improved household activities and improved management of the communal natural resources. The key also lies in using these linkages as incentives to the villagers. Villagers will understand that they will gain some benefits from various household or community activities (some of which will be income-producing) provided they are prepared to be involved in Co-Management activities which will ultimately improve their natural resources.

Some important linkages are shown in Table 4.1. Most of these activities, and their linkages with the state of the natural resources, serve several purposes. For example, improved arable and rangeland soils will have beneficial effects through reduced soil erosion, and improved rangeland and agricultural productivity, producing cash from sales of surplus agricultural products. In turn, spare cash can be invested in improved livestock and facilities, but this improvement will be wasted if the management of the soils and rangelands is neglected.

All these activities need effective training and extension services from external agencies if villagers are to understand the reasons for the cycle of environmental degradation which has brought them to their present conditions, and if they are to be helped to break this cycle. The cycle of environmental degradation can be reversed by improved co-management of the natural resources, particularly the rangeland and arable soils.

Table A.4.1: Linkages between various activities and the state of natural resources

ACTIVITY	LINKAGE WITH NATURAL RESOURCES
Forest improvement activities	Linked with and depend upon provision of funds from Ministry, and availability of labour from village. They improve natural resource productivity, forest soils, water supplies and soil erosion status. They improve timber supplies for village, and may improve social and economic opportunities for on-site and downstream processing.
Energy forest management activities	Linked with and depend upon provision of funds from Ministry, and active involvement of villagers. They improve fuelwood supplies, fodder supplies and water supplies, decrease pressures on other forest resources and minimise soil erosion and flooding.
Erosion control activities	Linked with and depend upon provision of funds from Ministry and involvement of villagers. Also depend strongly upon improvement of rangeland pastures and better grazing management. They improve quality and reliability of village water supplies, and decrease flooding.
Beekeeping	Linked with and depend upon bee fodder from flowers on improved fodder species in managed rangelands, fruit trees and some forest trees.
Provision of clean drinking water, and minor irrigation	Linked with and depend upon restoring the forest cover, repair of eroded soils and reduction of rates of soil erosion. Require improved rangeland pastures, better grazing management, and establishment of tree species.
Income-generating businesses, improved cropping, tourism, food preservation	Linked with and depend upon improved soil fertility, better crop seeds, better arable land management, minor irrigation, better animal husbandry, better fodder supplies, better grazing management, more work available in forests, and income from private forests.
Improvement of energy supplies (fuelwood, gas, coal, solar, biogas), better stoves, improved house insulation	Linked with and depend upon improved forest conditions and forest management, and upon establishment of more trees around the village. Also linked with reduction of fuelwood demand by use of other sources of energy, use of better stoves, communal laundries and house insulation. Strongly affected by demographic changes in the village.
Nutrition and health, vegetable seeds, greenhouse construction, mushroom cultivation, better stoves and house insulation, food preservation, fisheries	Linked with and depend upon more reliable and improved drinking water and irrigation water, better food from animals (meat, milk, cheese, yoghurt), better food from plants (fruits, nuts, vegetables). May produce a cash surplus, enabling investment in agriculture, animal husbandry and improved soil fertility.
Animal husbandry, improvement of breeds, stall feeding, improved animal housing	Linked with and depend upon improved fodder supplies on rangelands, and improved grazing management. Require cash investments in improved livestock and facilities, veterinary care, winter fodder production from arable lands and hay production from rangelands.

A.4.4 Erosion Control Measures

As stated above, the most successful prevention, mitigation and rehabilitation of soil erosion, and the most successful measures for sustainable soil conservation, will only be achieved if the cooperation and participation of the villagers is actively encouraged.

In addition, the State agencies have available some technical methods for:

- management and rehabilitation of existing forests;
- afforestation;
- rangeland management, especially if the new Pastures Law can be made effective; and
- rehabilitation of landscapes using a wide range of technical measures

which can greatly assist in rehabilitating eroded landscapes and preventing further soil erosion. These are briefly described in Chapter 5 of this Working Paper.

A.4.5 Objective Measurements of the Benefits of Erosion Control Measures

Over many years a very large amount of money, and a lot of time and effort, has been expended by State agencies in controlling soil erosion in many parts of Turkey. It is very unfortunate that until recently virtually no attempts have been made to obtain objective evidence which evaluates whether the money, time and effort have been effectively used to reduce discharges of suspended sediments from the treated catchments.

During this Master Plan Study senior officers in AGM have been formally asked:

1. Is there any reliable objective evidence that the large amounts of money and effort spent on erosion control in Anatolia over many years have produced significant reductions in suspended sediments leaving the micro-catchments?
2. Are there any plans to initiate well-planned scientific research studies in a selection of micro-catchments of the baseline and post-treatment effects of erosion control on suspended sediments leaving the micro-catchments?

The answer to the first question is basically “No”. The issue was identified during the planning for the Eastern Anatolia Watershed Rehabilitation Project, and some small studies were started. These included:

- Work by GDRS on periodic measurements and assessments of the changes in vegetation cover and types of vegetation in several quadrats at three sites within one micro-catchment. Some results have been collected, but they have not been analysed to date.
- Work by KHGM, with support from the Electrical Affairs Studies Office, to measure discharges of suspended sediments at five sites. Again, some data has been accumulated but not yet analysed. In some cases there has been no runoff, and therefore no sediments have been discharged.

Any studies of this type must include the following considerations:

- the studies must be designed in a scientifically valid manner;
- they must be commenced at least one year before erosion control activities are undertaken, to establish a valid baseline against which the effects of erosion control activities can be measured and assessed;
- they must include regular (six-monthly) periodic measurements of characteristics of the mini-catchment for many years, including scientific assessments of vegetation survival and cover, stream discharge and output of suspended sediments; and
- the data obtained in the baseline studies and periodic measurements must be regularly (yearly) monitored, evaluated and reported so that methods of erosion control for future use in other mini-catchments can be progressively modified to take account of the lessons learned.

Studies of this type are strongly recommended for the Coruh River catchment, and it is not too late to start them immediately. If baseline data is not collected prior to erosion control activities and if reliable periodic measurements of discharges of suspended sediments are not made for many years thereafter, it is not possible to make objective assessments of the effectiveness of the activities. The Study Team was frequently assured that subjective assessments confirmed their effectiveness, but this is not really sufficient to justify further political and administrative decisions to continue supporting the work with large injections of State funds.

A.5 LAND MANAGEMENT AND SOIL CONSERVATION

A.5.1 A Decision-Making Methodology for Rehabilitating Soil Erosion in the Coruh River Catchment

AGM staff are often required to make a decision whether or not to attempt to rehabilitate an eroded area. The area may be large (hundreds of hectares) or small (1-10 hectares). The decision is normally made by a senior experienced forester, who uses a “mental expert system” to consider, accept or reject numerous alternative courses of action. Eventually he comes to an informed decision about the rational use of scarce resources to accomplish an achievable goal.

However, junior staff are less experienced, and a need a formal, logical, standardized procedures to guide them in making a long series of decisions when considering a particular eroded area.

Table 5.1 presents a formal decision-making methodology – an expert system on paper – which will assist junior staff in their work. It will also be useful in training. While Decision-

Making Methodology is designed for making decisions for rehabilitation of soil erosion in the Coruh River catchment, the detailed criteria could easily be adapted for use elsewhere in Turkey.

It is strongly recommended that this Decision-Making Methodology should be adopted for use in the Coruh River catchment, and elsewhere.

Table A.5.1 A Decision-Making Methodology for Rehabilitating Soil Erosion in the Coruh River Catchment

Table 1: PRIMARY INDICATORS FOR DECIDING WHETHER TO IMPLEMENT SOIL CONSERVATION ACTIVITIES:

INDICATOR	METHOD OF CLASSIFICATION
The severity and location of the erosion problem	Qualitative and subjective assessment (from discussions with stakeholders and visual assessment) of three classes of **Minor**, **Moderate** and **Severe** erosion which present actual or potential direct threats to human lives, significant infrastructure or important agricultural areas.
Active or non-active visible erosion	**Active** soil erosion is demonstrated by visible evidence of: bare un-vegetated soils; fresh unconsolidated surface fine sediments and coarser rock debris (sheet erosion); river bed and bank deposits and colluvial fans of gravels, stones and boulders; new rill erosion; active gully erosion; active gully head retreat and surface flood debris.
Reversibility	If all or most of the Biophysical Indicators are assessed as generally favourable for rehabilitation, the erosion problem is probably reversible. Classes are **Reversible**, **Probably Reversible** and **Irreversible**.
Acceptability by village stakeholders	After extensive consultation with the villagers as a group and as individual stakeholders (women, agriculturists, bee-keepers, livestock herders and other identifiable groups) the classes are **Willing**, **Reluctant** and **Opposed**. If **Willing**, there should be written evidence that: • the proposed interventions are acceptable to the village as a whole and/or to individual groups of stakeholders; • the village as a whole and/or any individual group is willing to spend its own time and/or money in preventing or rehabilitating soil erosion; and • the status of land ownership permits the proposed activities.

Table 2: BIOPHYSICAL INDICATORS FOR SELECTING PARTICULAR TYPES OF SOIL CONSERVATION INTERVENTIONS:

INDICATOR	METHOD OF CLASSIFICATION
Slope	Percent slope in classes of **Gentle** [0-12%], **Moderate** [12-30%], **Steep** [30-45%], **Very Steep** [>45%], measured by clinometer
Aspect (as an indicator of the site climate)	Predominance of **North-facing Slopes** or **South-facing Slopes**, assessed by compass
Altitude (as an indicator of the site climate)	Three classes of **Low** [0-1,200m]. **Medium** [1,200-2,400m] and **High** [>2,400m], assessed by altimeter or on topographic maps. An altitude of 2,400m is generally regarded as the treeline.
Percentage cover of grasses and herbs	Three classes of cover percentage as **Sparse** [<20%], **Medium** [20-60%] and **Good** [>60%], measured by point transects
Percentage cover of shrubs and trees	Three classes of cover percentage as **Sparse** [<20%], **Medium** [20-60%] and **Good** [>60%]. In Forest Management Plans, the classes are Normal High Forest (NK), Degraded High Forest (BK), Normal Coppice Forest (Bt), Degraded Coppice Forest (BBt), Forest Areas Without Trees (OT). Agricultural Areas (Z) and Mer'a (M). OT areas generally have severe soil erosion and should be taken under the forest regime and rehabilitated.
Geological stability and erodibility	Two generalized classes of **Highly Unstable** rock types (granites, undifferentiated volcanic rocks, serpentines, gypsiferous mudstones, unconsolidated sandstones and mudstones, unconsolidated colluvia and alluvia) and **Moderately Stable** rock types (basalts, non-shattered sandstones, consolidated colluvia and alluvia)
Soil stability and erodibility	Two generalized classes of **Highly Erodible** (Brown Forest Soils, Brown Soils, Chestnut Soils, Non-Calcic Brown Forest and Brown Soils, Red-Yellow Podzolic Soils) and **Moderately Stable** (Basaltic Soils, stable Alluvial Soils, stable Colluvial Soils, High Mountain Pasture Soils)
Soil textures down the profile	Three generalised classes of **Fine-textured**, **Gravelly** and **Stony**, derived from a general visual assessment of the proportions of fine soil, gravels, stones and boulders down the soil profile
Soil depth	Three generalized classes of **Shallow** [0-20 cm], **Medium** [20-80 cm] and **Deep** [>80 cm], derived from a general visual assessment of a range of soil profiles
Delivery downslope and downstream of suspended sediments and bedloads	Qualitative and subjective visual assessment of evidence of **turbid streams**, and extensive bedload deposits as **Minor**, **Moderate** and **Severe** as a visually-assessed proportion of area under village use

ASSESSMENT OF AN ERODING AREA

Site: ……..……

Date: …….

Assessor: ……

PRIMARY INDICATORS				DECISION
STEP 1: The severity and location of the erosion problem	Minor	Moderate	Severe	If **Minor**, cease assessment. If **Moderate** or **Severe**, continue assessment.
STEP 2: Active or Non-Active visible erosion	Non-Active	Active		If the problem is of **Moderate** importance and erosion is **Non-Active**, cease assessment. If **Moderate** and **Active**, continue assessment. If **Severe** and **Non-Active**, continue assessment. If **Severe** and **Active**, continue assessment.
STEP 3: Reversibility	Irreversible	Probably Reversible	Reversible	If **Reversible**, continue assessment. If **Probably Reversible**, continue assessment. If **Irreversible**, cease assessment.
STEP 4: Acceptability by village stakeholders	Opposed	Reluctant	Willing	If the assessment under Steps 1, 2 and 3 has shown that erosion control must be undertaken, but if villagers are **Opposed**, cease assessment until villagers are persuaded to be **Willing** or **Reluctant**. Check that the status of land ownership permits the proposed activities.

If these FOUR STEPS, based on the Primary Indicators, show that actions for the prevention and/or rehabilitation of soil erosion should be undertaken, the site should then be assessed using the Biophysical Indicators.

BIOPHYSICAL INDICATORS				DECISION	FEASIBLE TECHNICAL ACTIONS
Slope	Gentle (0-12%)	Moderate (12-30%)	Steep (30-45%) and Very Steep (>45%)	If **Very Steep**, continue assessment only if other Biophysical Indicators are generally favourable.	If **Very Steep**, encourage natural regeneration by fencing and grazing control. If other slope classes, encourage natural regeneration, and implement terracing and planting, and gully plugging.
Aspect	North-facing slopes	South-facing slopes		If **South-facing Slopes**, continue assessment only if other Biophysical Indicators are generally favourable.	If **South-facing Slopes**, encourage natural regeneration by fencing and grazing control. If **North-facing Slopes**, implement terracing and planting, gully plugging, and grazing control and natural regeneration.
Altitude	Low (0-1000m)	Medium (1000-2400m)	High (>2400m)	If **High Altitude**, do not undertake afforestation.	If **High Altitude**, implement grazing control and gully plugging. If **Low** or **Medium Altitude**, implement all feasible technical actions.
Percentage cover of grasses and herbs	Good (>60%)	Medium (20-60%)	Sparse (<20%)	If **Sparse** or **Medium**, implement all feasible technical actions to increase vegetative cover. If **Good**, maintain vegetative cover.	In all cases, implement grazing control and pasture rehabilitation, and encourage natural regeneration.
Percentage cover of shrubs and trees	Good (>60%)	Medium (20-60%)	Sparse (<20%)	If **Sparse** or **Medium**, implement all feasible technical actions to increase vegetative cover. If **Good**, maintain vegetative cover by protection and silvicultural methods.	If **Sparse** implement grazing control, natural regeneration and pasture improvement. If **Medium** or **Good**, implement recognised silvicultural actions (including coppice management) to create and maintain the highest possible cover percentage.
Geological stability and erodibility	Moderately stable	Highly unstable		If **Highly Unstable**, carefully consider feasibility of technical actions.	**Moderately Stable** sites will be easier to rehabilitate by grazing control, pasture rehabilitation, terracing and tree planting, and gully plugging.

Soil stability and erodibility	Moderately stable	Highly erodible		If **Highly Erodible**, carefully consider feasibility of technical actions.	**Moderately Stable** sites will be easier to rehabilitate by grazing control, pasture rehabilitation, terracing and tree planting, and gully plugging.
Soil textures down the profile	Fine-textured	Gravelly	Stony	If **Stony**, carefully consider feasibility of technical actions.	**Fine textured** and **Gravelly** soils will be easier to rehabilitate by the usual technical measures. If **Stony**, encourage natural regeneration, and possibly localized soil improvement and tree planting.
Soil depth	Deep (>80cm)	Medium (20-80cm)	Shallow (0-20cm)	If **Shallow**, carefully consider feasibility of technical actions.	**Medium** and **Deep** soils will be easier to rehabilitate by the usual technical measures. If **Shallow**, encourage natural regeneration.
Contribution to delivery of sediments and bedloads	Turbid streams	Minor and Moderate	Severe	If streams are **Turbid**, and erosion is **Minor** or **Moderate**, implement all feasible technical actions. If **Severe**, only expensive mechanical actions are feasible.	If **Minor** or **Moderate**, use gully plugging and encourage natural regeneration. If **Severe**, expensive mechanical actions (bulldozing bedloads, gabions) will be required. Use gully plugging and gully revegetation.

A.5.2 Structures and Costs for Control and Rehabilitation of Soil Erosion

Directions and detailed specifications for many different types of erosion control structures have been admirably described in the book published by AGM in 1999 entitled *"Erozyon Kontrolu Uygulamalarinda Dikkate Alinacak Hususlar"* (literally: "Issues to be Considered for Implementing Erosion Control Projects"). The book first describes the types of soil erosion which might be found in Turkey (water, surface, gully, wind, avalanche and glacier erosion, and water flow down slopes). Chapter 3 then describes different types of erosion control structures and methods of afforestation. Some of these are listed below. Chapters 4 and 5 discuss afforestation and maintenance of forest plantings. Chapter 6 discusses fencing.

The Study Team inspected several different types of erosion control structures in the Study Area, including:

- Contour ("gradoni") terraces prepared by machines and/or by hand, including terraces with brush laid on the downslope side. See pages 40 to 96 of the AGM book.
- Control of discharge of water. See pages 97 to 105.
- Afforestation on terraces. See pages 106 to 121 and pages 166 to 175.
- Small check dams for gully plugging, made of stones or bags of soil. See pages 106 to 154.
- One large check dam built by DSI on a very active large gully.
- Gabions for control of riverbank erosion, and other "edge fortifications". See pages 155 to 165.
- Poplars and willows for control of riverbank erosion.
- Some attempts to control mass movements (landslides). See pages 286 to 213.
- Roadside and road drainage treatments, especially in the vicinity of the new roads near the dams under construction on the Coruh River near Artvin, Borcka and Muratli.

The costs of most of these physical interventions are rather high, and they can only be applied over relatively small areas given the financial constraints. The Study Team formally asked senior officers of AGM to comment on the following questions:

1. Would it might be possible to reduce the per-hectare costs of erosion control very significantly (thereby allowing many more hectares to be treated) by undertaking much more rangeland rehabilitation above eroded areas, and forage production for cut-and-carry on eroded areas, and by doing much less physical terracing and gully plugging?
2. Would these proposals be at least as effective, or perhaps even more effective, than current procedures in reducing suspended sediments leaving the micro-catchments?
3. Would these proposals be more cost-effective than current procedures?
4. Are these proposals realistic and acceptable to both farmers and AGM?

The answers are, generally, affirmative to all the questions. AGM is very much aware that costs are high and that they seriously constrain the amounts of erosion control activities which they can undertake each year. They are actively searching for lower-cost alternatives, some of which were tested during the Eastern Anatolia Watershed Rehabilitation Project. However, it must be accepted that: (i) much of the soil erosion in Turkey is severe in both its extent and nature; (ii) that rehabilitation requires expensive techniques; and (iii) that there are few possibilities for considerable cost reductions.

Therefore, any low-cost methods of preventing soil erosion before it becomes serious, rather than attempting to control it after it becomes evident, should be encouraged. Foremost among these strategies, is of course, rational management of rangelands above erosion-prone slopes, to maintain a satisfactory vegetative cover and to control the downslope movement of water. Such methods will not work in all cases, but they may (depending on sites and circumstances) go a considerable way towards lower-cost, effective, soil conservation.

The Staff Appraisal Report for the Eastern Anatolia Watershed Rehabilitation Project included seven different types of soil conservation interventions. The costs at that time were estimated as shown in Table 5.2. The cost advantage of rangeland rehabilitation is readily apparent.

The current costs for some of the types of activities listed in Table 5.2 were provided by the AGM office in Erzurum and from other sources within MEF, and have been revised by Mr Muzaffer Dogru. They are presented in Table 5.3.

As discussed in Section 4.5 and elsewhere in this Working Paper, it is important to monitor and evaluate the benefits of these soil conservation and erosion control activities. In relation to terracing and planting, the success of revegetation must be regularly monitored by undertaking (at the least) percentage survival counts, measures of percentage vegetation cover and perhaps height and diameter growth of trees. Discharge of suspended sediments should be measured by reliable scientific techniques, using regular and intermittent stream sampling. It is worth noting that much of the sediment discharge within any year may occur only during a few erosion events brought on by sudden storms. For the rest of the year there may be no stream discharge, and therefore no sediment discharge. This means that sampling intervals must be flexible and adjusted to the occurrence of storm events if valid measurements are to be achieved.

Table A.5.2 Estimated base costs of soil conservation interventions, EAWRP, 1993.

Type of Intervention	Estimated Base Cost (US$ per ha)
Soil Conservation Afforestation: mechanical terracing, planting acorns on prepared gradoni terraces between the bulldozed terraces, broadcast seeding of the entire area with a mixture of forage seed, grass seed and fertilisers. Gullies would be re-vegetated, and small check dams constructed.	884
Conifer Plantations: establishment of conifer plantations by planting on ripped or manually prepared slopes.	896
Oak Coppice Rehabilitation: cutting of degraded oak stands to encourage coppicing, and acorn sowing in open areas.	556
Rangeland Rehabilitation: by broadcast seeding with a mixture of forage seed, grass seed and fertilizers, and gully rehabilitation with multi-purpose tree planting (*Robinia*, willows, poplars, fruit and nut trees), and check dams where needed.	271
Gully Rehabilitation: check dams and gully planting with trees and shrubs.	396
Fuelwood Coppice Plantations: oak planting and acorn seeding on mechanically ripped and manually prepared sites.	749
Riverbank Protection: along unstable banks between low and high flood levels by planting poplars and willows.	205

Source: EAWRP Staff Appraisal Report, pages 66 and 74.

Table A.5.3 Costs of some erosion control activities.

Program or Activity	Unit	Cost per Unit (US$)
Soil Conservation Affoestation (by AGM)	**ha**	**660**
• Preparation of terraces by hand labour	ha	309
• Planting of seedlings	ha	126
• Seedling cost (1,500 seedlings on average)	ha	60
• Gully plugging	ha	20
• Fencing	ha	15
• Preparation of access roads	ha	5
(Sub-total for establishment operations = US$ 535/ha)		
• Replacement planting	ha	30
• First Year tending (weeding, hoeing, terrace repair)	ha	35
• Second Year tending (weeding, hoeing, terrace repair)	ha	30
• Third Year tending (weeding, hoeing, terrace repair)	ha	30
(Sub-total for tending and maintenance = US$ 125/ha)	ha	
• Protection of afforestation sites by Forest Guards	ha/year	10
• Protection of afforestation sites by village community	ha/year	4
Overheads (rough estimates for supervision, administration, planning *etc*.)	ha	66
Rehabilitation and revegetation by conservation on high slopes sites (AGM)	**ha**	**65**
• Seed sowing	ha	20
• Gully plugging	ha	20
• Fencing	ha	15
• Other expenditures	ha	10
• Protection of afforestation sites by Forest Guards	ha/year	10
• Protection of afforestation sires by village community	ha/year	4
Gallery plantation establishment (AGM)	**ha**	**1,008**
In-forest range planning and management (AGM)	**ha**	**116**
Rehabilitation and management of in-forest range areas (AGM)	**ha**	**137**

Rehabilitation of degraded oak coppice areas (OGM)	**ha**	**196**
• Conservation of natural oak vegetation	ha	4
• Rejuvenation cutting	ha	145
• Soil preparation by hand labour	ha	177
• Seed sowing	ha	75
• Seed	tonne	500
• Tending, thinning	ha	40
• Fencing	km	975
• Gully plugging	m^3	10
• Construction of service road	km	4,500
• Maintenance of service road	km	500
Rehabilitation of degraded high forest (OGM)	**ha**	**145**
• Protection	ha	4
• Soil preparation by hand labour	ha	177
• Seed sowing	ha	75
• Seed	tonne	500
• Planting	ha	126
• Seedlings	1000	34
• Tending	ha	88
• Rejuvenation cutting	ha	145
• Pruning	ha	35
• Thinning	ha	25
• Fencing	km	975
Rehabilitation in maquis areas (OGM)	**ha**	**165**
Non-wood forest products inventory (OGM)	**ha**	**33**
Combating biotic agencies (OGM)	**ha**	**8**

Source: AGM Office in Erzurum and other MEF agencies, revised by Mr Muzaffer Dogru, Study Team

A.5.3 Rangeland Rehabilitation by Farmer Participation

Sections 1.5, 3.1, 3.2, 4.1, 4.2 and 4.3 have discussed many aspects of the potential roles and responsibilities of villagers in many aspects of soil conservation and control of soil erosion.

It might be useful to introduce the idea of the "Virtuous Cycle of Soil Conservation" in which villagers may be able to contribute to an improving cycle of soil conservation by adopting some or all of the following measures:

- reducing their dependence on forests and rangelands;
- changing the composition of their herds towards fewer goats and sheep, and more cattle;
- grazing control by managing the timing and places of grazing on the rangelands
- rangeland improvement by becoming involved in active pasture rehabilitation;
- village development of alternative income-generating activities which minimise the needs for extensive grazing, and thus the pressures on rangelands;
- better animal husbandry through better veterinary care and feeding;
- introduction of much better conservation tillage on village arable lands;

- enthusiastic interest in education and training of farmers and shepherds in better methods for rangeland management; and
- active involvement in suitable methods for monitoring and evaluating the impacts of changed approaches to soil conservation.

Any incremental improvement of any one of these measures is likely to reinforce improvements in any others, thus developing an improving, ascending, "virtuous cycle" which could well replace the previous descending cycle of land degradation.

A.5.4 The Sustainability of Interventions

All these techniques for implementation of erosion control and soil conservation will not be very effective unless they are also sustainable – they must be maintained throughout many years. This involves:

- initial training in introducing the various activities and approaches;
- ensuring that the activities and approaches are maintained and continued, as appropriate, in the initial years after introduction, including further training; and
- ensuring that the benefits to the villagers of adopting these activities and approaches are evident to the farmers in the immediate future, and are also maintained for long into the future.

It is only when villagers are convinced that soil conservation measures are very likely, or even certain, to bring them both immediate and long-term financial benefits, and improvements to their farming systems and livelihoods, that they will adopt these measures and continue to support them as "land managers", thus becoming effective members of a large group of "soil conservationists" in the Coruh River catchment.

A.ANNEXES

A.ANNEX.1:
Distribution of Slope Classes by Area (ha) and Percentage in MCs

Sub-Catchment	Name of MC	Total Area (ha)	0-2% (ha)	2-6% (ha)	6-12% (ha)	12-30% (ha)	30-45% (ha)	>45% (ha)	0-2% (%)	2-6% (%)	6-12% (%)	12-30% (%)	30-45% (%)	>45% (%)
Berta	**BT-01**	41,673	464	2,357	4,273	15,962	12,740	5,876	1.1	5.7	10.3	38.3	30.6	14.1
	BT-02	13,605	84	623	939	4,719	4,744	2,497	0.6	4.6	6.9	34.7	34.9	18.4
	BT-03	40,485	1,240	3,373	7,016	17,751	7,970	3,134	3.1	8.3	17.3	43.8	19.7	7.7
	BT-04	18,518	479	1,880	3,155	8,991	3,046	967	2.6	10.2	17.0	48.6	16.4	5.2
	BT-05	18,419	205	944	1,949	8,128	4,628	2,565	1.1	5.1	10.6	44.1	25.1	13.9
	BT-06	34,521	120	742	1,216	6,933	13,564	11,947	0.3	2.2	3.5	20.1	39.3	34.6
	BT-07	60,810	833	2,948	5,733	28,864	16,212	6,219	1.4	4.8	9.4	47.5	26.7	10.2
	Sub-total	**228,030**	**3,426**	**12,867**	**24,281**	**91,347**	**62,905**	**33,204**	**1.5**	**5.6**	**10.6**	**40.1**	**27.6**	**14.6**
Lower Coruh	**LC-01**	12,429	58	279	380	2,645	5,291	3,775	0.5	2.2	3.1	21.3	42.6	30.4
	LC-02	36,421	158	773	1,361	10,342	14,337	9,450	0.4	2.1	3.7	28.4	39.4	25.9
	LC-03	36,349	176	717	1,452	12,293	13,239	8,473	0.5	2.0	4.0	33.8	36.4	23.3
	LC-04	21,003	290	918	1,297	6,480	7,385	4,633	1.4	4.4	6.2	30.9	35.2	22.1
	LC-05	16,135	177	419	612	5,172	6,551	3,204	1.1	2.6	3.8	32.1	40.6	19.9
	LC-06	30,168	309	751	1,160	8,044	11,686	8,219	1.0	2.5	3.8	26.7	38.7	27.2
	LC-07	25,187	72	379	757	6,450	10,123	7,406	0.3	1.5	3.0	25.6	40.2	29.4
	Sub-total	**177,693**	**1,239**	**4,238**	**7,020**	**51,426**	**68,612**	**45,159**	**0.7**	**2.4**	**4.0**	**28.9**	**38.6**	**25.4**
Middle Coruh	**MC-01**	23,854	74	501	857	5,823	9,889	6,710	0.3	2.1	3.6	24.4	41.5	28.1
	MC-02	28,463	220	928	1,648	10,527	10,137	5,004	0.8	3.3	5.8	37.0	35.6	17.6
	MC-03	21,554	186	656	1,188	8,288	6,976	4,260	0.9	3.0	5.5	38.5	32.4	19.8
	MC-04	18,197	234	572	729	3,979	7,386	5,297	1.3	3.1	4.0	21.9	40.6	29.1
	MC-05	23,778	158	546	784	4,252	9,655	8,384	0.7	2.3	3.3	17.9	40.6	35.3
	MC-06	26,176	9	281	743	6,637	11,412	7,094	0.0	1.1	2.8	25.4	43.6	27.1
	MC-07	16,524	32	298	612	4,276	6,478	4,828	0.2	1.8	3.7	25.9	39.2	29.2
	MC-08	31,722	246	927	1,453	8,499	12,177	8,419	0.8	2.9	4.6	26.8	38.4	26.5
	MC-09	24,348	47	326	596	4,904	9,660	8,815	0.2	1.3	2.4	20.1	39.7	36.2
	MC-10	44,406	147	992	1,754	11,957	16,183	13,374	0.3	2.2	3.9	26.9	36.4	30.1
	Sub-total	**259,022**	**1,353**	**6,028**	**10,364**	**69,142**	**99,952**	**72,184**	**0.5**	**2.3**	**4.0**	**26.7**	**38.6**	**27.9**
Oltu	**OL-01**	27,680	2,292	4,037	5,592	12,631	2,482	645	8.3	14.6	20.2	45.6	9.0	2.3

	OL-02	40,775	3,877	5,998	9,659	14,265	5,084	1,891	9.5	14.7	23.7	35.0	12.5	4.6
	OL-03	44,773	3,926	6,341	10,404	20,753	2,776	573	8.8	14.2	23.2	46.4	6.2	1.3
	OL-04	38,463	2,003	3,989	5,112	16,318	8,296	2,745	5.2	10.4	13.3	42.4	21.6	7.1
	OL-05	26,501	2,659	3,333	4,834	11,916	3,086	674	10.0	12.6	18.2	45.0	11.6	2.5
	OL-06	25,079	965	2,301	4,272	12,566	3,835	1,140	3.8	9.2	17.0	50.1	15.3	4.5
	OL-07	45,638	4,302	7,248	9,542	19,823	3,869	854	9.4	15.9	20.9	43.4	8.5	1.9
	OL-08	14,637	622	1,480	3,193	7,214	1,470	658	4.3	10.1	21.8	49.3	10.0	4.5
	OL-09	48,782	2,314	6,475	9,311	21,218	7,096	2,368	4.7	13.3	19.1	43.5	14.5	4.9
	OL-10	18,585	2,097	2,108	3,171	8,579	2,120	510	11.3	11.3	17.1	46.2	11.4	2.7
	OL-11	46,179	2,645	5,084	10,887	17,640	7,107	2,816	5.7	11.0	23.6	38.2	15.4	6.1
	OL-12	37,312	886	2,573	4,226	16,971	8,308	4,348	2.4	6.9	11.3	45.5	22.3	11.7
	OL-13	13,403	242	613	861	4,205	3,942	3,540	1.8	4.6	6.4	31.4	29.4	26.4
	OL-14	17,789	385	1,036	1,359	8,828	4,499	1,681	2.2	5.8	7.6	49.6	25.3	9.5
	OL-15	32,989	360	1,547	2,318	12,653	9,435	6,677	1.1	4.7	7.0	38.4	28.6	20.2
	OL-16	22,675	1,868	2,434	3,105	9,739	4,302	1,228	8.2	10.7	13.7	43.0	19.0	5.4
	Sub-total	**501,260**	**31,444**	**56,598**	**87,846**	**215,319**	**77,706**	**32,347**	**6.3**	**11.3**	**17.5**	**43.0**	**15.5**	**6.5**
	TR-01	38,331	1,534	3,486	5,040	17,236	7,451	3,584	4.0	9.1	13.1	45.0	19.4	9.3
	TR-02	34,858	1,418	4,305	7,036	15,257	4,944	1,898	4.1	12.3	20.2	43.8	14.2	5.4
	TR-03	29,090	1,946	3,777	5,128	10,020	5,556	2,663	6.7	13.0	17.6	34.4	19.1	9.2
Tortum	**TR-04**	38,548	1,362	3,292	6,157	12,205	10,150	5,381	3.5	8.5	16.0	31.7	26.3	14.0
	TR-05	31,523	679	1,335	1,774	11,961	9,540	6,234	2.2	4.2	5.6	37.9	30.3	19.8
	TR-06	30,684	330	1,138	1,760	9,315	10,058	8,083	1.1	3.7	5.7	30.4	32.8	26.3
	Sub-total	**203,035**	**7,269**	**17,333**	**26,896**	**75,995**	**47,699**	**27,843**	**3.6**	**8.5**	**13.2**	**37.4**	**23.5**	**13.7**
Upper Coruh	**UC-01**	51,532	2,802	7,105	8,832	20,687	9,552	2,555	5.4	13.8	17.1	40.1	18.5	5.0
	UC-02	41,129	2,756	4,514	6,238	20,078	5,835	1,708	6.7	11.0	15.2	48.8	14.2	4.2
	UC-03	21,873	1,286	1,867	2,372	8,953	5,540	1,855	5.9	8.5	10.8	40.9	25.3	8.5
	UC-04	44,212	2,428	4,522	6,390	21,197	7,565	2,112	5.5	10.2	14.5	47.9	17.1	4.8
	UC-05	24,038	2,466	2,752	3,099	10,036	4,585	1,100	10.3	11.4	12.9	41.8	19.1	4.6
	UC-06	21,264	5,199	5,066	4,809	5,390	700	101	24.4	23.8	22.6	25.3	3.3	0.5
	UC-07	79,695	19,703	14,578	14,500	24,550	5,428	936	24.7	18.3	18.2	30.8	6.8	1.2
	UC-08	80,357	14,320	13,739	13,554	29,960	7,750	1,034	17.8	17.1	16.9	37.3	9.6	1.3
	UC-09	42,230	5,292	5,539	6,106	17,206	6,955	1,131	12.5	13.1	14.5	40.7	16.5	2.7
	UC-10	19,058	949	1,558	1,857	8,675	4,762	1,258	5.0	8.2	9.7	45.5	25.0	6.6

	UC-11	28,316	4,087	3,973	5,001	12,487	2,455	312	14.4	14.0	17.7	44.1	8.7	1.1
	UC-12	20,439	823	2,111	3,448	10,158	3,054	845	4.0	10.3	16.9	49.7	14.9	4.1
	UC-13	27,858	966	2,249	3,744	11,958	6,472	2,469	3.5	8.1	13.4	42.9	23.2	8.9
	UC-14	31,167	535	1,471	3,432	13,465	8,515	3,749	1.7	4.7	11.0	43.2	27.3	12.0
	UC-15	46,224	1,501	3,804	4,859	22,494	10,962	2,603	3.2	8.2	10.5	48.7	23.7	5.6
	UC-16	33,637	443	1,852	2,624	14,871	9,963	3,884	1.3	5.5	7.8	44.2	29.6	11.5
	UC-17	38,785	185	927	1,689	9,903	15,872	10,209	0.5	2.4	4.4	25.5	40.9	26.3
	Sub-total	**651,814**	**65,739**	**77,627**	**92,556**	**262,065**	**115,965**	**37,862**	**10.1**	**11.9**	**14.2**	**40.2**	**17.8**	**5.8**
Others	665													
	Total	**2,020,855**	**110,470**	**174,691**	**248,963**	**765,293**	**472,838**	**248,599**	**5.5**	**8.6**	**12.3**	**37.9**	**23.4**	**12.3**

Source: remote sensed data processed by the GIS

A.ANNEX.2:
Geological Types by area (km^2) in each MC

SC	Name of MC	Total Area	A	Eoc., Flysch	Eoc., Volc. Facies	Juras.-Cret.	K	Lias	Lower Cret.	Lower Cret., Flysch	Malm	Mesoz. (Ophiol. Series), Mainly Cret.	Neog., Volc. Facies	Neog., Cont, Undif.	Oligo-Mioc., Gypsif. Facies	Paleoz., Metam.,	Q	Upper Cret.	Upper Cret., Flysch	Upper Cret., Volc. Facies	Upper Mioc.	Y	Others
Berta	BT-01	417	244	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	155	0	0	0
	BT-02	136	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	118	0	0	0
	BT-03	405	172	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	209	0	0	0
	BT-04	185	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90	0	0	0
	BT-05	184	10	0	33	9	0	0	0	0	0	0	0	0	0	0	0	0	0	132	0	0	0
	BT-06	345	85	0	0	18	3	0	0	0	0	0	0	0	0	73	0	0	0	166	0	0	0
	BT-07	608	46	53	0	0	0	0	0	0	0	0	0	0	0	2	3	18	0	486	0	0	0
	Sub-total	**2,280**	**670**	**53**	**33**	**27**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**42**	**75**	**3**	**18**	**0**	**1,356**	**0**	**0**	**0**
Lower Coruh	LC-01	124	0	0	0	1	0	0	0	0	0	0	0	0	0	59	0	0	0	64	0	0	0
	LC-02	364	0	0	34	6	0	0	0	0	0	0	0	0	0	29	0	0	0	295	0	0	0
	LC-03	363	0	0	88	0	10	0	0	0	0	0	0	0	0	0	0	0	0	265	0	0	0
	LC-04	210	0	0	192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	0	0
	LC-05	161	7	0	60	0	0	0	0	0	0	0	0	0	0	51	0	0	0	43	0	0	0
	LC-06	302	60	0	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	146	0	0	0
	LC-07	252	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	129	0	0	0
	Sub-total	**1,777**	**190**	**0**	**470**	**7**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**140**	**0**	**0**	**0**	**960**	**0**	**0**	**0**
Middle Coruh	MC-01	239	20	0	11	0	207	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	MC-02	285	22	0	169	0	13	21	0	4	1	0	0	0	0	0	18	37	0	0	0	0	0
	MC-03	216	0	103	47	0	7	4	0	0	0	0	0	0	0	0	13	0	7	0	0	35	0
	MC-04	182	0	2	30	0	146	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0
	MC-05	238	3	1	143	0	80	0	0	0	0	0	0	0	0	0	4	0	0	4	0	3	0
	MC-06	262	10	0	0	0	245	0	0	0	0	0	0	0	0	0	1	0	0	6	0	0	0
	MC-07	165	11	0	0	0	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0
	MC-08	317	0	0	26	0	62	0	0	7	22	0	0	0	0	53	0	0	0	99	0	47	0
	MC-09	243	0	0	1	0	6	0	0	0	18	0	0	0	0	142	0	0	0	65	0	12	0
	MC-10	444	0	0	0	66	15	2	0	14	65	0	0	0	0	31	0	22	0	190	0	39	0
	Sub-total	**2,590**	**66**	**106**	**426**	**66**	**925**	**27**	**0**	**25**	**105**	**0**	**0**	**0**	**0**	**227**	**40**	**59**	**7**	**364**	**0**	**147**	**0**

Oltu	**OL-01**	277	196	28	49	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0
	OL-02	408	33	51	0	0	2	0	0	18	0	24	0	0	113	0	3	0	108	30	0	24	0
	OL-03	448	224	48	13	0	0	0	0	0	0	6	0	0	131	0	14	0	0	12	0	0	0
	OL-04	385	10	0	0	0	0	0	0	91	5	0	0	0	21	2	24	0	209	0	0	22	0
	OL-05	265	20	28	0	0	0	0	0	0	0	45	0	22	143	0	5	0	0	2	0	0	0
	OL-06	251	141	0	0	0	0	0	0	0	0	84	0	25	0	0	0	0	0	0	0	0	0
	OL-07	456	307	21	0	0	0	0	0	0	0	106	0	21	0	0	0	0	0	0	0	0	0
	OL-08	146	95	0	0	0	0	0	0	0	0	20	0	32	0	0	0	0	0	0	0	0	0
	OL-09	488	325	0	0	0	0	0	0	0	0	0	4	150	0	0	0	0	0	0	0	0	8
	OL-10	186	29	0	0	0	0	0	0	2	0	0	0	23	104	6	0	22	0	0	0	0	0
	OL-11	462	225	27	0	0	0	0	0	25	49	0	0	0	27	47	0	62	0	0	0	0	0
	OL-12	373	15	94	0	0	0	2	0	6	84	0	0	0	16	21	0	131	0	0	0	2	0
	OL-13	134	0	0	0	0	13	24	0	5	68	0	0	0	0	3	0	0	0	0	0	22	0
	OL-14	178	0	0	0	0	4	0	0	17	14	0	0	0	0	137	0	5	1	0	0	0	0
	OL-15	330	0	0	0	0	19	4	0	185	78	0	0	0	0	35	0	0	6	0	0	1	0
	OL-16	227	15	8	0	0	0	0	0	9	10	0	0	0	62	32	11	36	19	25	0	0	0
	Sub-total	**5,013**	**1,636**	**306**	**63**	**0**	**38**	**30**	**0**	**360**	**309**	**285**	**5**	**273**	**618**	**283**	**57**	**256**	**344**	**69**	**0**	**72**	**8**
Tortum	**TR-01**	383	56	0	0	0	0	0	0	79	13	0	110	0	9	0	0	0	116	0	0	1	0
	TR-02	349	298	0	0	0	0	0	0	9	11	0	30	0	0	0	0	1	0	0	0	0	0
	TR-03	291	237	0	0	0	0	0	0	1	53	0	0	0	0	0	0	0	0	0	0	0	0
	TR-04	385	94	0	40	0	5	20	0	19	204	0	0	0	0	0	0	3	0	0	0	0	0
	TR-05	315	1	16	59	0	23	1	0	116	56	0	0	0	0	0	0	0	20	0	0	23	0
	TR-06	307	0	0	0	0	35	2	0	111	114	0	0	0	0	0	0	0	45	0	0	0	0
	Sub-total	**2,030**	**686**	**16**	**99**	**0**	**62**	**23**	**0**	**336**	**450**	**0**	**139**	**0**	**9**	**0**	**0**	**4**	**182**	**0**	**0**	**24**	**0**
Upper Coruh	**UC-01**	515	116	0	0	0	0	6	28	2	301	14	0	0	0	0	18	0	0	0	30	0	0
	UC-02	411	0	15	0	0	0	3	78	153	15	12	0	0	0	1	0	48	2	0	79	6	0
	UC-03	219	0	1	0	0	0	63	114	0	30	0	0	0	0	0	11	0	0	0	0	0	0
	UC-04	442	0	173	0	0	0	13	104	43	0	18	0	0	0	2	15	47	0	0	13	16	0
	UC-05	240	0	38	1	0	0	18	155	0	3	15	0	0	0	0	7	4	0	0	0	0	0
	UC-06	213	0	64	1	0	0	18	77	0	1	0	0	0	0	2	49	0	0	0	1	0	0
	UC-07	797	0	15	0	0	13	191	167	0	8	0	0	0	0	234	164	0	0	0	0	0	5
	UC-08	804	1	85	121	4	27	105	15	0	150	0	0	0	0	63	129	0	0	77	10	0	18
	UC-09	422	0	0	194	0	78	3	0	0	0	0	0	0	0	0	16	0	0	119	12	0	0
	UC-10	191	0	0	102	0	85	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	UC-11	283	0	68	19	0	0	113	0	0	59	0	0	0	0	0	21	0	2	0	0	0	0

	UC-12	204	0	55	7	0	9	111	0	0	15	0	0	0	0	0	7	0	0	0	0	0	0
	UC-13	279	0	33	34	0	0	72	0	0	117	0	0	0	0	0	22	0	0	0	0	0	0
	UC-14	312	7	0	140	0	2	62	0	0	69	0	0	0	0	0	14	18	0	0	0	0	0
	UC-15	462	0	0	280	0	181	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
	UC-16	336	0	0	65	0	271	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	UC-17	388	10	0	43	0	334	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-total	**6,518**	**134**	**548**	**1,006**	**4**	**1,000**	**782**	**738**	**197**	**767**	**58**	**0**	**0**	**0**	**302**	**475**	**118**	**4**	**196**	**144**	**22**	**24**
Others	7																						
Total		**20,209**	**3,383**	**1,028**	**2,097**	**104**	**2,039**	**862**	**738**	**918**	**1,632**	**343**	**145**	**273**	**669**	**1,025**	**574**	**456**	**536**	**2,945**	**144**	**265**	**32**

Note: Others include Cretaceous, undifferentiated with 8km^2, Permo-Carboniferous with 14 km^2 and Pliocene, Continental with 10 km^2.

Source: JICA Study Team calculation using GIS based on old (1960s) Geology maps (scale 1:500,000) by MTA.

A.ANNEX.3:
Geological types by percentage of each MC

SC	Name of MC	Total	A	Eoc., Flysch	Eoc., Volc. Facies	Juras.- Cret.	K	Lias	Lower Cret.	Lower Cret., Flysch	Malm	Mesoz. (Ophiol. Series), Mainly Cret.	Neog., Volc. Facies	Neog., Cont, Undif.	Oligo-Mioc., Gypsif. Facies	Paleoz., Metam.,	Q	Upper Cret.	Upper Cret., Flysch	Upper Cret., Volc. Facies	Upper Mioc.	Y	Others
Berta	BT-01	100.0	58.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	37.3	0.0	0.0	0.0
	BT-02	100.0	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	86.5	0.0	0.0	0.0
	BT-03	100.0	42.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	51.5	0.0	0.0	0.0
	BT-04	100.0	51.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.6	0.0	0.0	0.0
	BT-05	100.0	5.4	0.0	18.0	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	71.9	0.0	0.0	0.0
	BT-06	100.0	24.7	0.0	0.0	5.2	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.1	0.0	0.0	0.0	48.1	0.0	0.0	0.0
	BT-07	100.0	7.5	8.7	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	3.0	0.0	79.9	0.0	0.0	0.0
	Sub-total	**100.0**	**29.4**	**2.3**	**1.5**	**1.2**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**3.3**	**0.1**	**0.8**	**0.0**	**59.5**	**0.0**	**0.0**	**0.0**
Lower Coruh	LC-01	100.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.8	0.0	0.0	0.0	51.1	0.0	0.0	0.0
	LC-02	100.0	0.0	0.0	9.3	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0	0.0	81.1	0.0	0.0	0.0
	LC-03	100.0	0.0	0.0	24.3	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72.8	0.0	0.0	0.0
	LC-04	100.0	0.0	0.0	91.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.0	0.0	0.0
	LC-05	100.0	4.5	0.0	37.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.7	0.0	0.0	0.0	26.4	0.0	0.0	0.0
	LC-06	100.0	20.0	0.0	31.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.4	0.0	0.0	0.0
	LC-07	100.0	48.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.4	0.0	0.0	0.0
	Sub-total	**100.0**	**10.7**	**0.0**	**26.4**	**0.4**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**7.9**	**0.0**	**0.0**	**0.0**	**54.0**	**0.0**	**0.0**	**0.0**
Middle Coruh	MC-01	100.0	8.5	0.0	4.6	0.0	86.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	MC-02	100.0	7.6	0.0	59.2	0.0	4.5	7.4	0.0	1.5	0.2	0.0	0.0	0.0	0.0	0.0	6.5	13.1	0.0	0.0	0.0	0.0	0.0
	MC-03	100.0	0.0	47.7	21.8	0.0	3.3	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	3.2	0.0	0.0	16.3	0.0
	MC-04	100.0	0.0	1.3	16.4	0.0	80.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0
	MC-05	100.0	1.3	0.3	60.0	0.0	33.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	1.8	0.0	1.2	0.0
	MC-06	100.0	3.7	0.0	0.0	0.0	93.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	2.2	0.0	0.0	0.0
	MC-07	100.0	6.9	0.0	0.0	0.0	86.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	0.0
	MC-08	100.0	0.0	0.0	8.2	0.0	19.4	0.0	0.0	2.3	7.1	0.0	0.0	0.0	0.0	16.8	0.0	0.0	0.0	31.1	0.0	15.0	0.0
	MC-09	100.0	0.0	0.0	0.4	0.0	2.5	0.0	0.0	0.0	7.3	0.0	0.0	0.0	0.0	58.2	0.0	0.0	0.0	26.5	0.0	5.1	0.0

	MC-10	100.0	0.0	0.0	0.0	14.9	3.5	0.4	0.0	3.0	14.5	0.0	0.0	0.0	0.0	7.1	0.0	4.9	0.0	42.9	0.0	8.7	0.0
	Sub-total	**100.0**	**2.6**	**4.1**	**16.5**	**2.6**	**35.7**	**1.0**	**0.0**	**1.0**	**4.1**	**0.0**	**0.0**	**0.0**	**0.0**	**8.7**	**1.5**	**2.3**	**0.3**	**14.0**	**0.0**	**5.7**	**0.0**
Oltu	**OL-01**	100.0	71.0	10.0	17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OL-02	100.0	8.2	12.5	0.0	0.0	0.4	0.0	0.0	4.5	0.0	5.8	0.0	0.0	27.8	0.0	0.8	0.0	26.6	7.4	0.0	5.9	0.0
	OL-03	100.0	50.0	10.7	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	29.2	0.0	3.1	0.0	0.0	2.7	0.0	0.0	0.0
	OL-04	100.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	23.8	1.4	0.0	0.0	0.0	5.3	0.4	6.2	0.0	54.4	0.0	0.0	5.8	0.0
	OL-05	100.0	7.5	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.1	0.0	8.3	53.8	0.0	1.9	0.0	0.0	0.6	0.0	0.0	0.0
	OL-06	100.0	56.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.7	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OL-07	100.0	67.4	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.3	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OL-08	100.0	64.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.4	0.0	21.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	OL-09	100.0	66.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
	OL-10	100.0	15.5	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	12.4	56.2	3.2	0.0	11.8	0.0	0.0	0.0	0.0	0.0
	OL-11	100.0	48.7	5.9	0.0	0.0	0.0	0.0	0.0	5.4	10.7	0.0	0.0	0.0	5.8	10.1	0.0	13.4	0.0	0.0	0.0	0.0	0.0
	OL-12	100.0	4.0	25.2	0.0	0.0	0.0	0.7	0.0	1.7	22.6	0.0	0.0	0.0	4.3	5.8	0.0	35.2	0.0	0.0	0.0	0.7	0.0
	OL-13	100.0	0.0	0.0	0.0	0.0	9.3	17.6	0.0	3.9	50.5	0.0	0.0	0.0	0.0	2.3	0.0	0.1	0.0	0.0	0.0	16.3	0.0
	OL-14	100.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	9.6	8.1	0.0	0.0	0.0	0.0	76.9	0.0	2.8	0.4	0.0	0.0	0.0	0.0
	OL-15	100.0	0.0	0.0	0.0	0.0	5.9	1.3	0.0	56.2	23.8	0.0	0.0	0.0	0.0	10.8	0.0	0.0	1.8	0.0	0.0	0.3	0.0
	OL-16	100.0	6.6	3.5	0.0	0.0	0.0	0.0	0.0	4.1	4.3	0.0	0.0	0.0	27.3	14.0	5.0	15.9	8.4	11.0	0.0	0.0	0.0
	Sub-total	**100.0**	**32.6**	**6.1**	**1.3**	**0.0**	**0.8**	**0.6**	**0.0**	**7.2**	**6.2**	**5.7**	**0.1**	**5.5**	**12.3**	**5.6**	**1.1**	**5.1**	**6.9**	**1.4**	**0.0**	**1.4**	**0.2**
	TR-01	100.0	14.5	0.0	0.0	0.0	0.0	0.0	0.0	20.7	3.4	0.0	28.6	0.0	2.4	0.0	0.0	0.0	30.3	0.0	0.0	0.2	0.0
	TR-02	100.0	85.6	0.0	0.0	0.0	0.0	0.0	0.0	2.6	3.0	0.0	8.5	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0
	TR-03	100.0	81.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	18.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tortum	**TR-04**	100.0	24.3	0.0	10.4	0.0	1.3	5.3	0.0	5.0	52.8	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0
	TR-05	100.0	0.3	5.0	18.7	0.0	7.2	0.3	0.0	36.8	17.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	0.0	0.0	7.4	0.0
	TR-06	100.0	0.0	0.0	0.0	0.0	11.3	0.6	0.0	36.2	37.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6	0.0	0.0	0.1	0.0
	Sub-total	**100.0**	**33.8**	**0.8**	**4.9**	**0.0**	**3.1**	**1.1**	**0.0**	**16.5**	**22.2**	**0.0**	**6.8**	**0.0**	**0.5**	**0.0**	**0.0**	**0.2**	**8.9**	**0.0**	**0.0**	**1.2**	**0.0**
Upper Coruh	**UC-01**	100.0	22.6	0.0	0.0	0.0	0.0	1.2	5.4	0.4	58.4	2.7	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	5.8	0.0	0.0
	UC-02	100.0	0.0	3.7	0.0	0.0	0.0	0.7	19.0	37.2	3.7	2.8	0.0	0.0	0.0	0.2	0.0	11.6	0.4	0.0	19.1	1.5	0.0
	UC-03	100.0	0.0	0.3	0.0	0.0	0.0	28.8	52.3	0.0	13.7	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0
	UC-04	100.0	0.0	39.2	0.0	0.0	0.0	2.9	23.5	9.6	0.0	4.0	0.0	0.0	0.0	0.4	3.3	10.7	0.0	0.0	2.8	3.6	0.0
	UC-05	100.0	0.0	15.9	0.2	0.0	0.0	7.5	64.3	0.0	1.2	6.2	0.0	0.0	0.0	0.0	2.8	1.8	0.0	0.0	0.0	0.0	0.0
	UC-06	100.0	0.0	30.2	0.3	0.0	0.0	8.4	36.1	0.0	0.3	0.0	0.0	0.0	0.0	0.9	23.1	0.0	0.0	0.0	0.7	0.0	0.0
	UC-07	100.0	0.0	1.9	0.0	0.0	1.6	23.9	21.0	0.0	1.0	0.0	0.0	0.0	0.0	29.4	20.6	0.0	0.0	0.0	0.0	0.0	0.6

UC-08	100.0	0.1	10.5	15.0	0.5	3.4	13.1	1.8	0.0	18.6	0.0	0.0	0.0	0.0	7.9	16.1	0.0	0.0	9.5	1.2	0.0	2.3
UC-09	100.0	0.0	0.0	46.0	0.0	18.5	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0	28.3	2.8	0.0	0.0
UC-10	100.0	0.0	0.0	53.3	0.0	44.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UC-11	100.0	0.0	24.1	6.8	0.0	0.0	40.1	0.0	0.0	20.8	0.0	0.0	0.0	0.0	0.0	7.5	0.0	0.7	0.0	0.0	0.0	0.0
UC-12	100.0	0.0	26.9	3.4	0.0	4.6	54.3	0.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	0.0	0.0	0.0
UC-13	100.0	0.0	11.9	12.2	0.0	0.0	25.9	0.0	0.0	42.1	0.0	0.0	0.0	0.0	0.0	7.9	0.0	0.0	0.0	0.0	0.0	0.0
UC-14	100.0	2.2	0.0	44.9	0.0	0.5	19.9	0.0	0.0	22.1	0.0	0.0	0.0	0.0	0.0	4.5	5.9	0.0	0.0	0.0	0.0	0.0
UC-15	100.0	0.0	0.0	60.5	0.0	39.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0
UC-16	100.0	0.0	0.0	19.4	0.0	80.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
UC-17	100.0	2.6	0.0	11.2	0.0	86.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sub-total	**100.0**	**2.1**	**8.4**	**15.4**	**0.1**	**15.3**	**12.0**	**11.3**	**3.0**	**11.8**	**0.9**	**0.0**	**0.0**	**0.0**	**4.6**	**7.3**	**1.8**	**0.1**	**3.0**	**2.2**	**0.3**	**0.4**
Others																						
Total	**100.0**	**16.7**	**5.1**	**10.4**	**0.5**	**10.1**	**4.3**	**3.7**	**4.5**	**8.1**	**1.7**	**0.7**	**1.4**	**3.3**	**5.1**	**2.8**	**2.3**	**2.7**	**14.6**	**0.7**	**1.3**	**0.2**

Note: Others include Cretaceous, undifferentiated, Permo-Carboniferous and Pliocene, Continental.

Source: Old (1960s) MTA geological maos for Trabzon, Erzurum and Kars (1:500,000), processed by Study GIS

A.ANNEX.4:
Main Soil Classes, areas (km^2)

SC	Alluvial Soils	Basaltic Soils	Brown Forest Soils	Brown Soils	Chestnut Soils	Colluvium Soils	High Mountain Pasture Soils	Non-calcic Brown Forest Soils	Non-calcic Brown Soils	Red-Yellow Podzolic Soils	Others	No data	Sub-total
BT-01	0	0	272	0	0	0	82	0	0	40	0	22	417
BT-02	0	0	109	0	0	0	13	0	0	0	0	14	136
BT-03	1	0	325	0	0	0	67	0	0	0	0	13	405
BT-04	0	0	124	0	0	0	44	0	0	0	0	17	185
BT-05	0	0	162	0	0	0	20	0	0	0	0	2	184
BT-06	0	0	264	0	0	0	19	0	0	0	0	61	345
BT-07	0	0	462	0	3	2	106	0	0	0	0	35	608
	1	0	1,717	0	3	2	351	0	0	40	0	165	**2,280**
LC-01	0	0	75	0	0	0	2	42	0	0	0	5	124
LC-02	0	0	142	0	0	0	31	156	0	22	0	12	364
LC-03	0	0	19	0	0	1	29	3	0	288	0	24	364
LC-04	1	0	5	0	0	0	0	45	0	157	0	2	210
LC-05	0	0	151	0	0	0	3	3	0	0	0	4	161
LC-06	0	0	1	0	0	0	22	268	0	1	0	10	302
LC-07	0	0	0	0	0	0	12	0	0	207	0	20	239
	1	0	393	0	0	1	100	518	0	675	0	76	**1,765**
MC-01	1	0	150	0	0	0	46	0	0	0	0	46	244
MC-02	0	37	223	0	13	0	10	0	0	0	0	1	285
MC-03	2	2	185	0	0	0	3	0	0	0	0	23	216
MC-04	4	0	105	0	0	0	24	0	0	0	0	50	182
MC-05	2	0	169	0	0	0	3	25	0	0	0	39	238
MC-06	2	0	0	0	0	0	63	145	0	1	0	50	262
MC-07	0	0	0	0	0	0	76	30	0	0	0	60	165
MC-08	0	0	182	0	0	0	53	20	0	0	0	62	318
MC-09	0	0	197	0	0	0	10	0	0	0	0	37	243
MC-10	0	0	373	0	0	0	20	0	0	0	0	52	444
	12	39	1,584	0	13	0	307	220	0	1	0	419	**2,596**
OL-01	0	264	0	0	0	3	0	0	0	0	0	9	276
OL-02	0	119	0	215	0	30	0	0	0	0	0	43	408
OL-03	0	351	0	67	0	20	0	0	0	0	0	10	448
OL-04	0	39	91	201	0	39	0	0	0	0	0	15	385
OL-05	0	76	2	129	0	24	0	0	0	0	0	34	265
OL-06	0	227	0	6	0	0	0	0	0	0	0	18	251
OL-07	0	194	0	0	142	6	0	94	0	0	0	21	456
OL-08	0	141	0	25	0	0	0	0	0	0	0	31	197
OL-09	0	322	0	97	39	2	0	0	0	0	0	32	492
OL-10	0	28	50	78	0	18	0	0	0	0	0	12	186
OL-11	0	96	128	0	110	8	88	0	0	0	0	28	458
OL-12	0	1	110	0	93	4	49	0	0	0	0	116	373

OL-13	1	0	91	0	0	0	0	0	0	0	0	42	134
OL-14	0	0	159	0	0	4	0	0	0	0	0	15	178
OL-15	1	0	296	0	0	4	0	0	0	0	0	28	330
OL-16	0	0	157	51	0	15	0	0	0	0	0	4	227
	2	1,857	1,084	869	384	178	137	94	0	0	0	457	**5,063**
TR-01	0	80	1	213	50	15	0	0	0	0	0	26	383
TR-02	0	226	0	34	53	8	0	0	0	0	0	28	349
TR-03	0	239	0	24	20	6	0	0	0	0	0	2	291
TR-04	0	302	0	0	55	12	0	0	0	0	0	14	384
TR-05	2	40	224	0	0	2	20	0	0	0	2	25	315
TR-06	0	12	272	3	0	6	0	0	0	0	2	12	307
	2	898	497	274	177	49	20	0	0	0	4	107	**2,029**
UC-01	17	115	0	46	328	9	0	0	0	0	0	4	519
UC-02	2	0	0	70	289	11	0	0	0	0	0	39	411
UC-03	11	0	2	164	0	2	37	0	0	0	0	2	219
UC-04	6	0	0	130	216	12	0	0	0	0	0	77	441
UC-05	15	0	0	202	16	2	0	0	0	0	0	6	240
UC-06	28	0	0	182	0	0	0	0	0	0	0	2	212
UC-07	132	0	0	595	0	29	0	24	8	0	0	8	797
UC-08	88	0	15	467	0	21	123	43	34	0	0	13	804
UC-09	45	0	0	67	0	2	126	0	172	0	0	9	422
UC-10	2	0	0	31	0	1	55	0	88	0	0	14	191
UC-11	16	0	0	229	0	5	9	0	18	0	0	7	283
UC-12	0	0	0	183	1	3	15	0	0	0	0	2	204
UC-13	0	0	0	20	248	1	0	0	0	0	0	7	276
UC-14	0	47	23	0	209	1	0	0	0	0	0	32	312
UC-15	171	0	0	13	147	0	14	0	1	0	2	114	462
UC-16	42	0	68	0	51	1	104	0	0	0	0	65	331
UC-17	0	0	171	0	0	1	146	0	0	0	0	68	386
	575	162	280	2,401	1,505	101	630	67	320	0	2	469	**6,512**
Total	**593**	**2,956**	**5,555**	**3,545**	**2,082**	**333**	**1,545**	**900**	**320**	**717**	**6**	**1,694**	**20,244**

Note: Others include Gray Brown Podzolic soils with 4 km^2 and Saline-Alkaline and Mixture soils with 2 km^2.

Source: JICA Study Team based on GIS data by GDRS.

A.ANNEX.5:
Main Soil Classes (Percentage of Area)

SC	Allu-vial Soils	Basaltic Soils	Brown Forest Soils	Brown Soils	Chest-nut Soils	Collu-vium Soils	High Mountain Pasture Soils	Non-calcic Brown Forest Soils	Non-calcic Brown Soils	Red-Yellow Podzolic Soils	Others	No data	Total
BT-01	0.0%	0.0%	65.3%	0.0%	0.0%	0.0%	19.7%	0.0%	0.0%	9.7%	0.0%	5.4%	100.0%
BT-02	0.0%	0.0%	79.9%	0.0%	0.0%	0.0%	9.5%	0.0%	0.0%	0.0%	0.0%	10.6%	100.0%
BT-03	0.1%	0.0%	80.2%	0.0%	0.0%	0.0%	16.5%	0.0%	0.0%	0.0%	0.0%	3.2%	100.0%
BT-04	0.2%	0.0%	66.9%	0.0%	0.0%	0.0%	23.7%	0.0%	0.0%	0.0%	0.0%	9.1%	100.0%
BT-05	0.0%	0.0%	88.0%	0.0%	0.0%	0.0%	11.0%	0.0%	0.0%	0.0%	0.0%	1.1%	100.0%
BT-06	0.0%	0.0%	76.5%	0.0%	0.0%	0.0%	5.6%	0.1%	0.0%	0.0%	0.0%	17.8%	100.0%
BT-07	0.0%	0.0%	75.9%	0.0%	0.5%	0.4%	17.4%	0.0%	0.0%	0.0%	0.0%	5.8%	100.0%
	0.0%	**0.0%**	**75.3%**	**0.0%**	**0.1%**	**0.1%**	**15.4%**	**0.0%**	**0.0%**	**1.8%**	**0.0%**	**7.3%**	**100.0%**
LC-01	0.0%	0.0%	60.2%	0.0%	0.0%	0.0%	1.8%	33.8%	0.0%	0.0%	0.0%	4.3%	100.0%
LC-02	0.0%	0.0%	39.1%	0.0%	0.0%	0.0%	8.6%	42.9%	0.0%	6.1%	0.0%	3.3%	100.0%
LC-03	0.1%	0.0%	5.1%	0.0%	0.0%	0.3%	7.9%	0.8%	0.0%	79.1%	0.0%	6.7%	100.0%
LC-04	0.4%	0.0%	2.5%	0.0%	0.0%	0.0%	0.0%	21.7%	0.0%	74.7%	0.0%	0.8%	100.0%
LC-05	0.0%	0.0%	93.8%	0.0%	0.0%	0.0%	1.8%	2.1%	0.0%	0.0%	0.0%	2.3%	100.0%
LC-06	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	7.2%	89.0%	0.0%	0.4%	0.0%	3.2%	100.0%
LC-07	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5.1%	0.2%	0.0%	86.4%	0.0%	8.3%	100.0%
	0.1%	**0.0%**	**22.3%**	**0.0%**	**0.0%**	**0.1%**	**5.6%**	**29.4%**	**0.0%**	**38.2%**	**0.0%**	**4.3%**	**100.0%**
MC-01	0.4%	0.0%	61.7%	0.0%	0.0%	0.0%	19.0%	0.0%	0.0%	0.0%	0.0%	18.9%	100.0%
MC-02	0.0%	13.0%	78.4%	0.0%	4.6%	0.0%	3.6%	0.0%	0.0%	0.0%	0.0%	0.3%	100.0%
MC-03	1.2%	1.1%	85.9%	0.0%	0.0%	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	10.5%	100.0%
MC-04	2.2%	0.0%	57.5%	0.0%	0.0%	0.0%	13.0%	0.0%	0.0%	0.0%	0.0%	27.3%	100.0%
MC-05	0.8%	0.0%	71.0%	0.0%	0.0%	0.0%	1.3%	10.4%	0.0%	0.0%	0.0%	16.6%	100.0%
MC-06	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	23.9%	55.4%	0.0%	0.6%	0.0%	19.2%	100.0%
MC-07	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	45.7%	18.0%	0.0%	0.0%	0.0%	36.3%	100.0%
MC-08	0.1%	0.0%	57.3%	0.0%	0.0%	0.0%	16.8%	6.4%	0.0%	0.0%	0.0%	19.4%	100.0%
MC-09	0.0%	0.0%	80.8%	0.0%	0.0%	0.0%	4.0%	0.1%	0.0%	0.0%	0.0%	15.1%	100.0%
MC-10	0.0%	0.0%	83.9%	0.0%	0.0%	0.0%	4.4%	0.0%	0.0%	0.0%	0.0%	11.6%	100.0%
	0.5%	**1.5%**	**61.0%**	**0.0%**	**0.5%**	**0.0%**	**11.8%**	**8.5%**	**0.0%**	**0.1%**	**0.0%**	**16.1%**	**100.0%**
OL-01	0.0%	95.7%	0.0%	0.0%	0.0%	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.3%	100.0%
OL-02	0.0%	29.3%	0.0%	52.7%	0.0%	7.5%	0.0%	0.0%	0.0%	0.0%	0.0%	10.5%	100.0%
OL-03	0.0%	78.3%	0.0%	14.9%	0.0%	4.5%	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	100.0%
OL-04	0.0%	10.0%	23.7%	52.3%	0.0%	10.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%	100.0%
OL-05	0.0%	28.6%	0.7%	48.6%	0.0%	9.2%	0.0%	0.0%	0.0%	0.0%	0.0%	12.9%	100.0%
OL-06	0.0%	90.3%	0.0%	2.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.2%	100.0%
OL-07	0.0%	42.5%	0.0%	0.0%	31.1%	1.3%	0.0%	20.5%	0.0%	0.0%	0.0%	4.6%	100.0%
OL-08	0.0%	71.8%	0.0%	12.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	15.5%	100.0%
OL-09	0.0%	65.4%	0.0%	19.8%	8.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	6.4%	100.0%
OL-10	0.0%	14.8%	26.7%	42.2%	0.0%	9.8%	0.0%	0.0%	0.0%	0.0%	0.0%	6.5%	100.0%
OL-11	0.0%	21.0%	28.1%	0.0%	24.1%	1.6%	19.2%	0.0%	0.0%	0.0%	0.0%	6.0%	100.0%
OL-12	0.0%	0.1%	29.5%	0.0%	24.9%	1.2%	13.2%	0.0%	0.0%	0.0%	0.0%	31.0%	100.0%
OL-13	0.9%	0.0%	67.8%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%	31.1%	100.0%

OL-14	0.0%	0.0%	89.3%	0.0%	0.0%	2.4%	0.0%	0.0%	0.0%	0.0%	0.0%	8.3%	100.0%
OL-15	0.3%	0.0%	89.8%	0.0%	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	8.6%	100.0%
OL-16	0.0%	0.0%	69.1%	22.4%	0.0%	6.6%	0.0%	0.0%	0.0%	0.0%	0.0%	1.9%	100.0%
	0.0%	**36.7%**	**21.4%**	**17.2%**	**7.6%**	**3.5%**	**2.7%**	**1.9%**	**0.0%**	**0.0%**	**0.0%**	**9.0%**	**100.0%**
TR-01	0.0%	20.7%	0.2%	55.5%	12.9%	3.9%	0.0%	0.0%	0.0%	0.0%	0.0%	6.7%	100.0%
TR-02	0.0%	64.7%	0.0%	9.7%	15.1%	2.3%	0.0%	0.0%	0.0%	0.0%	0.0%	8.1%	100.0%
TR-03	0.0%	82.1%	0.0%	8.4%	6.8%	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.6%	100.0%
TR-04	0.0%	78.7%	0.0%	0.0%	14.4%	3.1%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	100.0%
TR-05	0.6%	12.6%	70.9%	0.0%	0.0%	0.7%	6.5%	0.0%	0.0%	0.0%	0.6%	8.1%	100.0%
TR-06	0.0%	3.9%	88.7%	1.0%	0.0%	1.8%	0.0%	0.0%	0.0%	0.0%	0.7%	3.8%	100.0%
	0.1%	**44.3%**	**24.5%**	**13.5%**	**8.7%**	**2.4%**	**1.0%**	**0.0%**	**0.0%**	**0.0%**	**0.2%**	**5.3%**	**100.0%**
UC-01	3.3%	22.2%	0.0%	8.8%	63.2%	1.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%	100.0%
UC-02	0.6%	0.0%	0.0%	17.1%	70.2%	2.7%	0.0%	0.0%	0.0%	0.0%	0.0%	9.5%	100.0%
UC-03	5.0%	0.0%	1.0%	75.0%	0.0%	1.0%	17.0%	0.0%	0.0%	0.0%	0.0%	1.0%	100.0%
UC-04	1.3%	0.0%	0.0%	29.6%	49.0%	2.6%	0.0%	0.0%	0.0%	0.0%	0.0%	17.6%	100.0%
UC-05	6.2%	0.0%	0.0%	84.1%	6.5%	0.8%	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	100.0%
UC-06	13.1%	0.0%	0.0%	86.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	100.0%
UC-07	16.6%	0.0%	0.1%	74.7%	0.0%	3.6%	0.0%	3.1%	1.0%	0.0%	0.0%	1.0%	100.0%
UC-08	10.9%	0.0%	1.9%	58.1%	0.0%	2.7%	15.3%	5.3%	4.2%	0.0%	0.0%	1.6%	100.0%
UC-09	10.8%	0.0%	0.0%	16.0%	0.0%	0.4%	29.9%	0.0%	40.8%	0.0%	0.0%	2.1%	100.0%
UC-10	1.1%	0.0%	0.0%	16.0%	0.0%	0.7%	29.1%	0.0%	46.0%	0.0%	0.0%	7.1%	100.0%
UC-11	5.5%	0.0%	0.0%	80.9%	0.0%	1.7%	3.1%	0.0%	6.3%	0.0%	0.0%	2.5%	100.0%
UC-12	0.0%	0.0%	0.0%	89.5%	0.4%	1.5%	7.4%	0.0%	0.0%	0.0%	0.0%	1.2%	100.0%
UC-13	0.0%	0.0%	0.0%	7.3%	89.9%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	2.5%	100.0%
UC-14	0.0%	14.9%	7.3%	0.0%	67.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	10.2%	100.0%
UC-15	37.0%	0.0%	0.0%	2.9%	31.8%	0.0%	3.1%	0.0%	0.2%	0.0%	0.3%	24.8%	100.0%
UC-16	12.8%	0.0%	20.6%	0.0%	15.4%	0.4%	31.3%	0.0%	0.0%	0.0%	0.0%	19.6%	100.0%
UC-17	0.0%	0.0%	44.3%	0.0%	0.0%	0.3%	37.8%	0.0%	0.0%	0.0%	0.0%	17.5%	100.0%
	8.8%	**2.5%**	**4.3%**	**36.9%**	**23.1%**	**1.6%**	**9.7%**	**1.0%**	**4.9%**	**0.0%**	**0.0%**	**7.2%**	**100.0%**
Total	**2.9%**	**14.6%**	**27.4%**	**17.5%**	**10.3%**	**1.6%**	**7.6%**	**4.4%**	**1.6%**	**3.5%**	**0.0%**	**8.4%**	**100.0%**

Note: Others include Gray Brown Podzolic soils and Saline-Alkaline and Mixture soils.

Source: JICA Study Team based on GIS data by GDRS.

A.ANNEX.6:
Land Capability by area (ha)

	I	II	III	IV	VI	VII	VIII	No data	Sub-total
BT-01			206	2,220	11,714	25,298	2,181	53	41,672
BT-02			101	562	2,256	9,238	1,428	20	13,605
BT-03		53	1,828	5,794	12,931	18,581	1,198	100	40,485
BT-04		40	476	3,155	5,509	7,648	1,649	41	18,518
BT-05			199	2,093	7,070	8,863	101	93	18,419
BT-06			28	315	2,806	25,222	6,088	61	34,521
BT-07		49	1,530	4,456	19,069	32,175	3,347	180	60,806
	0	141	4,368	18,596	61,356	127,026	15,991	547	**228,025**
LC-01				95	440	11,366	506	22	12,429
LC-02				35	5,815	29,368	873	330	36,421
LC-03		24		893	6,459	26,562	2,278	153	36,370
LC-04	75			154	1,841	18,769	76	89	21,004
LC-05			43	225	1,823	13,680	190	174	16,135
LC-06				289	3,561	25,354	767	198	30,168
LC-07				185	2,081	19,682	1,929	61	23,939
	75	24	43	1,877	22,021	144,780	6,619	1,027	**176,466**
MC-01		99		39	4,887	14,740	4,471	134	24,369
MC-02					1,482	5,080	21,801	99	28,462
MC-03		222	26	540	3,642	14,863	2,225	36	21,554
MC-04		339	67	115	2,756	9,958	4,899	64	18,197
MC-05		182		690	683	18,285	3,851	88	23,778
MC-06				74	7,548	13,518	4,993	22	26,156
MC-07					7,783	2,739	5,981	21	16,524
MC-08		34	234	494	5,901	18,932	6,087	73	31,757
MC-09			19	194	2,047	18,414	3,540	134	24,348
MC-10			3	3,130	4,248	31,859	4,680	487	44,406
	0	876	349	5,275	40,977	148,387	62,529	1,159	**259,552**
OL-01	27		445	4,939	6,023	15,276	803	112	27,625
OL-02	1,368	1,035	1,820	5,840	5,739	20,674	4,115	180	40,771
OL-03	1,379	467	741	5,367	6,559	29,267	855	194	44,829
OL-04		6	3,668	456	4,613	28,251	1,259	258	38,512
OL-05		748	3,038	5,114	1,134	13,010	3,106	301	26,451
OL-06			612	3,870	607	18,180	1,744	67	25,079
OL-07		1,940	7,849	4,806	3,611	25,345	1,908	182	45,641
OL-08			1,246	770	6,323	8,281	2,987	72	19,680
OL-09		366	201	15,323	7,426	22,733	2,888	264	49,201
OL-10		741	2,524	1,043	2,775	10,299	1,017	186	18,584
OL-11		137	2,010	4,420	7,910	28,551	1,552	1,199	45,779
OL-12		15	631	2,364	7,062	15,660	2,049	9,531	37,312
OL-13		122	28	744	1,166	7,171	3,757	414	13,403
OL-14			434	382	6,620	8,882	1,399	71	17,789
OL-15		87	449	1,421	1,962	26,233	2,742	96	32,989
OL-16		1,128	636		3,858	16,633	305	117	22,677
	2,774	6,791	26,332	56,858	73,388	294,445	32,487	13,245	**506,322**
TR-01		385	1,304	2,295	5,509	26,286	2,404	148	38,331
TR-02		587	1,570	7,526	7,032	15,333	2,710	117	34,876

TR-03		1,200	832	8,499	3,248	15,137	32	143	29,091
TR-04		1,701	888	7,529	2,955	23,881	1,364	68	38,387
TR-05		183	183	704	4,868	23,040	2,457	83	31,519
TR-06		6	220	594	5,383	23,302	1,161	19	30,684
	0	4,062	4,998	27,146	28,995	126,980	10,128	579	**202,889**
UC-01		3,274	115	4,945	7,019	36,144		424	51,919
UC-02		778	658	4,968	6,052	24,774	3,694	206	41,129
UC-03		1,410	64	640	4,727	14,821	77	133	21,873
UC-04	31	1,328	415	5,240	2,473	26,869	7,562	181	44,098
UC-05		1,688	75	1,722	1,418	18,581	211	343	24,038
UC-06		3,752	2,390	2,849	5,325	6,706	23	175	21,220
UC-07	9,058	5,436	9,321	4,077	7,846	43,152		805	79,695
UC-08	2,255	10,520	5,179	6,281	18,108	36,810	801	449	80,402
UC-09		4,751	2,530	1,224	14,394	18,432	435	458	42,224
UC-10		370			6,530	10,802	1,209	154	19,065
UC-11		2,043	1,319	3,862	4,815	15,564	394	318	28,316
UC-12		112	362	740	3,134	15,848	105	137	20,439
UC-13		231	1,437	2,912	1,829	20,506	476	226	27,617
UC-14		908	197	2,467	5,119	19,303	2,930	244	31,167
UC-15		17,326	171	375	2,542	14,364	11,117	328	46,224
UC-16		4,337	214	527	10,513	11,048	6,306	176	33,122
UC-17		9	126		14,749	16,964	6,564	212	38,623
	11,344	58,272	24,574	42,827	116,593	350,687	41,905	4,968	**651,171**
Totals	**14,194**	**70,166**	**60,664**	**152,580**	**343,331**	**1,192,305**	**169,659**	**21,525**	**2,024,424**

Sources: GDRS data processed by the Study GIS

A.ANNEX.7:
Land Capability by percentage of each MC

	I	II	III	IV	VI	VII	VIII	No data	Sub-total
BT-01	0.0	0.0	0.5	5.3	28.1	60.7	5.2	0.1	41,672
BT-02	0.0	0.0	0.7	4.1	16.6	67.9	10.5	0.1	13,605
BT-03	0.0	0.1	4.5	14.3	31.9	45.9	3.0	0.2	40,485
BT-04	0.0	0.2	2.6	17.0	29.8	41.3	8.9	0.2	18,518
BT-05	0.0	0.0	1.1	11.4	38.4	48.1	0.6	0.5	18,419
BT-06	0.0	0.0	0.1	0.9	8.1	73.1	17.6	0.2	34,521
BT-07	0.0	0.1	2.5	7.3	31.4	52.9	5.5	0.3	60,806
	0.0	0.1	1.9	8.2	26.9	55.7	7.0	0.2	**228,025**
LC-01	0.0	0.0	0.0	0.8	3.5	91.4	4.1	0.2	12,429
LC-02	0.0	0.0	0.0	0.1	16.0	80.6	2.4	0.9	36,421
LC-03	0.0	0.1	0.0	2.5	17.8	73.0	6.3	0.4	36,370
LC-04	0.4	0.0	0.0	0.7	8.8	89.4	0.4	0.4	21,004
LC-05	0.0	0.0	0.3	1.4	11.3	84.8	1.2	1.1	16,135
LC-06	0.0	0.0	0.0	1.0	11.8	84.0	2.5	0.7	30,168
LC-07	0.0	0.0	0.0	0.8	8.7	82.2	8.1	0.3	23,939
	0.0	0.0	0.0	1.1	12.5	82.0	3.8	0.6	**176,466**
MC-01	0.0	0.4	0.0	0.2	20.1	60.5	18.3	0.6	24,369
MC-02	0.0	0.0	0.0	0.0	5.2	17.8	76.6	0.3	28,462
MC-03	0.0	1.0	0.1	2.5	16.9	69.0	10.3	0.2	21,554
MC-04	0.0	1.9	0.4	0.6	15.1	54.7	26.9	0.3	18,197
MC-05	0.0	0.8	0.0	2.9	2.9	76.9	16.2	0.4	23,778
MC-06	0.0	0.0	0.0	0.3	28.9	51.7	19.1	0.1	26,156
MC-07	0.0	0.0	0.0	0.0	47.1	16.6	36.2	0.1	16,524
MC-08	0.0	0.1	0.7	1.6	18.6	59.6	19.2	0.2	31,757
MC-09	0.0	0.0	0.1	0.8	8.4	75.6	14.5	0.6	24,348
MC-10	0.0	0.0	0.0	7.0	9.6	71.7	10.5	1.1	44,406
	0.0	0.3	0.1	2.0	15.8	57.2	24.1	0.4	**259,552**
OL-01	0.1	0.0	1.6	17.9	21.8	55.3	2.9	0.4	27,625
OL-02	3.4	2.5	4.5	14.3	14.1	50.7	10.1	0.4	40,771
OL-03	3.1	1.0	1.7	12.0	14.6	65.3	1.9	0.4	44,829
OL-04	0.0	0.0	9.5	1.2	12.0	73.4	3.3	0.7	38,512
OL-05	0.0	2.8	11.5	19.3	4.3	49.2	11.7	1.1	26,451
OL-06	0.0	0.0	2.4	15.4	2.4	72.5	7.0	0.3	25,079
OL-07	0.0	4.3	17.2	10.5	7.9	55.5	4.2	0.4	45,641
OL-08	0.0	0.0	6.3	3.9	32.1	42.1	15.2	0.4	19,680
OL-09	0.0	0.7	0.4	31.1	15.1	46.2	5.9	0.5	49,201
OL-10	0.0	4.0	13.6	5.6	14.9	55.4	5.5	1.0	18,584
OL-11	0.0	0.3	4.4	9.7	17.3	62.4	3.4	2.6	45,779
OL-12	0.0	0.0	1.7	6.3	18.9	42.0	5.5	25.5	37,312
OL-13	0.0	0.9	0.2	5.6	8.7	53.5	28.0	3.1	13,403
OL-14	0.0	0.0	2.4	2.1	37.2	49.9	7.9	0.4	17,789
OL-15	0.0	0.3	1.4	4.3	5.9	79.5	8.3	0.3	32,989
OL-16	0.0	5.0	2.8	0.0	17.0	73.3	1.3	0.5	22,677
	0.5	1.3	5.2	11.2	14.5	58.2	6.4	2.6	**506,322**
TR-01	0.0	1.0	3.4	6.0	14.4	68.6	6.3	0.4	38,331

TR-02	0.0	1.7	4.5	21.6	20.2	44.0	7.8	0.3	34,876
TR-03	0.0	4.1	2.9	29.2	11.2	52.0	0.1	0.5	29,091
TR-04	0.0	4.4	2.3	19.6	7.7	62.2	3.6	0.2	38,387
TR-05	0.0	0.6	0.6	2.2	15.4	73.1	7.8	0.3	31,519
TR-06	0.0	0.0	0.7	1.9	17.5	75.9	3.8	0.1	30,684
	0.0	2.0	2.5	13.4	14.3	62.6	5.0	0.3	**202,889**
UC-01	0.0	6.3	0.2	9.5	13.5	69.6	0.0	0.8	51,919
UC-02	0.0	1.9	1.6	12.1	14.7	60.2	9.0	0.5	41,129
UC-03	0.0	6.4	0.3	2.9	21.6	67.8	0.4	0.6	21,873
UC-04	0.1	3.0	0.9	11.9	5.6	60.9	17.1	0.4	44,098
UC-05	0.0	7.0	0.3	7.2	5.9	77.3	0.9	1.4	24,038
UC-06	0.0	17.7	11.3	13.4	25.1	31.6	0.1	0.8	21,220
UC-07	11.4	6.8	11.7	5.1	9.8	54.1	0.0	1.0	79,695
UC-08	2.8	13.1	6.4	7.8	22.5	45.8	1.0	0.6	80,402
UC-09	0.0	11.3	6.0	2.9	34.1	43.7	1.0	1.1	42,224
UC-10	0.0	1.9	0.0	0.0	34.2	56.7	6.3	0.8	19,065
UC-11	0.0	7.2	4.7	13.6	17.0	55.0	1.4	1.1	28,316
UC-12	0.0	0.5	1.8	3.6	15.3	77.5	0.5	0.7	20,439
UC-13	0.0	0.8	5.2	10.5	6.6	74.3	1.7	0.8	27,617
UC-14	0.0	2.9	0.6	7.9	16.4	61.9	9.4	0.8	31,167
UC-15	0.0	37.5	0.4	0.8	5.5	31.1	24.1	0.7	46,224
UC-16	0.0	13.1	0.6	1.6	31.7	33.4	19.0	0.5	33,122
UC-17	0.0	0.0	0.3	0.0	38.2	43.9	17.0	0.5	38,623
	1.7	8.9	3.8	6.6	17.9	53.9	6.4	0.8	**651,171**
Totals	**0.7**	**3.5**	**3.0**	**7.5**	**17.0**	**58.9**	**8.4**	**1.1**	**2,024,424**

Sources: GDRS data processed by the Study GIS

A.ANNEX.8:
Soil Erosion areas (ha) and percentage of each MC in the four Erosion Classes

SC	Name of MC	Total Area (ha)	Erosion Class 1 (ha)	Erosion Class 2 (ha)	Erosion Class 3 (ha)	Erosion Class 4 (ha)	No Data	Erosion Class 1 (%)	Erosion Class 2 (%)	Erosion Class 3 (%)	Erosion Class 4 (%)	No Data
Berta	BT-01	41,672	0	11,218	25,192	3,027	2,234	0.0	26.9	60.5	7.3	5.4
	BT-02	13,605	0	2,920	9,238	0	1,448	0.0	21.5	67.9	0.0	10.6
	BT-03	40,485	53	18,021	18,677	2,437	1,297	0.1	44.5	46.1	6.0	3.2
	BT-04	18,518	40	9,141	7,648	0	1,690	0.2	49.4	41.3	0.0	9.1
	BT-05	18,419	0	8,771	9,454	0	194	0.0	47.6	51.3	0.0	1.1
	BT-06	34,521	0	3,150	25,222	0	6,149	0.0	9.1	73.1	0.0	17.8
	BT-07	60,806	0	23,749	32,988	542	3,526	0.0	39.1	54.3	0.9	5.8
	subtotal	**228,025**	**92**	**76,968**	**128,420**	**6,006**	**16,538**	**0.0**	**33.8**	**56.3**	**2.6**	**7.3**
Lower Coruh	LC-01	12,429	0	339	11,366	196	528	0.0	2.7	91.4	1.6	4.3
	LC-02	36,421	0	4,819	29,100	1,298	1,203	0.0	13.2	79.9	3.6	3.3
	LC-03	36,370	24	7,340	26,231	344	2,431	0.1	20.2	72.1	0.9	6.7
	LC-04	21,004	75	1,995	18,769	0	165	0.4	9.5	89.4	0.0	0.8
	LC-05	16,135	0	2,091	13,407	273	364	0.0	13.0	83.1	1.7	2.3
	LC-06	30,168	0	3,850	25,354	0	965	0.0	12.8	84.0	0.0	3.2
	LC-07	23,939	0	2,267	19,682	0	1,990	0.0	9.5	82.2	0.0	8.3
	subtotal	**176,466**	**99**	**22,701**	**143,908**	**2,111**	**7,646**	**0.1**	**12.9**	**81.6**	**1.2**	**4.3**
Middle Coruh	MC-01	24,369	99	4,666	14,979	21	4,605	0.4	19.1	61.5	0.1	18.9
	MC-02	28,462	0	5,121	18,688	4,554	99	0.0	18.0	65.7	16.0	0.3
	MC-03	21,554	249	4,182	13,992	871	2,261	1.2	19.4	64.9	4.0	10.5
	MC-04	18,197	406	2,871	8,699	1,258	4,963	2.2	15.8	47.8	6.9	27.3
	MC-05	23,778	182	1,372	17,926	359	3,939	0.8	5.8	75.4	1.5	16.6
	MC-06	26,156	0	7,543	13,597	0	5,015	0.0	28.8	52.0	0.0	19.2
	MC-07	16,524	0	7,783	2,739	0	6,002	0.0	47.1	16.6	0.0	36.3
	MC-08	31,757	34	6,622	18,463	477	6,160	0.1	20.9	58.1	1.5	19.4
	MC-09	24,348	0	2,260	16,110	2,304	3,674	0.0	9.3	66.2	9.5	15.1
	MC-10	44,406	0	4,373	32,641	2,226	5,167	0.0	9.8	73.5	5.0	11.6

	subtotal	**259,552**	**969**	**46,793**	**157,834**	**12,070**	**41,886**	**0.4**	**18.0**	**60.8**	**4.7**	**16.1**
Oltu	**OL-01**	27,625	262	14,239	12,210	0	914	0.9	51.5	44.2	0.0	3.3
	OL-02	40,771	1,369	10,658	17,949	6,500	4,295	3.4	26.1	44.0	15.9	10.5
	OL-03	44,829	1,379	10,401	19,515	12,484	1,049	3.1	23.2	43.5	27.8	2.3
	OL-04	38,512	1,866	4,474	22,473	8,182	1,517	4.8	11.6	58.4	21.2	3.9
	OL-05	26,451	9	9,016	14,020	0	3,406	0.0	34.1	53.0	0.0	12.9
	OL-06	25,079	0	4,652	10,980	7,635	1,811	0.0	18.6	43.8	30.4	7.2
	OL-07	45,641	1,619	13,773	12,753	15,406	2,090	3.5	30.2	27.9	33.8	4.6
	OL-08	19,680	0	6,687	9,767	167	3,060	0.0	34.0	49.6	0.8	15.5
	OL-09	49,201	227	23,947	21,230	644	3,153	0.5	48.7	43.2	1.3	6.4
	OL-10	18,584	914	5,423	11,044	0	1,203	4.9	29.2	59.4	0.0	6.5
	OL-11	45,779	0	16,353	18,320	8,355	2,751	0.0	35.7	40.0	18.3	6.0
	OL-12	37,312	15	10,057	7,603	8,057	11,580	0.0	27.0	20.4	21.6	31.0
	OL-13	13,403	122	3,757	4,635	717	4,172	0.9	28.0	34.6	5.4	31.1
	OL-14	17,789	0	816	15,499	3	1,470	0.0	4.6	87.1	0.0	8.3
	OL-15	32,989	534	1,626	26,286	1,705	2,838	1.6	4.9	79.7	5.2	8.6
	OL-16	22,677	236	1,527	20,492	0	422	1.0	6.7	90.4	0.0	1.9
	subtotal	**506,322**	**8,553**	**137,406**	**244,775**	**69,856**	**45,733**	**1.7**	**27.1**	**48.3**	**13.8**	**9.0**
Tortum	**TR-01**	38,331	347	10,033	9,458	15,941	2,552	0.9	26.2	24.7	41.6	6.7
	TR-02	34,876	866	15,139	11,632	4,412	2,827	2.5	43.4	33.4	12.6	8.1
	TR-03	29,091	1,200	11,078	8,109	8,529	176	4.1	38.1	27.9	29.3	0.6
	TR-04	38,387	1,701	9,331	6,563	19,359	1,432	4.4	24.3	17.1	50.4	3.7
	TR-05	31,519	183	5,557	14,771	8,467	2,540	0.6	17.6	46.9	26.9	8.1
	TR-06	30,684	6	6,118	11,164	12,217	1,179	0.0	19.9	36.4	39.8	3.8
	subtotal	**202,889**	**4,303**	**57,255**	**61,698**	**68,926**	**10,707**	**2.1**	**28.2**	**30.4**	**34.0**	**5.3**
Upper Coruh	**UC-01**	51,919	2,768	12,653	19,850	16,224	424	5.3	24.4	38.2	31.2	0.8
	UC-02	41,129	843	6,413	17,792	12,182	3,899	2.0	15.6	43.3	29.6	9.5
	UC-03	21,873	1,474	4,935	13,496	1,758	210	6.7	22.6	61.7	8.0	1.0
	UC-04	44,098	1,359	6,521	24,194	4,281	7,743	3.1	14.8	54.9	9.7	17.6
	UC-05	24,038	1,688	2,554	19,242	0	554	7.0	10.6	80.0	0.0	2.3
	UC-06	21,220	2,774	11,542	6,706	0	198	13.1	54.4	31.6	0.0	0.9
	UC-07	79,695	13,766	18,896	45,267	961	805	17.3	23.7	56.8	1.2	1.0
	UC-08	80,402	9,991	30,832	34,011	4,318	1,250	12.4	38.3	42.3	5.4	1.6

UC-09	42,224	4,550	9,411	17,311	10,059	893	10.8	22.3	41.0	23.8	2.1
UC-10	19,064	211	4,404	5,598	7,489	1,363	1.1	23.1	29.4	39.3	7.1
UC-11	28,316	2,043	8,913	16,510	137	712	7.2	31.5	58.3	0.5	2.5
UC-12	20,439	82	3,335	15,496	1,284	242	0.4	16.3	75.8	6.3	1.2
UC-13	27,617	2	5,116	11,578	10,218	702	0.0	18.5	41.9	37.0	2.5
UC-14	31,167	0	15,827	10,678	1,489	3,174	0.0	50.8	34.3	4.8	10.2
UC-15	46,224	17,091	3,323	14,005	359	11,446	37.0	7.2	30.3	0.8	24.8
UC-16	33,122	4,239	11,454	10,947	0	6,482	12.8	34.6	33.1	0.0	19.6
UC-17	38,623	0	14,989	16,858	0	6,776	0.0	38.8	43.6	0.0	17.5
subtotal	651,170	**62,880**	**171,120**	**299,538**	**70,760**	**46,873**	**9.7**	**26.3**	**46.0**	**10.9**	**7.2**
Totals	**2,024,424**	**76,897**	**512,243**	**1,036,174**	**229,729**	**169,382**	**3.8**	**25.3**	**51.2**	**11.3**	**8.4**

Source: GDRS data manipulated by the Study GIS

B. Forest Resources and Forest Management

CONTENTS

B.1 FOREST AND FORESTRY IN THE REPUBLIC OF TURKEY

B.1.1 Outline of Forest and Forestry

B.1.1.1 Outline of Forest

Forests cover roughly 27% of Turkey's land area and have significant economic, environmental and cultural functions. About 15% of Turkey's population lives in forest villages or neighboring villages where forest resources make an essential contribution to villagers and their domestic livestock.

Table B.1.1-1 Land Classification

Area		ha	%
Total area		77,945,000	100.0%
Inland waters	(Lakes,Rivers)	1,215,400	1.6%
Land		76,729,800	98.4%
	Forest and other wooded land	20,763,247	26.6%
	Other land	55,966,553	71.8%

source ; Ministry of Forestry, 1991

Turkish forests also embraces great diversity of flora of economic importance, including various medical, aromatic, industrial and ornamental plants; and provide the major habitats for most species of fauna.

Turkish forests also play a key role in watershed conservation, soil erosion control and flood control, that are issues of major importance in Turkey.

B.1.1.2 State Forestry Organization

The State forestry organization is represented by the Ministry of Forestry (MOF), which is responsible for the protection, management and utilization of the all state forests, accounting for over 99 % of the forest lands in Turkey.

The MOF is composed of a Headquarter Organization and four general directorates at the central level. The Field level consists of regional forest directorates, regional directorates of the ministry and general directorates and their sub-units, forestry research directorates, Forest Seeds and Trees Improvement Institute and Forest Soil Laboratories.

The main unit of the headquarters is the Research Planning and Coordination Board, responsible for planning, supervising and coordinating all activities of the ministry. The four general directorates of the central level are: General Directorate of Forestry (OGM), General Directorate of Afforestation and Erosion Control (AGM), General Directorate of National Parks, Game and Wildlife (MPG), and General Directorate of Forest Village Relations (ORKOY).

These General Directorates are responsible for planning, coordinating, supervising and developing the forestry programs and implementations in their respective fields.

Forest management plans prepared and implemented by OGM aim principally at conservation of the existing forest resources and at development of forest tree vegetation (i.e. improving wood growing stock, age and diameter class distribution, and wood quality) and adequate wood production. Forest inventories, with its intension concentrated exclusively on trees, provide insufficient attention to other resources and function of forests.

The AGM has the primary responsibility for afforestation of all classes of land, particularly eroded or degraded forest areas, and also is responsible for the prevention of soil erosion. During the period of 1995 to 1999, approximately 1,689,000 ha of afforestation was accomplished, virtually all of this since 1963, but the annual rate of afforestation slowed down due to funding limitations.

However, after the "National Afforestation and Erosion Control Mobilization Law" was passed in 1995, the MOF at that time has stated an aim to increase the rate of afforestation to 300,000 ha yearly.

Table B.1.1-2 Forest activities

years	Activities (ha)						Number of seedling production (100,000
	Afforestation	Erosion control	Range improve	Artificial regreneration	Natural regeneration	Establishment of coppice forest	
1995	24,257	6,114	3,455	22,870	23,661	12,808	192
1996	37,927	26,329	3,834	23,079	20,586	11,588	270
1997	32,031	26,124	3,120	34,200	19,391	5,573	242
1998	25,959	29,430	2,885	13,502	13,915	10,274	195
1999	11,529	22,571	4,096	21,263	13,103	11,048	112

source ; Ministry of Forest, General Directrate of Forestry

"The National Parks Law No: 2873" provides for a country wide diffusion of services for the national parks, nature parks, natural monuments and wildlife reserve areas beyond the overall forestry system. Although sites can be found all over the country, the majority of these are found in the western and northern regions of the Turkey. All these activities have been and are being undertaken by MPG.

Table B.1.1-3 Forest protection status

Items		Total area (ha)	Forest and other wooded land (ha)	Volume (m3)
Managed mainly for science, wilderness, eco-system, history, culture, recreation	National parks	630,247	298,925	26,159,323
	Nature reserve	77,618	22,498	3,419,562
	Nature parks	31,188	15,326	1,182,185
	Natural monument	333	11	–
	sub-total	739,386	336,760	30,761,070
Managed mainly for soil and water protection	Conservation forests	403,344	210,192	8,245,401
	Forests characterised as conservation forests	3,185,684	3,185,684	122,259,214
	sub-total	3,589,028	3,395,876	130,504,615
TOTAL		4,328,414	3,732,636	161,265,685

source ; Ministry of Forestry, 1999

An estimated population of 7.2 million people lives in and around forest areas. As far as it is recognized by Government, these people do not benefit from adequate development services and their efforts to sustain their livelihoods is often at the cost of serious resource degradation. As a consequence of harsh conditions in forest areas, and partly as a result of the weakness of efforts to provide development services, out- migration from forest areas is severe and in some means propels the poverty of the remaining population. The primary response of the government to these problems has been the subsidy of forest products and the field activities of ORKOY. The ORKOY was established nearly 25 years ago with the aim of minimizing frictions between foresters and forest villagers, and specifically for reducing pressures on forests by assisting villagers developing their communities. ORKOY now gives credits at concessional financial assistance for about 30 different type of income generating activities, such as apiculture, milking and feeding of cows and sheep, handicraft, poultry, freshwater fishery, etc., and other activities such as roofing and heating-cooking to individuals and cooperatives, provides supervision to their activities and conducts feasibility and marketing studies for new activities.

B.1.2 Forest Management Program and Achievements

B.1.2.1 Forest Law

The constitution, along with a number of related laws, addresses the sustainability of forests and the interaction between forests and the public. The Constitution states that the “protection of forests and the development of forest villages is a responsibility of the Turkish Republic.”

The Ministry of Forestry was established on July 8, 1991, by Decree No.4112, Law No.3800 for the establishment of the Ministry of Forestry.

B.1.2.2 Planning Activities in the Forestry Sector

Different plans and projects that were prepared and implemented for different purposes in the forestry sector are briefly explained in the following.

Forestry sector master plans (FSMP)

Master Plans were prepared two times for the forestry sector. The first plan prepared in 1972 covered the period of 1973 – 1995. The second plan that was prepared in 1982 with further development and revised data and figures covered 1990 – 2009 period. These plans provided detailed information about forest policies, long term targets, supply demand estimates for wood and non-wood products, present and future targets for various forestry activities, revenue, investment and other expenditure estimates.

Integrated forest region plans

Integrated regional forestry plans were prepared and implemented for 24 forest region

directorates (forest conservancy area) during 1975-1992 periods. These plans provided implementation targets, input and budget requirement estimates, production targets and revenue estimates, for all kinds of forestry activities and programs (production, protection, reforestation, afforestation, management and silviculture, national parks, protected areas, and recreation activities) with the exception of forest village relations at the regional basis with plan periods corresponding to the five year development plan periods. Their implementations continued during 1978-1992. After this date, due to different reasons and constraints, preparation of new plans was stopped and instead of them, preparation and implementation of annual projects (implementation projects) for the main forestry programs (i.e. Forest Protection and Management Project, Reforestation Project, Erosion Control Project, National Parks Project, Forest Recreation Areas Project, Forest Village Relations Project, Forest Research Project, Foreign Financed Projects) were started.

Integrated watershed development plans for reforestation, erosion control and range improvement activities

These plans were prepared for 457 main watershed areas during 1971-1984 and provided information about the ecological and socio-economic conditions, potential areas and implementation targets for reforestation, afforestation, erosion control and range improvement activities to be carried out by the State forestry sector. They also provided evaluation of different activities as regards to different criteria (B/C ratio, NPV, IRR, impacts on employment creation and foreign exchange saving). These plans also provided information about the breakdown of the potential reforestation sites according to social conflict categories.

Regional plans for the nursery production, reforestation, erosion control and range improvement activities

These plans were prepared during 1978-1981 and provided information about implementation targets, input and budget requirements and revenue estimates for different seed and nursery production, reforestation, afforestation, erosion control and range improvement activities to be carried out by the General Directorate of Afforestation and Erosion Control during the plan period corresponding to the five year development plan.

District level forest village development plans

These plans were prepared during 1974-1984 for 532 districts (administrative) in forest regions. They provided detailed information about socio-economic conditions and problems, potential forest village development activities for improving village income and living conditions that should improve the relations between forest organizations and village communities and consequently should help elimination of the conflicts preventing efficient conservation, development and management of forest resources.

National park and protected area plans

According to the National Parks Law No. 2837, preparation of a master (management) plan

for each national park or other protected area is compulsory, and without such plan, no action for any construction or installation on site neither by the state nor by the local people should permitted. Plans should provide detailed information about ecological conditions, natural and cultural values of the area, principles and development guidelines as well as targets for conservation and utilization activities in different zones of the site. Reconstruction and development plans are also to be prepared for providing detailed guidelines and provisions for all kinds of building and installation establishments by the state or local communities.

Forest management plans

Forest management plans have been conventionally considered as the most basic planning documents for Turkish Forestry. They are prepared mostly for the forest chief area which is the lowest level of field unit of GDF. Forest management plans are prepared by the forest management planning teams (FMPT) of GDF that work under the Forest Management and Planning Department. Depending on the forest type (high forest or coppice forest) plan periods cover 10-20 years. Preparation of the first plans for the forests of the whole country was started in 1963 and completed in 1972. Preparation of the second stage, which was the renewing of plans was started in 1974 and have been completed up to approximately for 18,300,000 ha of forest area at the end of 1996. During recent years, preparation of some management plans have been contracted to private sectors (i.e. around 292,000 ha in 1997) and this implementation is expected to continue increasingly during the coming period. Under the present system, surveys, measurements and data collection are carried out by FMPTs, during a 6-7 month (in summer and spring) field work. Office work, calculations and writing of plans are done in Ankara during the remaining period of the term. Topographic map of 1/25,000, aerial photographs and forest stand maps, prepared by Forest Mapping and Photogrammetry Directorate are utilized for field and office works. Some special computer software have been developed and introduced in planning activities during recent years. Efforts are continuing for further development of adequate computerized data information and management planning system.

Forest management plans provide detailed inventories for forest tree vegetation, growing stock and increment conditions, division of the plan area forests between management classes, in regeneration and maintenance blocks, allowable cut and production yield quantities by compartments in different years, designation of the areas for reforestation and conservation purposes. They are plans if anything emphasizing on regeneration, forest structure (age and diameter class distribution) development, wood production and utilization aspects. As increasingly recognized during recent years, attention on demands and potentials for protective and environmental, biodiversity and socio-economic aspects are inadequate and require urgent development. With this understanding, some new initiatives have been started recently by GDF for the development of forest management system in Turkey.

The preliminary results of the partially completed renewed management plans during 1975-1995 have been recently evaluated. Forest inventory results obtained from these

evaluations provided and compared with the previous plans (prepared during 1963-1972) results in Table B.1.2-1 to B.1.2-4.

Table B.1.2-1 Distribution of forest lands by management classes

Management classes	Forest land (ha)		Proportion (%) to			
			Forest area		Country area	
	1963-1972 Inventory	1973-1995 Inventory	63-72 invent.	73-95 invent.	63-72 invent.	73-95 invent.
Productive high forest	6,176,899	7,729,635	30.60	37.60	7.9	9.9
Degraded high forest	4,757,708	5,580,894	23.50	27.15	6.1	7.1
Productive coppice	2,679,558	2,563,950	13.30	12.47	3.4	3.0
Degraded coppice	6,585,131	4,684,691	32.60	22.79	8.5	6.0
Total	20,199,296	20,559,170	100.00	100.00	25.9	26.0

Source: MOF and Forest Management Planning Department of GDF

Table B.1.2-2 Distribution of growing stock by management classes

Management class	Standing stock (m^3-stere)		Proportion to total growing stock (%)	
	63-72 Inventory	73-95 Inventory	63-72 Inv.	73-95 Inv.
Productive high forest (m^3)	758,732,197	960,002,573	93.3	94.8
Degraded high forest(m^3)	54,349,847	60,614,361	6.7	5.2
Productive coppice (stere)	117,734,424	112,797,746	72.1	84.9
Degraded coppice (stere)	45,505,717	38,264,255	27.9	15.1
Total m^3	813,082,044	1,020,616,934	100.0	100.0
Total stere	163,240,717	151,062,001	100.0	100.0

Source: MOF and Forest Management Planning Department of GDF

Table B.1.2-3 Distribution of increment by management classes

Management class	Total annual increment (m^3/stere)		Proportion to total increment (%)	
	63-72 Inventory	73-95 Inventory	63-72 Inv.	73-95 Inv.
Productive high forest (m^3)	20,791,672	24,633,151	93.9	94.8
Degraded high forest(m^3)	1,343,744	1,342,723	6.1	5.2
Productive coppice (stere)	6,417,596	6,470,326	81.2	84.9
Degraded coppice (stere)	1,486,123	1,148,553	18.8	15.1
Total m^3	22,135,416	25,975,874	100.0	100.0
Total stere	7,903,719	7,618,879	100.0	100.0

Source: MOF and Forest Management Planning and Department of GDF

Table B.1.2-4 Current annual allowable cut (m3)

Yield class	Conifers		Non-conifers		Total	
	63-72 Inv.	73-95 Inv.	63-72 Inv.	73-95 Inv.	63-72 Inv.	73-95 Inv.
Selective	749,817	398,869	143,966	38,928	893,783	437,797
Regeneration	5,121,879	6,377,327	1,958,874	2,076,388	7,080,753	8,453,715
Tending	5,727,861	2,571,388	2,220,187	852,372	7,948,048	3,423,760
Cleaning	515,821	100,383	381,473	35,562	897,294	135,945
	12,115,378	9,447,967	4,704,500	3,003,250	16,819,878	12,451,217
Total for coppice forests					7,946,743	8,888,547

Source: MOF and Forest Management Planning and Department of GDF

These comparisons show an increase of 358,985 ha in the forest area and some increase in the

growing stock and increment in high forests. These differences may be the result of :
Afforestation sites established on forest openings (on the lands considered non-forest area);
invasion of some abandoned farmlands by natural regeneration (as a result of rapid out-migration from forest villages);
some mistakes made in previous inventories which were prepared in shorter times using less developed techniques; and
different methods implemented during the two inventories (i.e. in the 1963 – 1972 inventory, only the trees determined by tele-relascop were measured on the sample plot areas, whereas in the new inventories all trees on the sample plots were measured).

However, considering the general opinion about the fact that the deforestation and degradation is a continuing process on large areas of the Turkish forests, careful analysis, interpretation and discussion of the results are urgently needed.

Forestry sector special expertise commission reports for five year development plans

Special expertise commission (SEC) reports are prepared to assist in the preparation of the five year development plans started by the State Planning Organization every five years.

The policies concerning Forestry in the 8th Five Year Development Plan, 2001-2005 is summarized as follows.

① Within the ecosystem approach and in line with the principle of sustainability, multi-purpose utilization, participation, specialization, biological diversity, protection of water and wild life and development of social stability, forests shall be exploited, protected and improved by taking into consideration the realities of forest site conditions, interdependent among sectors. Production and carrying capacity, forest health, landscape, ecotourism, productivity, pollution, fire, insects, landslide, snow, avalanche, flood, frost and drought and ergonomic factors.

② In order to ensure safety of areas, effectiveness in protection, observance of public interest and efficiency of investments within the forest regime, cadastral demarcation works shall be intensified by taking into consideration protection of the integrity of forest areas, giving priority to the regeneration and afforestation areas.

③ Nature Protection Areas, National Parks and similar Protected Areas shall be improved and expanded with a view to protecting biological diversity, water and wild life, cultural and aesthetic values, enabling studies on undiscovered benefits of the forests, preventing soil erosion, landslide and avalanche, and improving eco-tourism. Within these activities, it will be the main principle that ecosystems shall have adequate size for protecting the values of ecosystem.

④ Forest, pasture and water management plans shall be rearranged in line with sustainable forest management principles by taking into account social requirements, various factors of the ecosystem, site inventory including wood and non-wood products and services, management purposes, protected areas, endangered wild life

and flora. Regeneration activities shall be carried out regularly in accordance with silviculture plans by taking into consideration natural tree species.

⑤ Protection of soil, fauna and flora and the quality of water shall be a main principle in all the activities such as buildings, facilities, roads, mining, installation of electricity mains and similar construction works and wood production to be carried out by various organizations. Moreover, necessary rearrangements shall be carried out, by improving standards.

⑥ In order to protect the environment in forest regions and to prevent unfeasible investments and sink-cost, importance shall be attached to road constructions at technical standards, whereby the improvement of current roads shall have priority. Within the 8^{th} Plan period new roads of 5 thousand km-length will be constructed.

⑦ It is expected that within the Plan period afforestation works covering an area of 300 thousand hectares, as well as 175 thousand hectares of soil protection and 30 thousands hectares of pasture improvement works will be carried out in a manner not to create biologically deserted environment and in order to prevent such natural disasters as deforestation, desertification, soil erosion, flood, landslide and avalanche, to contribute to improvement of the global carbon balance, to meet wood requirement and to improve the socio-economic condition of the villagers. Regarding these works, special importance shall be given to fast growing tree species and forest maintenance works shall not be neglected nor delayed.

⑧ Social and agricultural forestry activities, consisting of raising oaks, acacia, and pines and other species providing multi faced benefits and the production of medical, aromatic and decoration plants shall be improved with the aim of improving the prosperity of the forest villagers. The intentions of legal and real persons to establish private forests shall be encouraged.

⑨ In regard of prevention of and combating against forest fires, alongside with taking silvicultural measures, establishing fire safety roads and fire breaks and implementing such measures as controlled burning, activities on the employment of fire teams equipped with modern tools, increase of using helicopters and aeroplanes and especially water sprinkler trucks, improvement of early warning and transport systems, and education and enlightenment of the public shall be made more efficient. Regarding the control of harmful insects and diseases, biological methods shall be emphasized..

⑩ In order to ensure forestry activities to be carried out in sound and safe environment and conditions, necessary ergonomic arrangements, related with the man-work-environment system from preventive clothes to mechanization and working environment, shall be realized . Furthermore, standards shall be improved , pursued and on the job inspection is to be carried out.

⑪ Forestry research units and studies shall be organized, within the framework of global integration, including land utilization, biological diversity, pollution, green house effects, acid rains, endangered aquatic species and wild life, and production and carrying capacity of the area, producing the value added and other economic data. In this connection, cooperation among the researchers, implementing units,

non-governmental organization and forest villagers shall be sought.

⑫ Regarding all forestry activities, especially the preparation of management plans, the controlling of forest fires, insect and diseases and the enforcement of cadastral work, importance shall be given on the utilization of remote control methods from the aspect of health and efficiency.

⑬ The Forest Law No 6831 shall be rearranged considering environmental protection , public interest, integrity of the ecosystem and protection of wild life.

B.1.3 Forest Classification

According to Turkish Forest Management Plan, forest areas are classified into two groups in terms of appearance: High Forest and Coppice Forest. High Forest areas accounts for 67% of the forests in the whole area. In the High Forests, coniferous forests are dominant with the share of 71 %, followed by deciduous forest S with 19% and mixed forest S with 10%.

Table B.1.3-1 Forestry Area and Forest Classification

unit; ha

Quality	Coniferous Forest	Deciduous Forest	Mixed Forest	High Forest	Coppice Forest	Forestry Land
Normal Forest	5,955,120	1,414,876	632,859	8,002,855	2,545,132	10,547,987
Degraded Forest	3,937,335	1,178,461	720,525	5,836,321	4,318,814	10,155,135
Total	9,892,455	2,593,337	1,353,384	13,839,176	6,863,946	20,703,122

source ; Ministry of Forestry, 1997

Table B.1.3-2 Standing Stock of every Forest Classification

Quality	Coniferous Forest		Deciduous Forest		High Forest		Coppice Forest	
	Total (㎥)	㎥/ha	Total (㎥)	㎥/ha	Total (㎥)	㎥/ha	Total (㎥)	㎥/ha
Normal Forest	720,990,975	121.1	272,663,862	192.7	993,654,837	124.2		
Degraded Forest	45,150,167	11.5	16,470,485	14.0	61,620,652	10.6		
Total	766,141,142	77.4	289,134,347	111.5	1,055,275,489	76.3	148,320,399	21.6

source; Ministry of Forest, 1997

Table B.1.3-3 Annual Growing Stock of every Forest Classification

Quality	Coniferous Forest		Deciduous Forest		High Forest		Coppice Forest	
	Total (㎥)	㎥/ha	Total (㎥)	㎥/ha	Total (㎥)	㎥/ha	Total (㎥)	㎥/ha
Normal Forest	18,998,826	3.2	6,534,653	4.6	25,533,479	3.2		
Degraded Forest	954,895	0.2	370,897	0.3	1,325,792	0.2		
Total	19,953,721	2.0	6,905,550	2.7	26,859,271	1.9	7,439,696	1.1

source; Ministry of Forest, 1997

The main forest tree species seen in the high forests are scotch pine (*Pinus sylvestris*), spruce (*Picea orientalis*), fir (*Abies sp.*), and beech (*Fagus orientalis*) for coniferous, and alder (*Alnus sp.*) and oak (*Quercus sp.*) for broad-leaved, respectively. On the other hand, the coppice forests, which represents one third of the forest area, are predominated by oak.

Table B.1.3-4 Main Forest tree species

Classification	Major trees	High forest(ha)	Coppice(ha)	Total (ha)
Coniferous	Pinus sp.	5,540,992	1,776	5,542,768
	Abies sp.	463,526	150	463,676
	Cedrus sp.	223,918	0	223,918
	Picea orientalis	185,331	0	185,331
	Juniperus sp.	80,146	1,493	81,639
	Pinus maritima	55,435	0	55,435
	Pinus radiata	2,429	0	2,429
	Pseudotsuga menziesii	345	0	345
	Other conifers	8,074	1	8,075
	sub-total	6,560,196	3,420	6,563,616
Deciduous	Fagus sp.	1,060,976	1,405	1,062,381
	Qurcus sp.	350,329	1,524,011	1,874,340
	Castanea sp.	56,944	15,456	72,400
	Alnus sp.	57,684	83	57,767
	Carpinus sp.	58,844	4,438	63,282
	Fraxinus sp.	8,098	2,123	10,221
	Eucalyptus sp.	83,897	235,831	319,728
	Other non-conifers	785	3,048	3,833
	sub-total	1,677,557	1,786,395	3,463,952
TOTAL		8,237,753	1,789,815	10,027,568

source : Ministry of Forestry, 1999

The High Forests and Coppice Forests are further classified into “Normal Forests (productive)” and “Degraded Forests (unproductive forest)” respectively by crown density (canopy density). The forests with 0-10% of crown density are regarded “Degraded” and that of 11-100% is defined as “Normal”. Based on this definition, some 51% of the forest areas are classified as degraded and unproductive.

B.2 PRESENT SITUATION OF THE STUDY AREA

B.2.1 Natural conditions

B.2.1.1 Topography and Geology

The Study area is located between the Northern Anatolian Mountains and the Allahuekber Mountains. The Northern Anatolian Mountains, extends roughly in and East-West direction along Black Sea, with the Allahuekber Mountains running parallel in the inland part of the Northern Anatolian mountains. There is great altitudinal difference in the Study area. The Study area can be largely divided into 2 (two) parts; the plateau area with the altitude approximately 500~1000m, and the mountainous area exceeding 2000m. The lowest altitude point is about 550m, and the highest is the Kaskar Mountain, which is 3397m. More than 30% of the Study area has steep slopes of over 30% slant. And more than 50% of the area is even steeper with the slant exceeding 30%, mainly distributing in the Lower and Middle part of Coruh river.

Coruh river has its rise in the west of Bayburt, and streams almost East – North direction and flows into the Black Sea via Georgia. The total extension of Coruh river within Turkey is 442km out of the total extension of 466km. Geological conditions in the Study area are widely covered with volcanic rocks, and sedimentary and metamorphic rocks are also seen. Most widely distributed is Andesite, followed by Upper Cretaceous Volcanic facies and Eocene Volcanic facies.

The following impediment factors exist upon topographical and geological conditions in relation to plant growth.

1. Rain water do not infiltrate in the steep slope easily.
2. Organic matters such as fallen leaves do not hold on easily in the steep slope.
3. Seeds are hard to hold on in the steep slope, and the invasion and settling of the vegetation are difficult.
4. In a steep slope, a surface soil will not settled and transfer easily in a few trigger.
5. A root does not expand in the place where a soil layer is insufficient by bedrock of the unweathering has been exposed.

   Plants easily receive arid damage in such a place.

1-4 is a problem of the stability of the soil on slope soil, and 5 can be said to be various characters of the soil and problem of the quantity of the soil.

Relation with vegetation and slope inclination can be roughly described as follows.

0%～30%

Soil erosion is comparatively little at an incline of this range, because if it is possible to cover a slope completely with the tree grasses. Moreover, the vegetation is often naturally restored if given sufficient moisture. The restorations of plant community by trees are possible under usual natural condition.

30%～60%

The plant community can be restored under natural conditions. However, the possibility of soil erosion is present, and the use soil erosion prevention countermeasures are necessary.

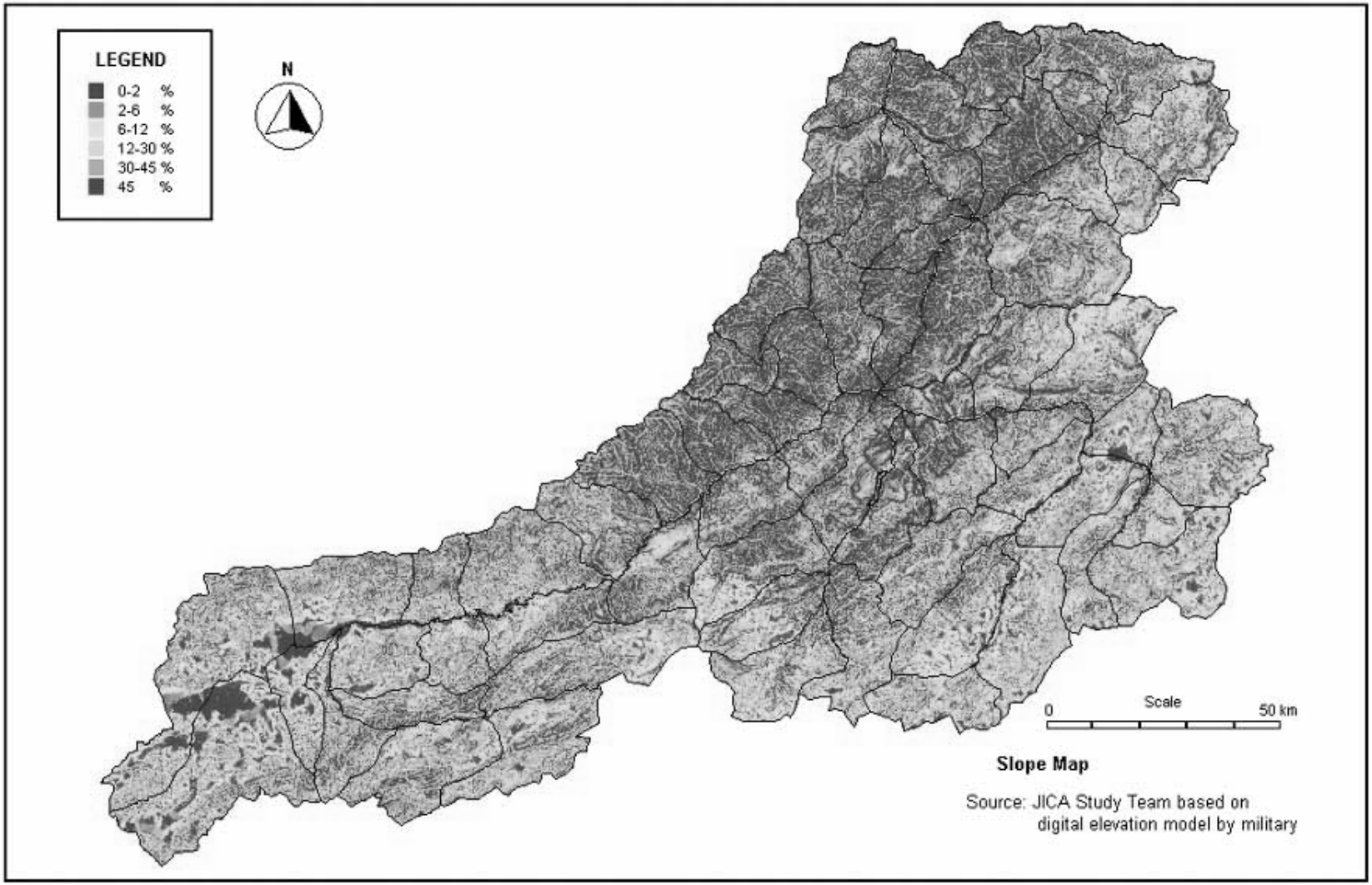
60%~100%

The plant community by shrub can be restored with foundation of seedling and planting works are used together.

100% or more

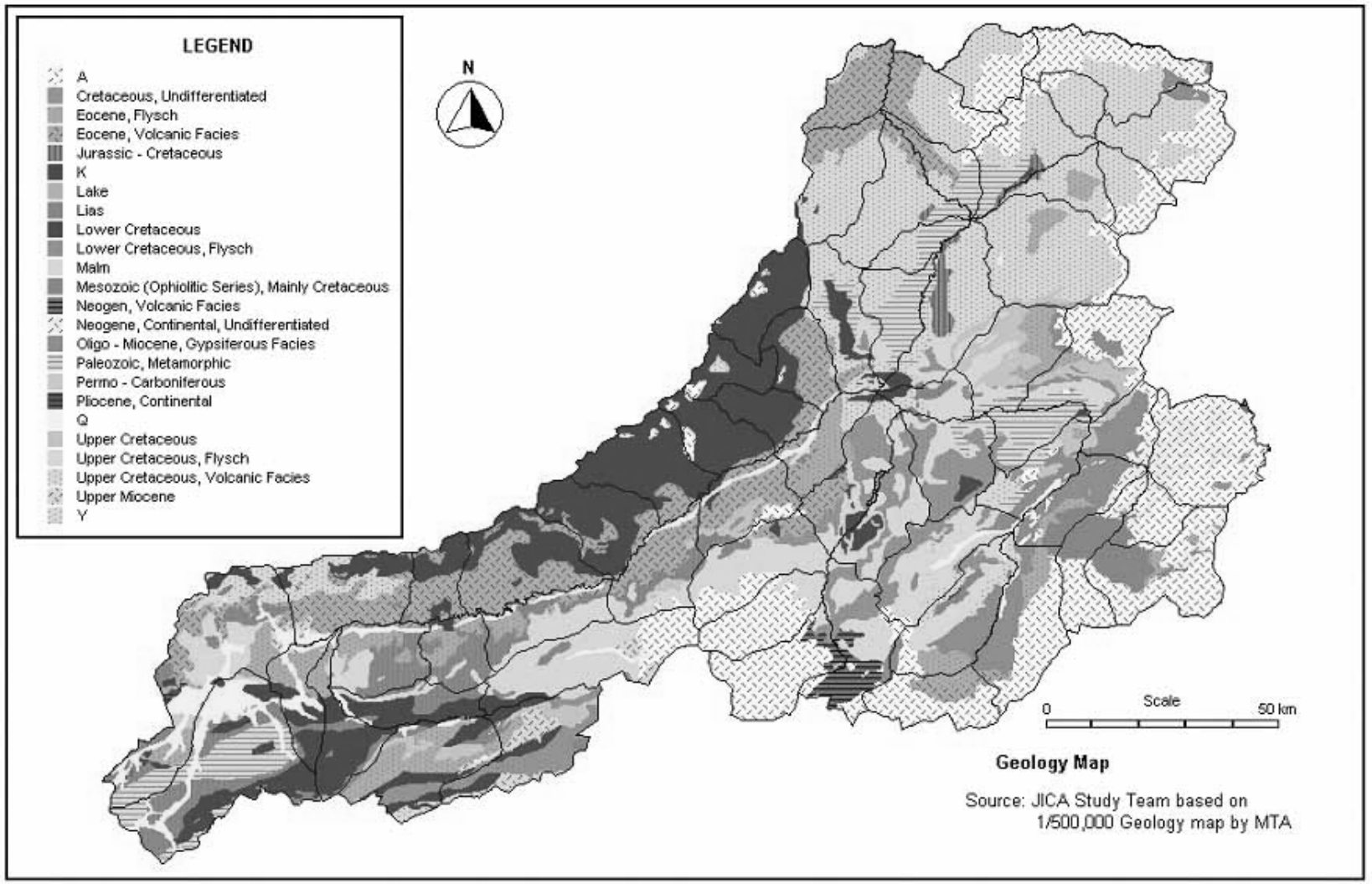
The low-growing plant community by grass or/and shrub can be restored. But foundation of seedling and planting works with solid structure is necessary for prevention of possible soil erosion in the future

Judging from topographical and geological conditions in the Study area stated above, it may be said that the creation of plant community by only tree planting is difficult in most places of the Study area. The usage of trees in combination with foundation of seedling and planting works or/and grasses might be necessary.



Slope Map

Source: JICA Study Team based on
digital elevation model by military


LEGEND
A
Cretaceous, Undifferentiated
Eocene, Flysch
Eocene, Volcanic Facies
Jurassic - Cretaceous
K
Lake
Lias
Lower Cretaceous
Lower Cretaceous, Flysch
Malm
Mesozoic (Ophiolitic Series), Mainly Cretaceous
Neogen, Volcanic Facies
Neogene, Continental, Undifferentiated
Oligo - Miocene, Gypsiferous Facies
Paleozoic, Metamorphic
Permo - Carboniferous
Pliocene, Continental
Q
Upper Cretaceous
Upper Cretaceous, Flysch
Upper Cretaceous, Volcanic Facies
Upper Miocene
Y
N
0
Scale
50 km
Geology Map
Source: JICA Study Team based on
1/500,000 Geology map by MTA

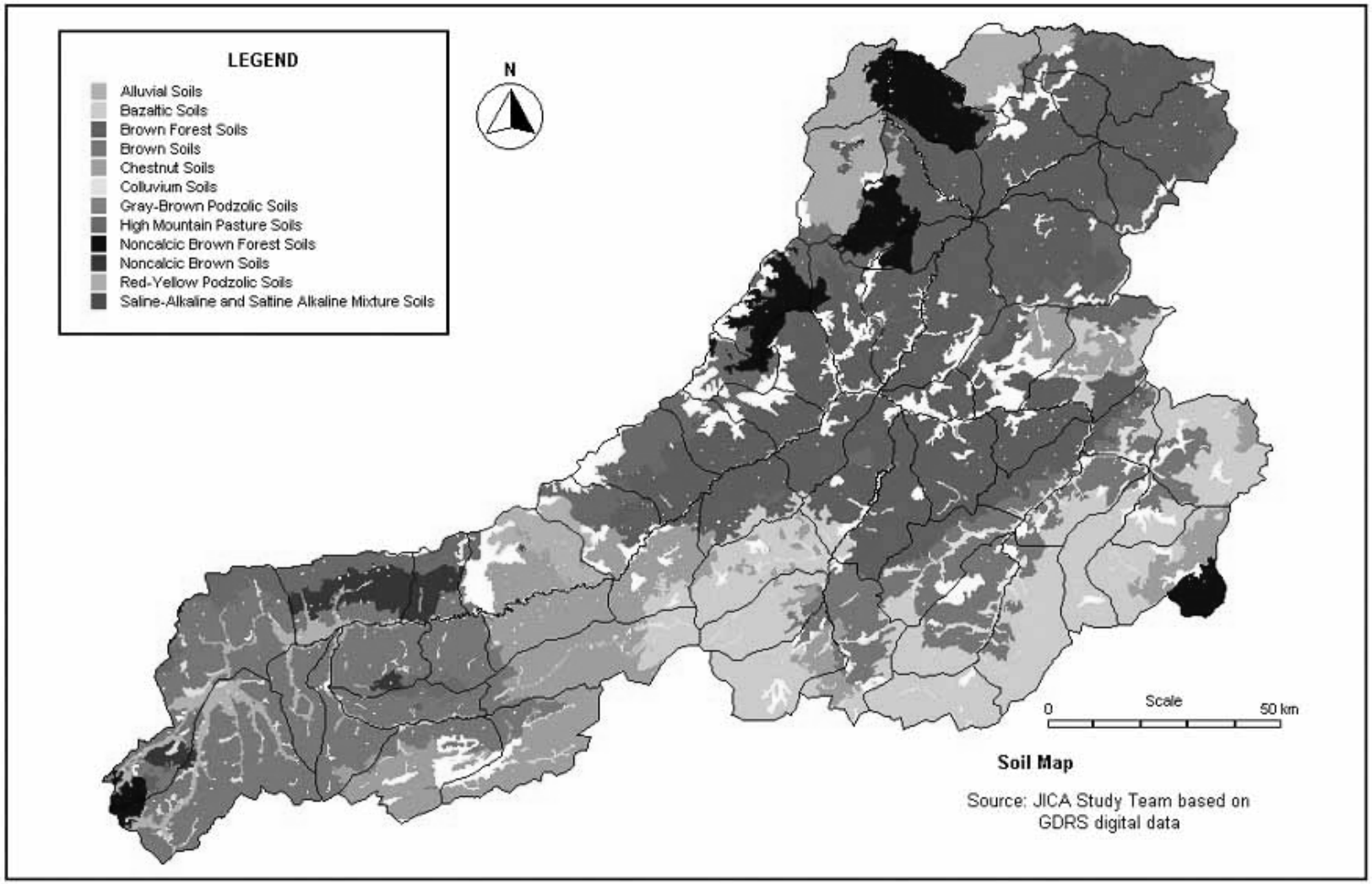
B.2.1.2 Soil

Brown forest soil is widely distributed in Lower and Middle Coruh river basin, while Brown soil is mainly distributed in Upper Coruh river basin and Oltu river basin. Bazaltic soil is seen in the mountainous site.

The most common soil in the Study area are Bazaltic soil, Brown forest soil, Brown soil, Chestnut soil, and Mountain pasture soil and soil synthesized from them. These soils account for almost 77% of the whole river basin.

> The physical and chemical data of these soils were not able to acquire, but they receiving strong an influence of arid climate, production of the plants is a little.

Therefore, it is thought that organic matters on the soil surface are little and growing condition for plants on these soils is severe.


LEGEND
Alluvial Soils
Bazaltic Soils
Brown Forest Soils
Brown Soils
Chestnut Soils
Colluvium Soils
Gray-Brown Podzolic Soils
High Mountain Pasture Soils
Noncalcic Brown Forest Soils
Noncalcic Brown Soils
Red-Yellow Podzolic Soils
Saline-Alkaline and Saline Alkaline Mixture Soils
N
0
Scale
50 km
Soil Map
Source: JICA Study Team based on
GDRS digital data

B.2.1.3 Climate

The Lower Coruh river basin, belonging to Mediterranean climate, shows high temperature and dryness in summer, and warm in winter.

The others area in the Study area show the characteristics of the Steppe climate, such as large seasonal and daily temperature differences and small amounts of precipitation.

Table B.2.1-1 shows monthly average temperatures in the Study area. Monthly average temperature in Artvin in Lower Coruh river basin is 12.2 °C, and 15.0 °C in Yusufeli in Middle Coruh river basin. On the other hand monthly average temperatures in Bayburt in Upper Coruh river basin, Tortum river basin and Oltu river basin are 6.5°C, 8.3°C and 6.5° respectively.

The annual changes of the maximum temperatures in major cities of the Study Area shown in Table B.2.1-1, indicates the severe temperature variances in the basins of Tortum and Oltu river.

Table B.2.1-1 Monthly Average Temperatures in the Study Area

(unit: °C)

	Artvin	*Erzurum*	*Bayburt*	*Yusufeli*	*Tortum*	*Oltu*
January	2.7	-8.3	-7.1	3.8	-3.4	-1.7
February	3.8	-7.0	-5.4	5.2	-2.2	-1.6
March	7.1	-3.0	-3.0	10.0	1.6	-4.0
April	12.0	5.1	6.8	14.8	7.2	10.3
May	15.9	10.9	11.6	19.3	12.4	14.9
June	18.6	15.0	15.0	23.4	16.1	18.3
July	20.5	19.1	18.8	26.0	19.6	22.0
August	20.6	19.6	18.4	26.3	19.5	22.8
September	17.9	14.9	14.5	21.7	15.3	16.9
October	13.8	8.6	8.8	14.6	9.5	11.3
November	9.2	2.0	2.6	9.5	5.0	6.1
December	4.6	-5.1	-3.4	4.8	-0.6	0.4
Annual avera	12.2	6.0	6.5	15.0	8.3	10.2
	1929-1970	1929-1970	42 years		1954-1970	5years

Note: Elevations of each meteorological station are as follows:
Artvin: 628m, Erzurum: 1758m, Bayburt: 1584m, Yusufeli: 611m, Tortum: 1550m and Oltu: 1275
Source: Reports on Soil Fertility and Fertilizer Requirement in the Study Area Province,
: General Directorate of Rural Services
: Statistical Year Book of Turkey 2001(Erzurum)
: General Directorate of Forestry (Artvin, Eruzurum)

	Artvin	Erzurum	Bayburt	Yusufeli	Tortum	Oltu
Maximum temp. (°C)	25.9	34.0	26.7	42.5	35.4	36.6
Minimum temp. (°C)	-0.4	-30.1	-11.4	-	-20.8	-20.1

Figure B.2.1-1 shows the annual temperature changes in each city. The tendency of temperature variation in each city draws similar curves.

Figure B.2.1-1 Change of Monthly Average Temperatures in the Study Area

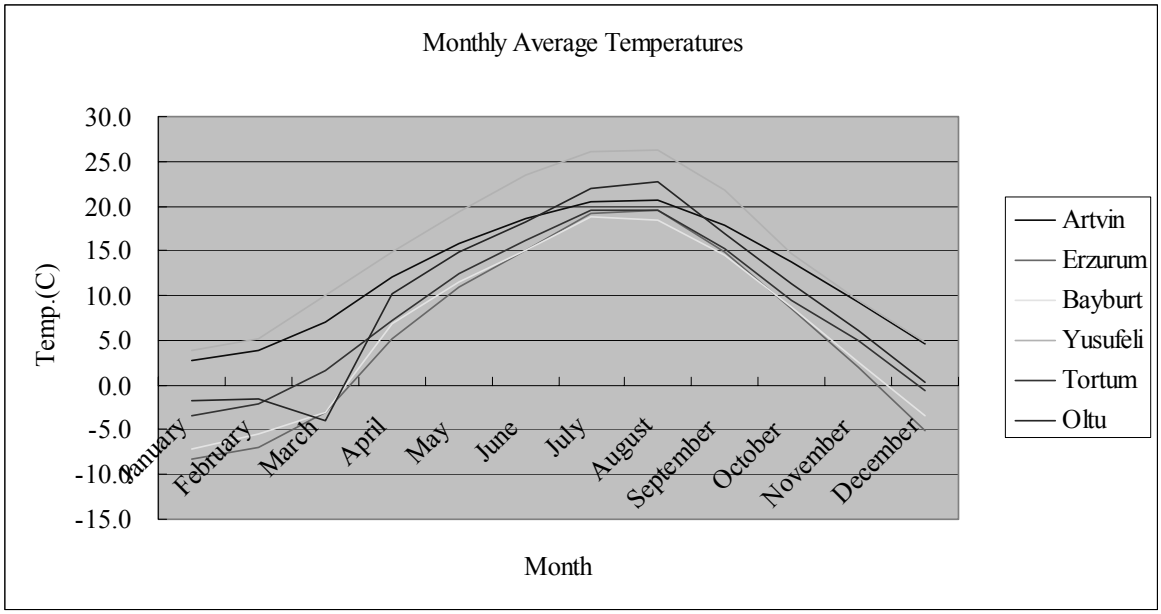


Table B.2.1-2 shows monthly average humidity in the Study area.
The average humidity in Artvin tends to rise in summer season in contrast with other cities showing high values in winter season.

Table B.2.1-2 Monthly Average Humidity in the Study Area

unit: %

	Artvin	Erzurum	Bayburt	Tortum	Oltu
January	64	76	74	67	65
February	64	75	74	64	63
March	62	74	71	66	54
April	61	65	64	59	57
May	65	60	61	58	51
June	68	56	59	55	52
July	72	50	53	52	51
August	71	46	51	50	53
September	70	49	52	51	60
October	66	60	62	56	66
November	65	71	71	62	69
December	65	75	74	68	58
Annual avera	66	63	64	59	58
	1929-1970	42 years	1929-1970	1954-1970	5years

Note: Elevations of each meteorological station are as follows:
Artvin: 628 m; Erzurum 1,758m ;Bayburt:1,584m, Tortum:1,550m and Oltu:1,275m
Source: Reports on Soil Fertility and Fertilizer Requirement in the Study Area Province,
General Directorate of Rural Services
: Statistical Year Book of Turkey 2001(Erzurum)

Table B.2.1-3 shows monthly average precipitation in the Study area and Figure B.2.1-2 shows annual tendency of precipitation. The annual precipitation in Artvin is about 660mm with abound precipitation in winter and less precipitation in summer. However, the annual

precipitation of other cities in the Study area are approximately 400mm and show tendencies of abound precipitation in summer. With regard to Yusufeli in the Middle Coruh river basin, the annual precipitation is extremely minimal, showing amounts of less than 300mm.

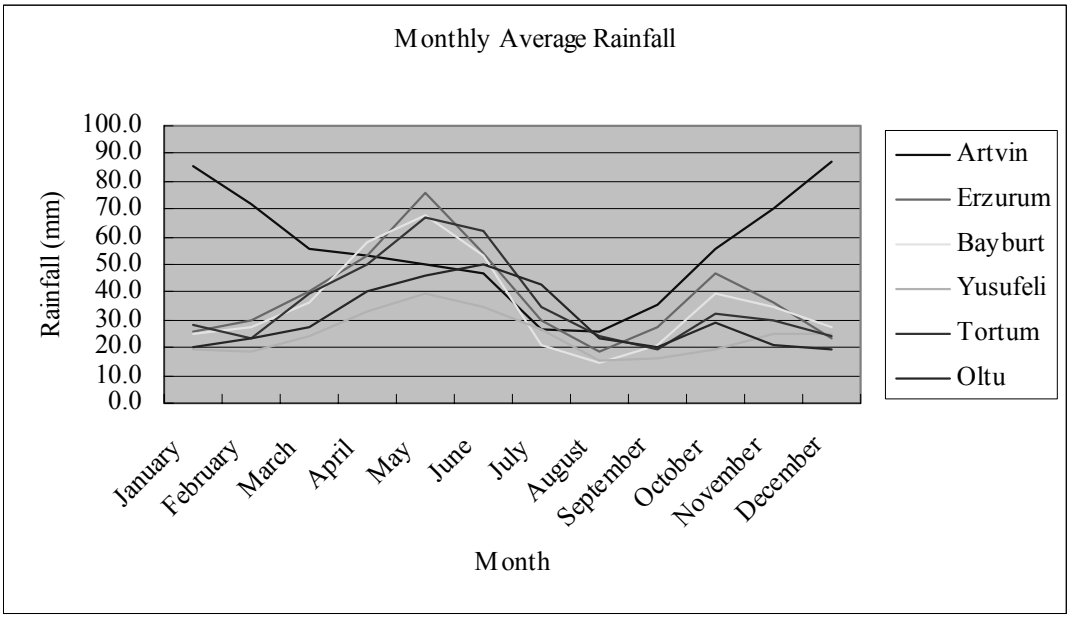
Table B.2.1-3 Monthly Average Precipitation in the Study Area

unit: mm

	Artvin	*Erzurum*	*Bayburt*	*Yusufeli*	*Tortum*	*Oltu*
January	85.1	25.7	24.8	19.4	28.4	20.4
February	71.4	30.2	27.1	18.5	23.6	23.0
March	55.6	40.0	36.6	24.1	39.6	27.2
April	53.1	53.5	57.8	33.0	50.1	40.7
May	50.3	75.8	67.6	39.3	66.6	45.6
June	46.8	53.7	53.4	34.7	62.1	49.6
July	27.0	29.7	21.2	26.3	34.6	42.8
August	25.8	18.6	14.6	15.6	24.5	23.7
September	35.1	27.1	20.9	16.4	19.2	20.2
October	55.6	46.7	39.7	19.0	32.0	28.8
November	70.0	35.9	35.0	25.0	29.8	20.8
December	87.1	23.6	27.5	24.6	24.4	19.5
Annual total	662.9	460.5	426.2	295.8	434.9	382.3
	1929-1970	1929-1970	42 years		1954-1970	5years

Note: Elevations of each meteorological station are as follows:
Artvin: 628m, Erzurum:1758m, Bayburt: 1584m, Yusufeli: 611m, Tortum: 1550m and Oltu: 1275ı
Source: Reports on Soil Fertility and Fertilizer Requirement in the Study Area Province,
: General Directorate of Rural Services
: Statistical Year Book of Turkey 2001(Erzurum)
: General Directorate of Forestry (Artvin,Eruzurum)

Figure B.2.1-2 Change of Monthly Average Precipitation



Bare slope lands spreading out in the Study Area are particularly vulnerable to climatic effects. It is known that both extremes of air and soil temperature in bare land exceeds that of forests. Therefore, in most areas in the Study Area has very severe growth conditions for vegetation.

Table B.2.1-4 Monthly Average Climate Data in the Study Area

	Jan.	Fab.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Period
Artvin Observation period: 1932-1990					Latitude: 41 11'N			Longitude: 41 49'E			Elevation: 628 m			
Average temp. (°C)	2.7	3.8	7.1	12.0	15.9	18.6	20.5	20.6	17.9	13.8	9.2	4.6	12.2	42 yrs
Maximum temp. (°C)	6.2	8.2	12.4	18.0	22.0	24.2	25.5	25.9	23.7	19.5	13.6	7.9	25.9	42 yrs
Minimum temp. (°C)	-0.4	0.3	2.8	7.2	11.1	14.0	16.5	16.6	13.8	9.8	5.8	1.7	-0.4	42 yrs
Humidity (%)	64	64	62	61	65	68	72	71	70	66	65	65	66	42 yrs
Rainfall (mm)	85.1	71.4	55.6	53.1	50.3	46.8	27.0	25.8	35.1	55.6	70.0	87.1	662.9	42 yrs
Evaporation (mm)	-	-	89.4	100.5	116.0	116.8	122.0	121.4	107.9	85.0	49.6	65.9	974.5	26 yrs
Sunshine hours (min)	137	187	250	352	366	407	360	413	383	273	179	120	286	6 yrs
Solar rad. (cal/cm2/min)	141.7	238.1	316.7	401.3	450.1	487.7	453.8	441.8	363.8	246.9	158.9	118.7	318	6 yrs
Days of frost	3.7	2.4	3.3	0.6	0.0	-	-	-	-	0.4	2.6	5.4	18.4	42 yrs
Erzurum Observation period:					Latitude:			Longitude:			Elevation:1869m			
Average temp. (°C)	-8.3	-7.0	-3.0	5.1	10.9	15.0	19.1	19.6	14.9	8.6	2.0	-5.1	6.0	42 yrs
Maximum temp. (°C)	8.0	10.6	17.8	23.5	29.6	32.2	34.0	34.0	31.4	26.0	20.7	12.3	34.0	42 yrs
Minimum temp. (°C)	-30.1	-27.5	-24.8	-18.5	-6.4	-3.2	1.8	1.2	-3.8	-12.0	-25.6	-28.0	-30.1	42 yrs
Rainfall (mm)	25.7	30.2	40.0	53.5	75.8	53.7	29.7	18.6	27.1	46.7	35.9	23.6	460.5	42 yrs
10mm<Rainfall day (days)	0.3	0.4	0.8	1.4	2.4	1.7	0.9	0.5	0.8	1.5	0.9	0.3	11.9	42 yrs
Daily Max.Rainfall (mm)	40.3	23.4	35.6	39.5	34.3	43.8	42.1	44.6	39.2	46.3	33.5	35.4	46.3	42 yrs
Hourly Max.Rainfall(mm)													21.5	
Evaporation (mm)	76	75	74	65	60	56	50	46	49	60	71	75	63	41yrs
Sunshine hours (min)	185	253	308	377	483	616	681	663	558	423	271	187	423	50 yrs
Days of snowfall	29.4	26.5	21.5	4.0	0.2				0.0	0.9	6.4	23.2	112.2	70 yrs
Days of frost	30.7	27.8	28.2	11.9	1.1	0.1			0.3	5.5	18.4	29.8	153.9	42yrs
10 (°C)> days				4.5	18.3	27.9	30.8	30.9	26.9	9.5			148.9	15yrs
Bayburt Observation period: 1929-1990					Latitude: 40 15'N			Longitude: 40 14'E			Elevation: 1584 m			
Average temp. (°C)	-7.1	-5.4	-3.0	6.8	11.6	15.0	18.8	18.4	14.5	8.8	2.6	-3.4	6.5	30 yrs
Maximum temp. (°C)	-1.9	0.1	5.0	12.6	17.8	21.9	26.4	26.7	23.0	16.1	8.5	1.3	26.7	30 yrs
Minimum temp. (°C)	-11.4	-9.8	-4.6	1.7	5.6	8.2	10.9	10.4	7.0	3.1	-1.8	-7.3	-11.4	30 yrs
Humidity (%)	74	74	71	64	61	59	53	51	52	62	71	74	64	30 yrs
Rainfall (mm)	24.8	27.1	36.6	57.8	67.6	53.4	21.2	14.6	20.9	39.7	35.0	27.5	426.2	62 yrs
Evaporation (mm)	-	-	-	-	98.1	139.8	179.1	170.8	128.6	61.0	26.8	-	804.2	14 yrs
Days of frost	3.5	3.1	4.4	2.8	0.8	0.2	0.0	0.0	0.9	6.0	9.6	4.8	36.0	57 yrs
Yusufeli Observation period:					Latitude:			Longitude:			Elevation: 611m			
Average temp. (°C)	3.8	5.2	10.0	14.8	19.3	23.4	26.0	26.3	21.7	14.6	9.5	4.8	15.0	
Maximum temp. (°C)	16.8	22.2	24.0	34.0	36.1	40.0	42.0	42.5	38.5	31.5	25.2	17.6	42.5	
Rainfall (mm)	19.4	18.5	24.1	33.0	39.3	34.7	26.3	15.6	16.4	19.0	25.0	24.6	295.8	
Days of frost	18.0	15.4	8.2	0.8						0.1	1.9	12.6	57.0	
Tortum Observation period: 1954-1970					Latitude: 40 18'N			Longitude: 40 34'E			Elevation: 1550 m			
Average temp. (°C)	-3.4	-2.2	1.6	7.2	12.4	16.1	19.6	19.5	15.3	9.5	5.0	-0.6	8.3	18yrs
Maximum temp. (°C)	10.0	11.4	16.0	25.1	28.1	32.0	35.4	35.0	30.5	26.4	20.0	12.2	35.4	18yrs
Minimum temp. (°C)	-18.5	-20.8	-19.0	-12.7	-3.0	-3.3	5.5	6.0	-0.6	-8.0	-15.3	-19.0	-20.8	18yrs
Humidity (%)	67	64	66	59	58	55	52	50	51	56	62	68	59	18yrs
Rainfall (mm)	28.4	23.6	39.5	50.1	66.6	62.1	34.6	24.5	19.2	32.0	29.8	24.4	434.9	18yrs
10mm<Rainfall day (days)	0.6	0.4	1.1	1.2	1.9	1.8	0.9	0.8	0.4	0.9	0.7	0.4	11.1	18yrs
Daily Max.Rainfall (mm)	30.8	30.3	26.8	59.7	43.0	36.0	50.0	30.3	16.9	37.0	32.2	27.0	59.7	18yrs
10 (°C)> days			0.4	8.3	24.8	29.3	31.0	31.0	29.1	15.7	2.4		172.1	18yrs
Days of frost	28.0	25.7	21.6	8.3	0.8	0.1			0.1	4.0	11.0	25.6	125.3	18yrs
Oltus Observation period:					Latitude: N			Longitude: E			Elevation: 1275m			
Average temp. (°C)	-1.7	-1.6	-4.0	10.3	14.9	18.3	22.0	22.8	16.9	11.3	6.1	0.4	10.2	5 yrs
Maximum temp. (°C)	11.5	16.8	19.0	30.0	30.7	36.5	36.6	36.3	32.6	26.8	19.6	12.0	36.6	5 yrs
Minimum temp. (°C)	-18.7	-20.1	-16.2	-4.0	-1.3	-0.4	8.0	8.7	1.5	-4.2	-15.2	-14.7	-20.1	5 yrs
Humidity (%)	65	63	54	57	51	52	51	53	60	66	69	58	58	20 yrs
Rainfall (mm)	20.4	23.0	27.2	40.7	45.6	49.6	42.8	23.7	20.2	28.8	20.8	19.5	382.3	yrs
10mm<Rainfall day (days)	0.3	0.4	0.6	0.9	2.0	1.3	1.4	0.8	0.6	1.0	0.6	0.4	10.2	5yrs
Daily Max.Rainfall (mm)	40.1	29.9	19.7	41.7	27.9	27.3	42.1	42.5	45.0	48.6	21.4	21.5	48.6	20yrs
Hourly Max.Rainfall(mm)													31.2	
10 (°C)> days			0.4	8.3	24.8	29.3	31.0	31.0	29.1	15.7	2.4		172.1	7yrs
Days of frost	28.0	25.7	21.6	8.3	3.0	0.1		0.0	0.1	4.0	11.0	25.6	125.3	10 yrs

Source: Reports on Soil Fertility and Fertilizer Requirement in the Study Area, General Directorate of Rural Services
: Statistical Yearbook of Turkey 20001 (Erzurum)
: General Directorate of Forestry (Artvin, Eruzurum)

B.2.1.4 Vegetation

The vegetation in the Study area is roughly divided by precipitation, geographical condition and so on into three (3) types (based on "Ecoregious of Turkey", Dr.Iberahim Atalay) . The Lower and Middle Coruh river basin (Ispir, Artvin, Savsat, Oltu, Narman, and etc.) belongs to Dry Forest-Shrub region, while the Kackar and Yalnizcan Mountain ranges are Mountain Grass region, and Bayburt, Tortum and etc. are Dry Forest-Anthropogene Steppe region.

The vegetation of Dry Forest-Shrub region has abundant vegetation communities and plant species owing to suitable humidity carried from Black Sea, sufficient solar radiation amount and topographical aspects etc. Plants having Mediterranean aspects, for instance, olive, mulberry, pomegranate and figs are distributed along in the Coruh river. In the mountainous site is seen coniferous species such as *Pinus sylvestris, Pinus brutia, Abies nordmanniana, Picea orientalis* and so on, furthermore, broad leaf tree (hardwood) species such as *Fagus sp., Quercus sp., Alnus.sp.* and so on are also seen. Afforested *Poplus nigra* is seen around settlements, arable areas and riversides. Several kinds of herbal vegetations are seen in the Mountain Grass region. For instance, Festuca violacea. Also, rocky site habitable herbal species are seen in the high altitude zone exceeding the altitude of 2000m.

The feature of Dry Forest-Anthropogene Steppe region is Oak forest which accompanies Juniper species to the upper part of the natural steppe zone. Widely afforested *Pinus sylvestris, Quecus sp., Robinia pseudoacacia* and *Poplus nigra,* etc. are also seen.

The Flora in Bayburt province is follows.

Turkish Name	English Name	Scientific Name
Sarican	Scotch pine	*Pinus sylvestris*
Goknar	Fir	*Abies nortmanniana*
Mese	Oak	*Quercus iberica*
Kavak	Poplar	*Populus tremula*
Findik	Hazel	*Corylus colurna*
Bogurtlen	Blackberry	*Rubus Fruticosa*
Kizilagac	Alder	*Alnus gluttinosa*
Ardic	Juniper	*Juniperus sp.*
Isirgan	Nettle	*Utrica dioica*
Yabani gul	Eglantine (rosehip)	*Rosa canina*
Cayirotlari	Timothy grass	*Germinea*
Kuzu kulagi	Sheep's sorrel	*Rumex acetosa*
Menekse	Violet	*Viola canina*
Gelincik	Corn-poppy	*Papaver argenona*
Sutlegen	Euphorbia	*Lactuca momolla*
Deve dikeni	Creeping thistle	*Cirsiun arvense*
At kuyrugu	Marestail	*Eknisenturn arnese*
Geven	Goat's thorn	*Astra galus*

The feature of the vegetation type in the Study area is shown as in the following figure.

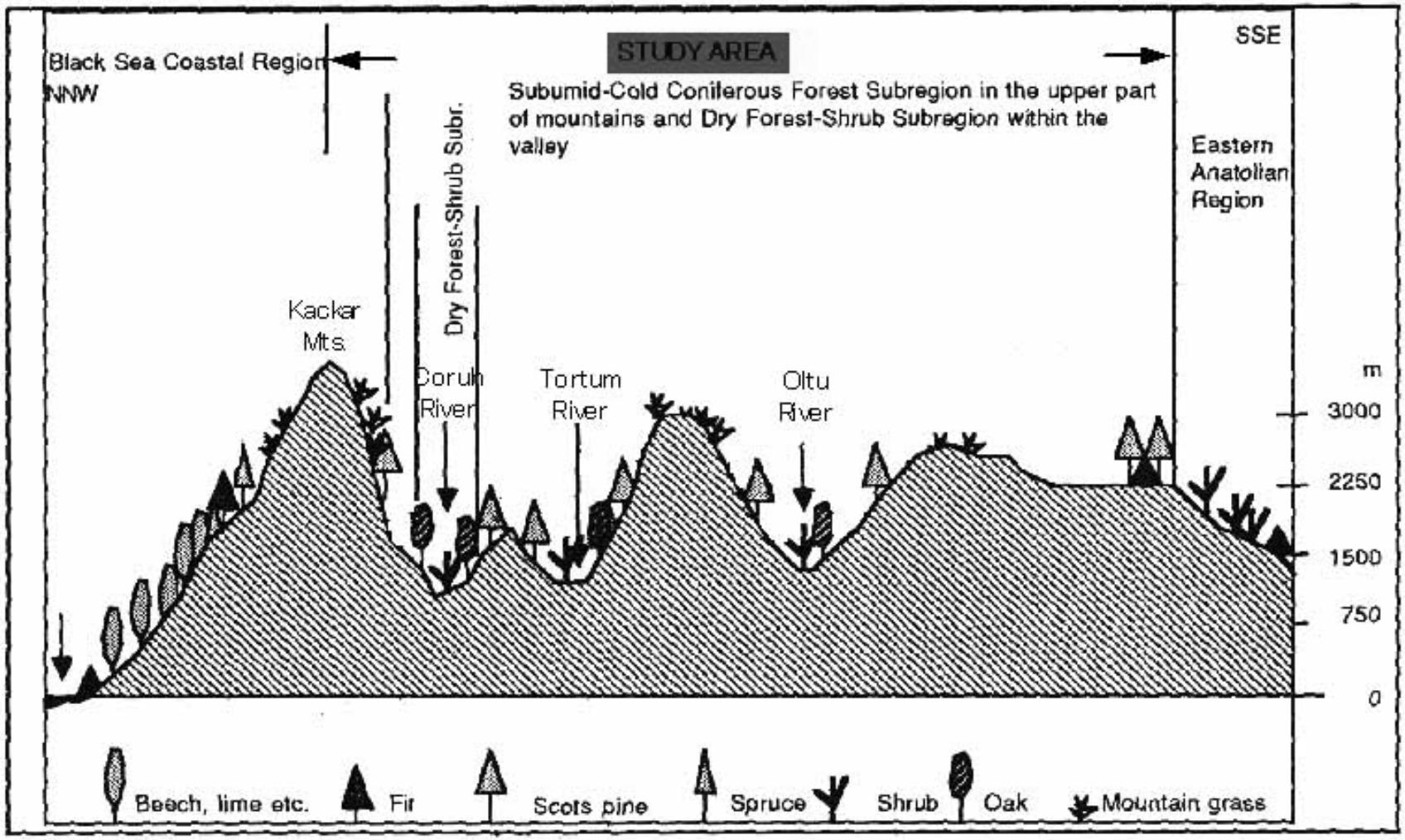


Figure Ecological Units on the topographic properties in the Study area

Source ; Ecoregions of Turkey

B.2.1.5 Land use

Table B.2.1-5 shows land use in the Study area from 1982/84 in 2001.

Table B.2.1-5 Land use in the Study Area in 1982/84 and 2001.

Unit : ha

SC	Year	Forests	Shrub & Bushland	Pasture Rangeland Grassland	Arable land	Others	Total
Berta	1982-84	111,532	20,292	44,436	35,042	16,724	228,025
	2001	78,192	45,565	83,516	18,338	2,920	228,531
		(33,340)	25,273	39,080	(16,704)	(13,804)	506
Lower Coruh	1982-84	131,749	8,629	10,994	17,447	7,646	176,466
	2001	127,035	18,757	26,739	3,759	1,814	178,104
		(4,714)	10,128	15,745	(13,688)	(5,832)	1,638
Middle Coruh	1982-84	121,306	40,415	42,376	13,568	41,886	259,552
	2001	99,244	22,188	67,090	51,799	19,069	259,390
		(22,062)	(18,227)	24,714	38,231	(22,817)	(162)
Oltu	1982-84	95,705	57,149	239,654	66,920	46,693	506,322
	2001	70,427	69,985	253,207	71,090	37,575	502,284
		(25,278)	12,836	13,553	4,170	(9,118)	(4,038)
Tortum	1982-84	24,582	12,500	138,130	16,946	10,731	202,889
	2001	28,829	27,328	92,387	36,000	19,311	203,855
		4,247	14,828	(45,743)	19,054	8,580	966
Upper Coruh	1982-84	9,316	46,014	387,734	161,234	46,873	651,170
	2001	36,500	52,695	412,282	99,853	50,912	652,242
		27,184	6,681	24,548	(61,381)	4,039	1,072
Total	1982-84	494,191	184,999	863,326	311,155	170,752	2,024,424
	2001	440,227	236,518	935,221	280,839	131,601	2,024,406
		(53,964)	51,519	71,895	(30,316)	(39,151)	(18)

Unit : %

SC	Year	Forests	Shrub & Bushland	Pasture Rangeland Grassland	Arable land	Others	Total
Berta	1982-84	48.9	8.9	19.5	15.4	7.3	100.0
	2001	34.2	19.9	36.5	8.0	1.3	100.0
	2001/1984	**0.7**	**2.2**	**1.9**	**0.5**	**0.2**	**1.0**
Lower Coruh	1982-84	74.7	4.9	6.2	9.9	4.3	100.0
	2001	71.3	10.5	15.0	2.1	1.0	100.0
	2001/1984	**1.0**	**2.2**	**2.4**	**0.2**	**0.2**	**1.0**
Middle Coruh	1982-84	46.7	15.6	16.3	5.2	16.1	100.0
	2001	38.3	8.6	25.9	20.0	7.4	100.0
	2001/1984	**0.8**	**0.5**	**1.6**	**3.8**	**0.5**	**1.0**
Oltu	1982-84	18.9	11.3	47.3	13.2	9.2	100.0
	2001	14.0	13.9	50.4	14.2	7.5	100.0
	2001/1984	**0.7**	**1.2**	**1.1**	**1.1**	**0.8**	**1.0**
Tortum	1982-84	12.1	6.2	68.1	8.4	5.3	100.0
	2001	14.1	13.4	45.3	17.7	9.5	100.0
	2001/1984	**1.2**	**2.2**	**0.7**	**2.1**	**1.8**	**1.0**
Upper Coruh	1982-84	1.4	7.1	59.5	24.8	7.2	100.0
	2001	5.6	8.1	63.2	15.3	7.8	100.0
	2001/1984	**3.9**	**1.1**	**1.1**	**0.6**	**1.1**	**1.0**
Total	1982-84	24.4	9.1	42.6	15.4	8.4	100.0
	2001	21.7	11.7	46.2	13.9	6.5	100.0
	2001/1984	**0.9**	**1.3**	**1.1**	**0.9**	**0.8**	**1.0**

According to the satellite photo image analysis at the time of 2001, the dominant land use of the area is pasture-rangeland-grassland (46%), followed by forest (22%), arable land (14%) and shrub-bush land (12%).

The characteristics of each SCs (sub-basin) are summarized as follows.

Berta : dominated by pasture-rangeland-grassland and forests
Lower Coruh : dominated by forests
Middle Coruh : dominated by forests and pasture-rangeland-grassland
Oltu : dominated by pasture-rangeland-grassland
Tortum : dominated by pasture-rangeland-grassland
Upper Coruh : dominated by pasture-rangeland-grassland

Table B.2.1-5 and Figure B.2.1-3 shows transition of landuse from 1982/84 to 2001.

The Forest areas of the Survey area decreased at the rate of about 9% in these 20 years, and pasture-rangeland-grassland increased at about 9%.

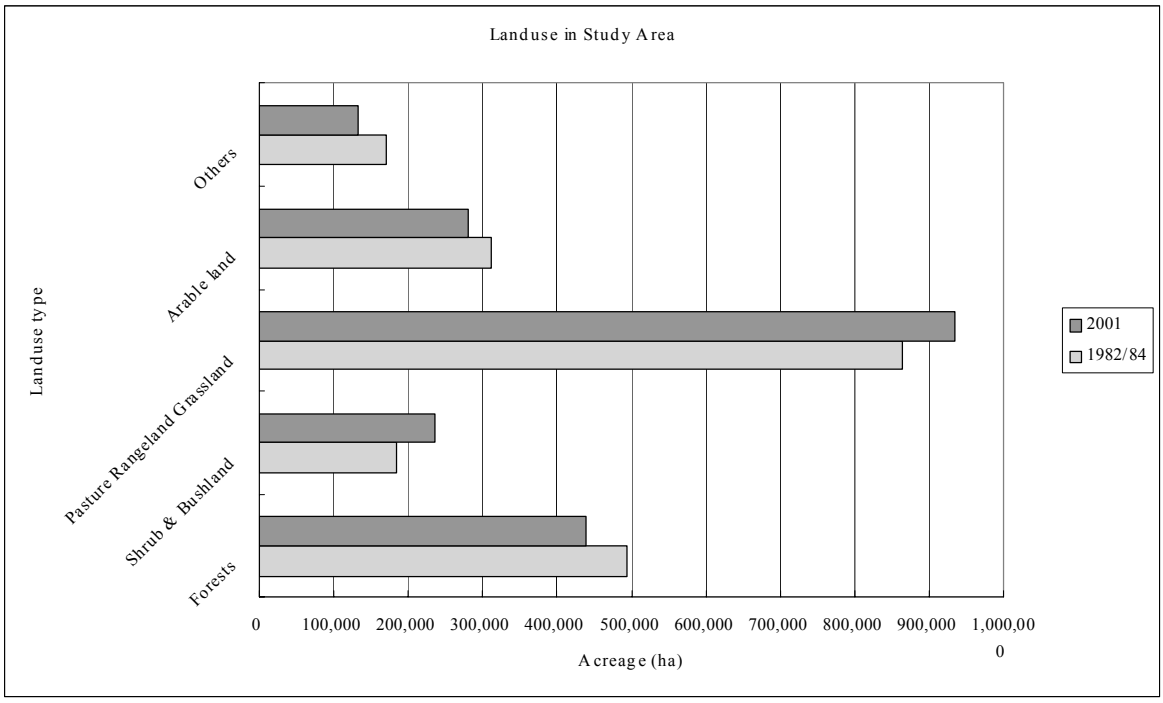


Figure B.2.1-3 Transition of Landuse

The pasture-rangeland-grassland has decreased in the Tortum river basin and arable land have decreased in the Berta, Upper and Lower Coruh river basins. In contrast, forest areas in the Upper Coruh river basin has extended greatly.

It is thought that the tendency of landuse largely influenced by natural conditions such as climate, soil, and geographical and topographical conditions and magnitude of grazing.

Table B.2.1-6 Land use in the Study Area

Unit: ha

District	Forest area				Treeless area				Total
	Normal Forest	Degraded Forest	Severely Degraded Forest	Total	Agriculture land	Pasture land	Other land	Total	
Artvin	131,452.5	45,021.5	186,435.0	362,909.0	79,296.5	142,191.5	79,484.0	300,972.0	663,881.0
Erzurum	56,777.0	89,017.7	0.0	145,794.7	107,704.0	400,758.3	22,295.3	530,757.5	676,552.2
Bayburt				14,163.0	131,995.0	216,362.0	2,680.0	351,037.0	365,200.0
Total	188,228.5	134,039.2	186,435.0	522,866.7	318,995.5	759,311.8	104,459.3	1,182,766.5	1,705,633.2

District	Other		
	Illegal cutting area	Erosion control area	Afforestation impossible area
Artvin	0.0	170,873.0	20,097.5
Erzurum	0.0	86,121.9	0.0
Bayburt	-	-	-
Total	0.0	256,994.9	20,097.5

Source: Forestry Regional Directorate of Artvin, Eastern Anatolia Forestry Regional Directorate in Erzurum and Bayburt Forest Enterprise

B.2.2 River and Watershed

B.2.2.1 Watershed Classification

A watershed management in the general meaning is lead to the result of assumption as the ideal plan beforehand because of comprising all resources, economics and industry in whole watershed like TVA plan.

However, the watershed management in this study aim to the improvement of living standard level of local inhabitants centering on the revival of the forest, and it is based on thought of useful for the environmental preservation of a wide area to keep the forest in a watershed to be desirable for the preservation/cultivation of water resource and soil.

On the occasion of studying of watershed management plan, it is necessary to divide watershed for the selection of suitable area for a detail plan.

Watershed is an area that receives and keeps rainwater then flow it to the sea only through one main passage. One watershed is separated from other surrounding areas or other watershed by a topography separator in the form of peak/ridge, etc.
In this survey, at first it was settled the boundary of Coruh watershed by the topographical map of 1:100,000. It is the range of the Study area. It is about 2,030,000ha.

Next, the main stream and the tributaries were divided according to the shape of the river. The main stream is Coruh river where the west side of Bayburt is made a riverhead, and Coruh river has three main branches such as Tortum, Oltu, and Berta.

The first order basin is consists of Coruh river and the basins of main tributaries become secondary order basins. Furthermore, the third order basin was divided in consideration of the landform of water catchments and the size of basin, etc.

The third order basin can have been done by dividing further about Tortum, Oltu, and the Berta tributaries. However, in case of the Coruh river when the third order basin is accurately divided same as Tortum, Oltu and Berta tributaries, these basin size becomes small too much compared with the third order basin in Tortum, Oltu, and the Berta tributaries. Then the Coruh river divided into 3 parts such as the Upper river basin, Middle river basin and Lower river basin. These river basins were expediently the secondary river basin, these basin are the first river basin under normal conditions.

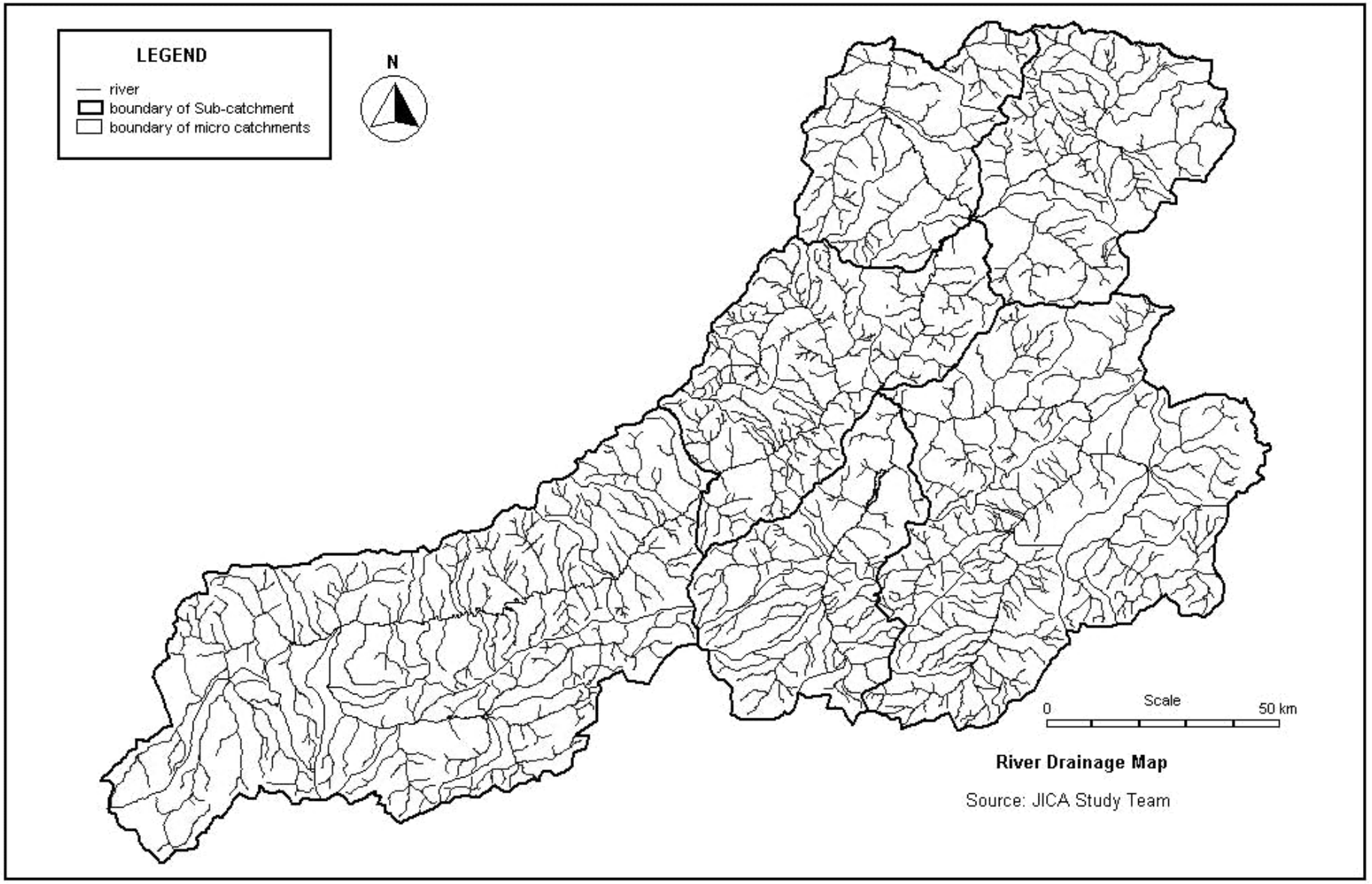
It is shows the result in Table B.2.2-1 and Map.

The Coruh river basin was able to be divided into 6 Sub-basin (SC) and 63 Micro-basin (MC). Thinking as a unit of the investigation is appropriate because there is accurately

something composed of plural valleys in the third valley.

By the way, the watershed division is prescribed as follows in Turkey.

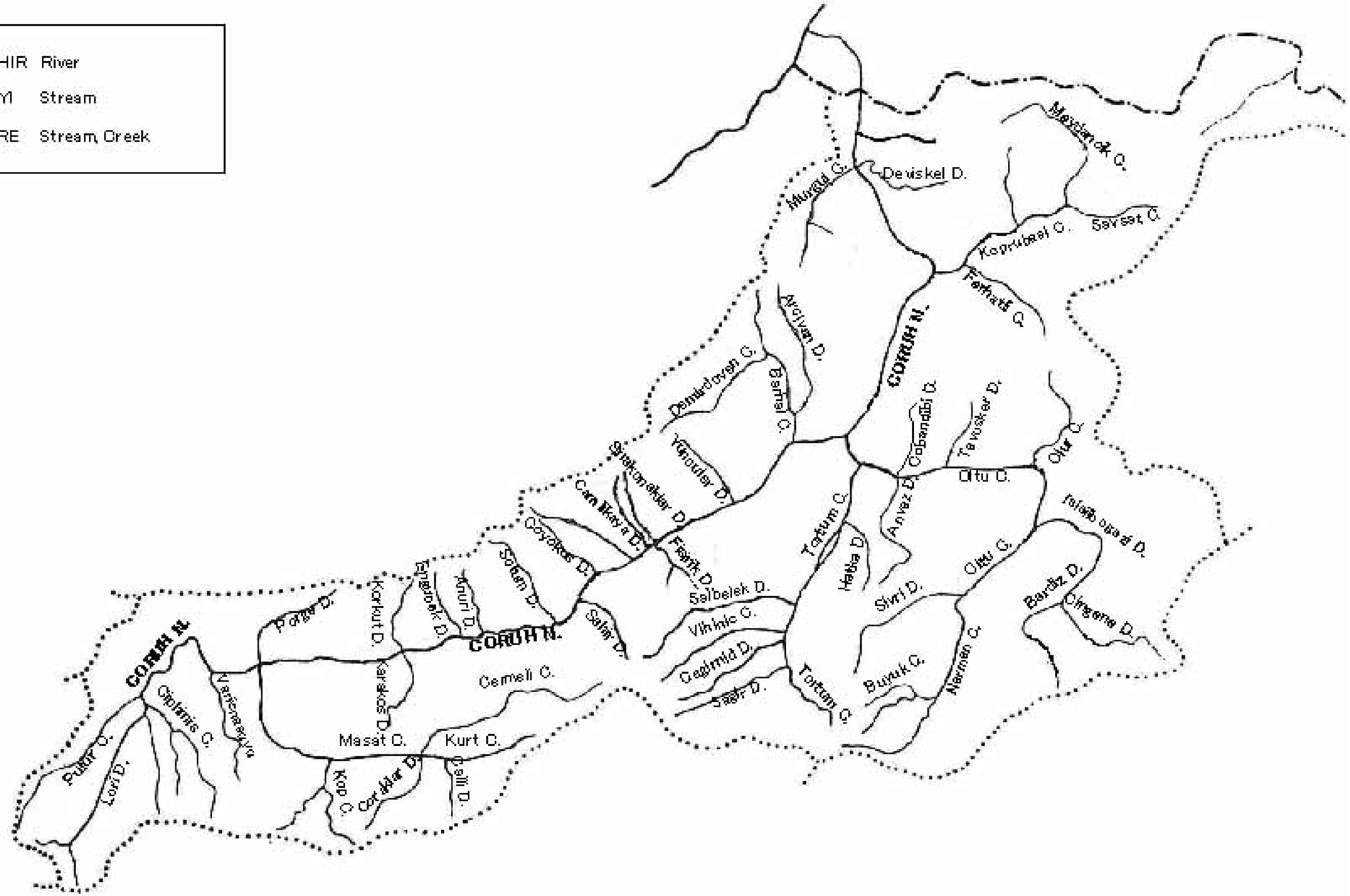
Su Hauzasi (Catchments)
Alt Hauza (Sub- Catchments) :maybe 200,000-600,000 ha scale
Micro Hauza (Micro-Catchments) :maybe 5,000-30,000 ha scale

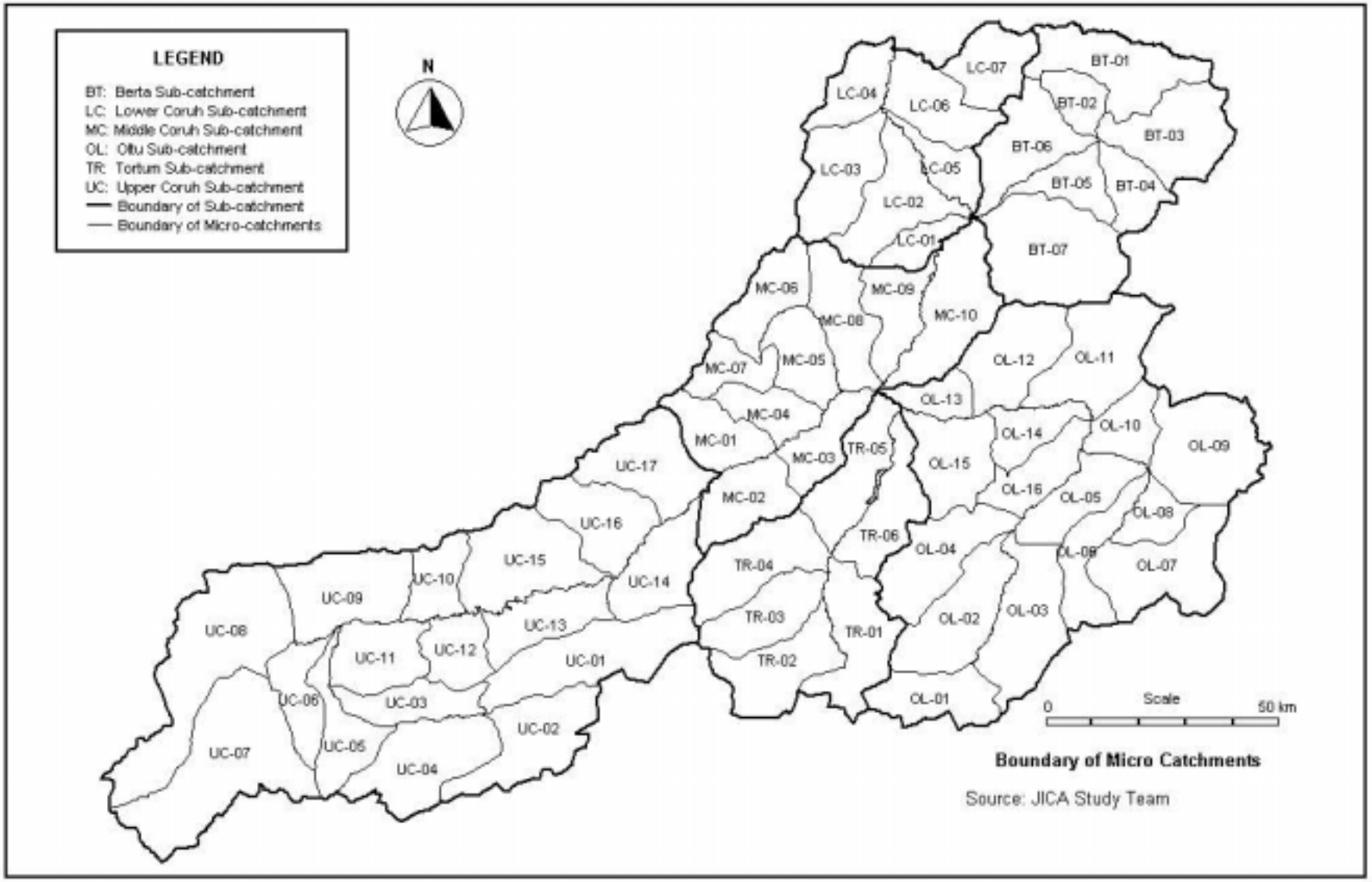


River Drainage Map

Source: JICA Study Team

N.	NEHIR	River
C.	CAYI	Stream
D.	DERE	Stream, Creek




LEGEND
BT: Berta Sub-catchment
LC: Lower Coruh Sub-catchment
MC: Middle Coruh Sub-catchment
OL: Oltu Sub-catchment
TR: Tortum Sub-catchment
UC: Upper Coruh Sub-catchment
Boundary of Sub-catchment
Boundary of Micro-catchments
N
LC-07
BT-01
LC-04
LC-06
BT-02
BT-03
BT-06
LC-03
LC-05
BT-05
BT-04
LC-02
LC-01
BT-07
MC-06
MC-09
MC-10
MC-08
MC-07
MC-05
OL-12
OL-11
OL-13
MC-04
OL-14
OL-10
OL-09
MC-01
MC-03
TR-05
OL-15
UC-17
OL-16
OL-05
MC-02
OL-08
UC-16
TR-06
OL-04
OL-06
UC-15
OL-07
TR-04
UC-10
UC-14
UC-09
TR-03
OL-02
OL-03
UC-13
UC-08
TR-01
UC-11
UC-12
UC-01
TR-02
UC-06
UC-03
OL-01
UC-02
UC-07
UC-05
UC-04
0
Scale
50 km
Boundary of Micro Catchments
Source: JICA Study Team

B.2.2.2 Hydrological Conditions

Table B.2.2-2 shows the water potential and Table B.2.2-3 shows groundwater conditions in the Coruh watershed.

Table B.2.2-2 Average Annual Water Potential by River Basins in 1995

Name of river basin	Average annual precipitation (mm)	Average annual volume (km2)	Average annual flow (mm)	Average annual flow rate (m3/sec)	Averace annual yield (if/sec/km2)
Coruh	629.40	6.57	330.30	208.30	10.41
Turkey	642.60	189.96	225.10	226.10	8.04

*The lake areas are not included in the preicipitation area
*"Turkey" weighted mean value, without "annual volume"
source : General Directorates of State Hydraulic Works

Table B.2.2-3 Average Ground Water Reserve and the Amount of Ground Water Used for Various Purposes by River Basin

unit : 10^6m3year

Name of river basin	year	Available groundwater reserve	Total withdrawal of groundwater	The ratio of groundwater withdrawal	Drinking-using and indusutry	Irrigation
Coruh	1984	−	6,100	−	400	5,700
	1987	−	10,100	−	4,400	5,700
	1989	−	12,000	−	6,300	5,700
	1991	70,000	23,260	0.33	11,860	11,400
	1992	70,000	17,560	0.25	11,860	5,700
	1993	70,000	17,560	0.25	11,860	5,700
	1994	71,020	18,580	0.26	12,880	5,700
	1995	71,020	19,720	0.28	14,020	5,700

source : River basin statistics 1995

Figure B.2.2-1 and Table B.2.2-4 shows the hydrological conditions in 9 observatories in the Survey area by DSI and Map shows these locations.
The secondary hydrological data which was able to be acquired is only 9 observatories in the middle and lower Coruh river, Tortum, Oltu and Berta rivers.

With regard to water quality, were not surveyed. But will be described a limited data of Oltu river in 2.4 Freshwater Fisheries section.

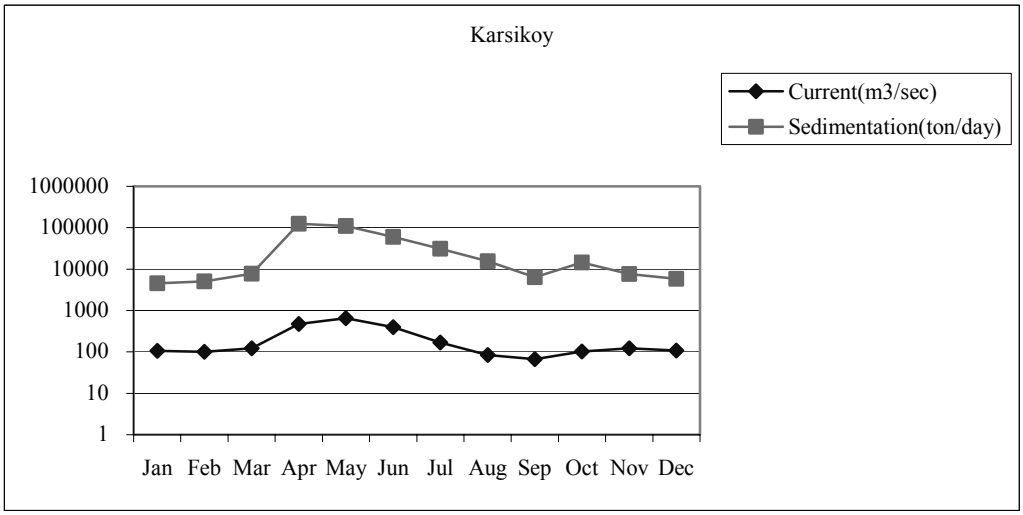


Figure B.2.2-1(1) Hydrological Conditions of Coruh River at Karsikoy

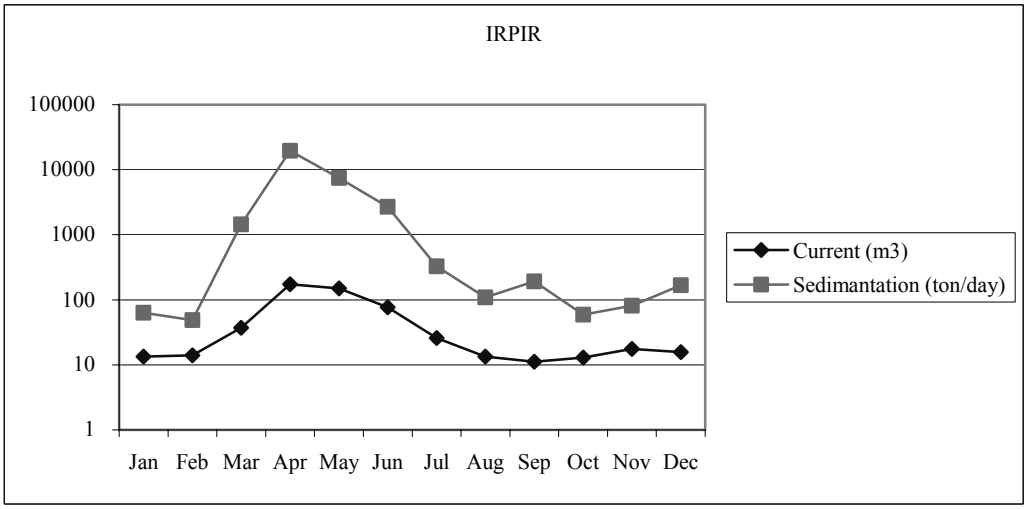


Figure B.2.2-1(2) Hydrological Conditions of Coruh River at Ispir Bridge

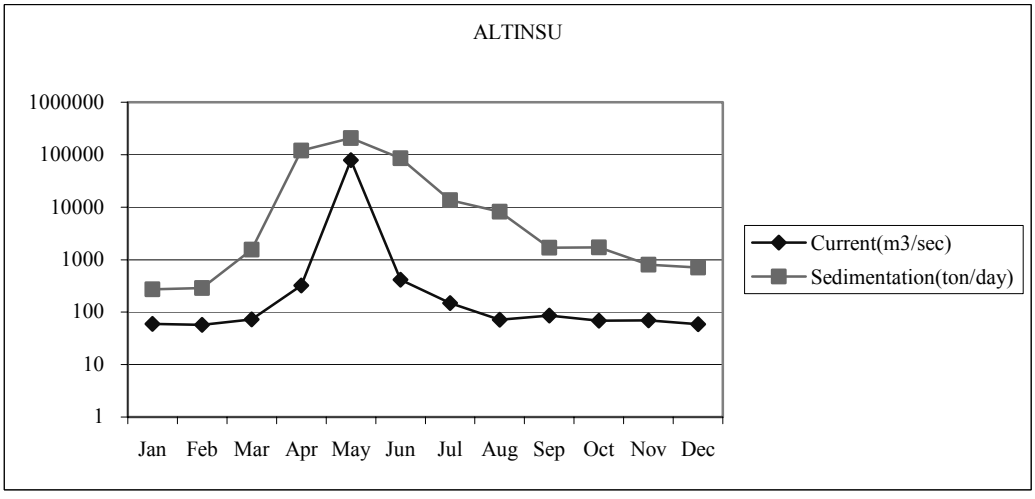


Figure B.2.2-1(3) Hydrological Conditions of Coruh River at Altinsu

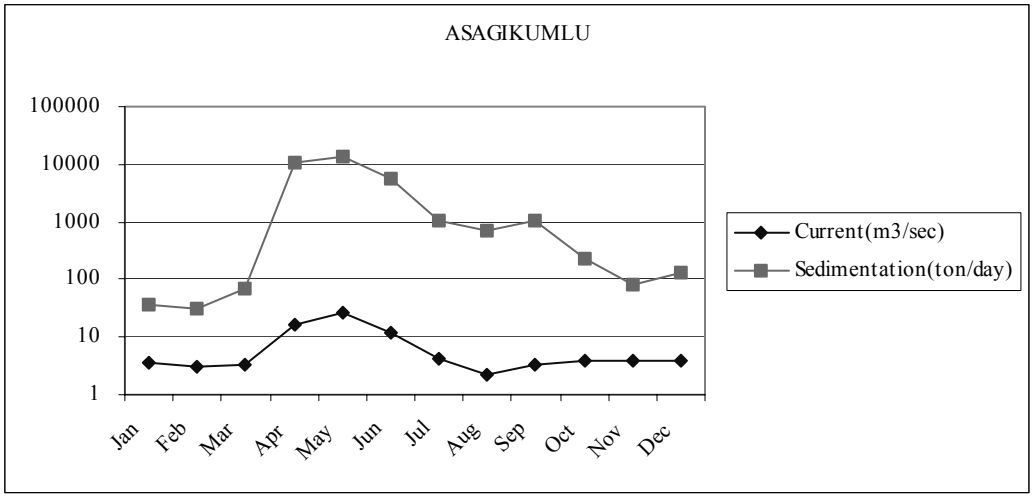


Figure B.2.2-1(4) Hydrological Conditions of Oltu River at Asagikumlu

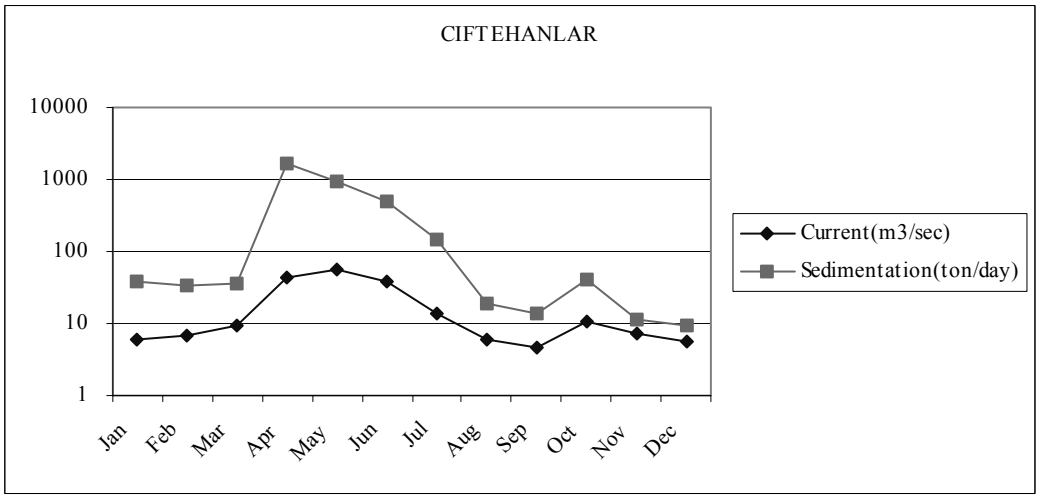


Figure B.2.2-1(5) Hydrological Conditions of Berta River at Ciftehaniar

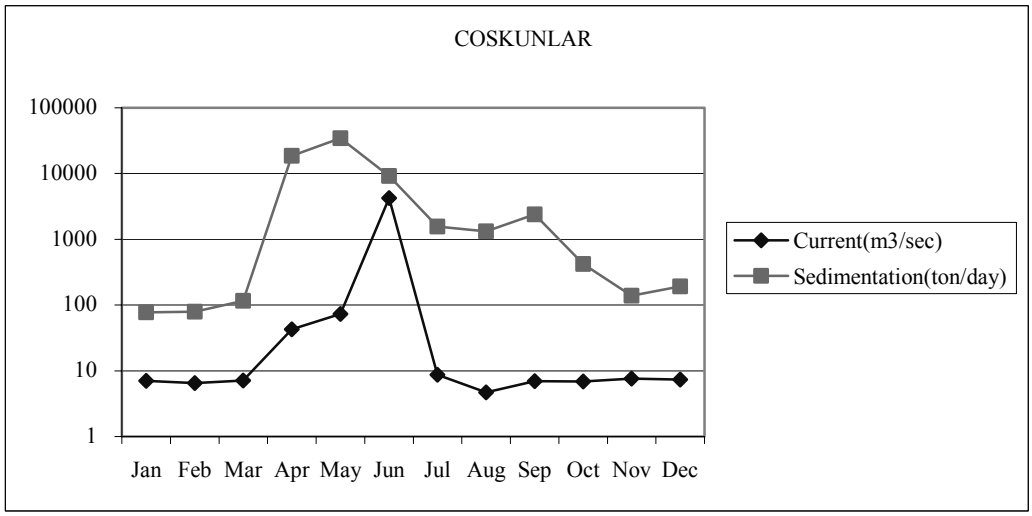


Figure B.2.2-1(6) Hydrological Conditions of Oltu River at Coskunlar

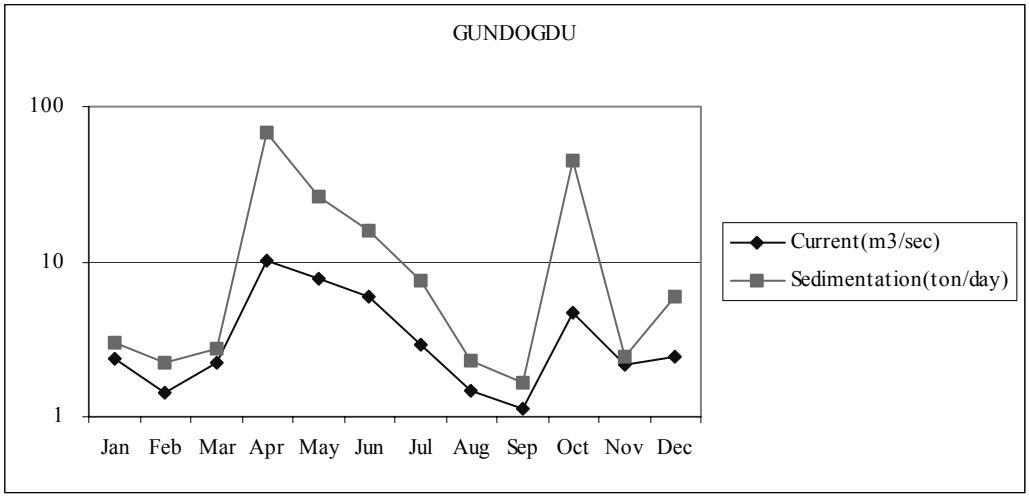


Figure B.2.2-1(7) Hydrological Conditions of Deviskel River at Gundogdu

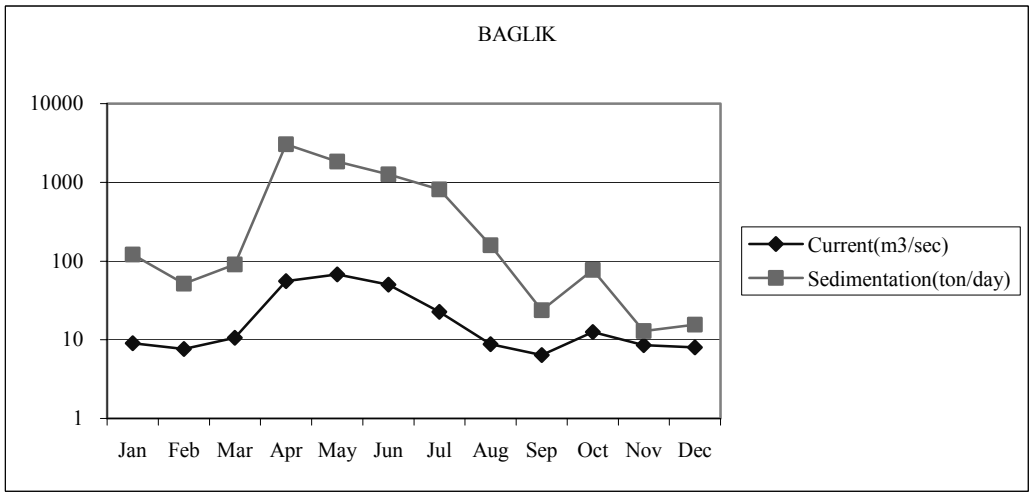


Figure B.2.2-1(8) Hydrological Conditions of Berta River at Boglik

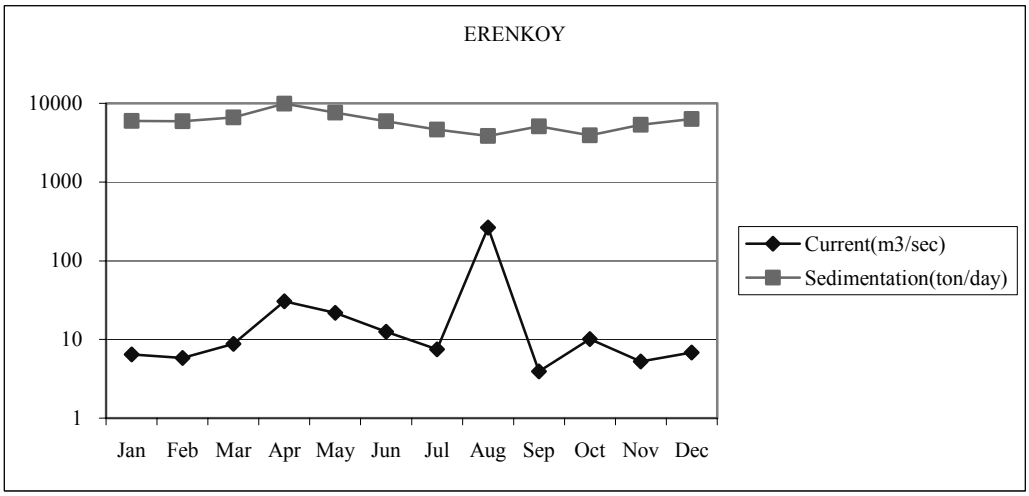


Figure B.2.2-1(9) Hydrological Conditions of Murgul River at Erenkoy

Table B.2.2-4 Explanatory Notes of the Observatories

Watershed and Region Number,Name	: 23 Coruh watershed	09 Rize Region
Station number and Name	**: 2315 Coruh River - Karsikoy**	
	: 57 m,	(41°42' 38"N, 41°27' 07"W)
Elevation and Place	: Choruh river is in the 13th km of Karsikoy to Maradit sub-district from Borcka district which is boundry with Artvin.	
Gross and Net Perticipation Area	: Gross : 19,654.4 km2	Net : 17,835.4km2
Sedimentation Observation Years	: 1967/6/20 - 1999/9/08 32 year	356 data
Average Sedimentation Distribution	: Sand : 53.2%	Clay and Silt : 46.8%
Average Sedimentation and it's Output	: Amount : 7,146,932 ton/year	Output : 401 ton/yr/km2
Explanations	: Tortum Lake 1,819km2	decreased from total
	: Deriner Dam 18,839km2	in construction
Water Area Decreased from Total	: 1,819 km2	

Watershed and Region Number,Name	: 23 Coruh watershed	09 Erzincan Region
Station number and Name	**: 2316 Coruh River - Ispir bridge**	
	: 1,170 m,	(40°57' 40"N, 40°27' 32"W)
Elevation and Place	: On the erzurum-Ispir highway, 40m above of the bridge on Choruh river which is 5km to Ispir.	
Gross and Net Perticipation Area	: Gross : 5,505.2 km2	Net : 5,505.2 km2
Sedimentation Observation Years	: 1969/9/26 - 1999/9/28 30 year	348 data
Average Sedimentation Distribution	: Sand : 42.6%	Clay and Silt : 57.4%
Average Sedimentation and it's Output	: Amount : 505,796 ton/year	Output : 92 ton/yr/km2

Watershed and Region Number,Name	: 23 Coruh watershed	09 Rize Region
Station number and Name	**: 2322 Coruh River - Altinsu**	
	: 201 m,	(41°53' 36"N, 41°097' 47"W)
Elevation and Place	: At the roadside near Altinsu and it is 5 km to Artvin - Yusufeli highway.	
Gross and Net Perticipation Area	: Gross : 18,326.4 km2	Net : 1,762.0km2
Sedimentation Observation Years	: 1984/3/20 - 1999/9/09 15 year	191 data
Average Sedimentation Distribution	: Sand : 59.3%	Clay and Silt : 40.7%
Average Sedimentation and it's Output	: Amount : 6,962,121 ton/year	Output : 422 ton/yr/km2
Explanations	: Tortum Lake 1,819km2	decreased from total
	: Deriner Dam 18,839km2	in construction
Water Area Decreased from Total	: 1,819 km2	

Watershed and Region Number,Name	: 23 Coruh watershed	09 Rize Region
Station number and Name	**: 2325 Oltu Stream - Asagikumlu**	
	: 1,129 m,	(42°07' 48"N, 40°37' 58"W)
Elevation and Place	: Near Asagikumlu street that is at the 16 km of Oltu - Golu highway connected to Erzurum	
Gross and Net Perticipation Area	: Gross : 1,762.0 km2	Net : 17,835.4km2
Sedimentation Observation Years	: 1977/6/23 - 1999/9/22 22 year	254 data
Average Sedimentation Distribution	: Sand : 62.0%	Clay and Silt : 38.0%
Average Sedimentation and it's Output	: Amount : 854,690 ton/year	Output : 485 ton/yr/km2

Watershed and Region Number,Name	: 23 Coruh watershed	09 Rize Region
Station number and Name	**: 2327 Berta Stream - Ciftehaniar**	
	: 570 m,	(42°09' 43"N, 41°15' 31"W)
Elevation and Place	: Near Ciftehaniar which is 12 km to Sovsali from Artvin - Ardahan road junction.	
Gross and Net Perticipation Area	: Gross : 1,216.4 km2	Net : 1,216.4km2
Sedimentation Observation Years	: 1995/10/11 - 1998/9/22 3 year	36 data
Average Sedimentation Distribution	: Sand : 45.0%	Clay and Silt : 55.0%
Average Sedimentation and it's Output	: Amount : 73,730 ton/year	Output : 61 ton/yr/km2

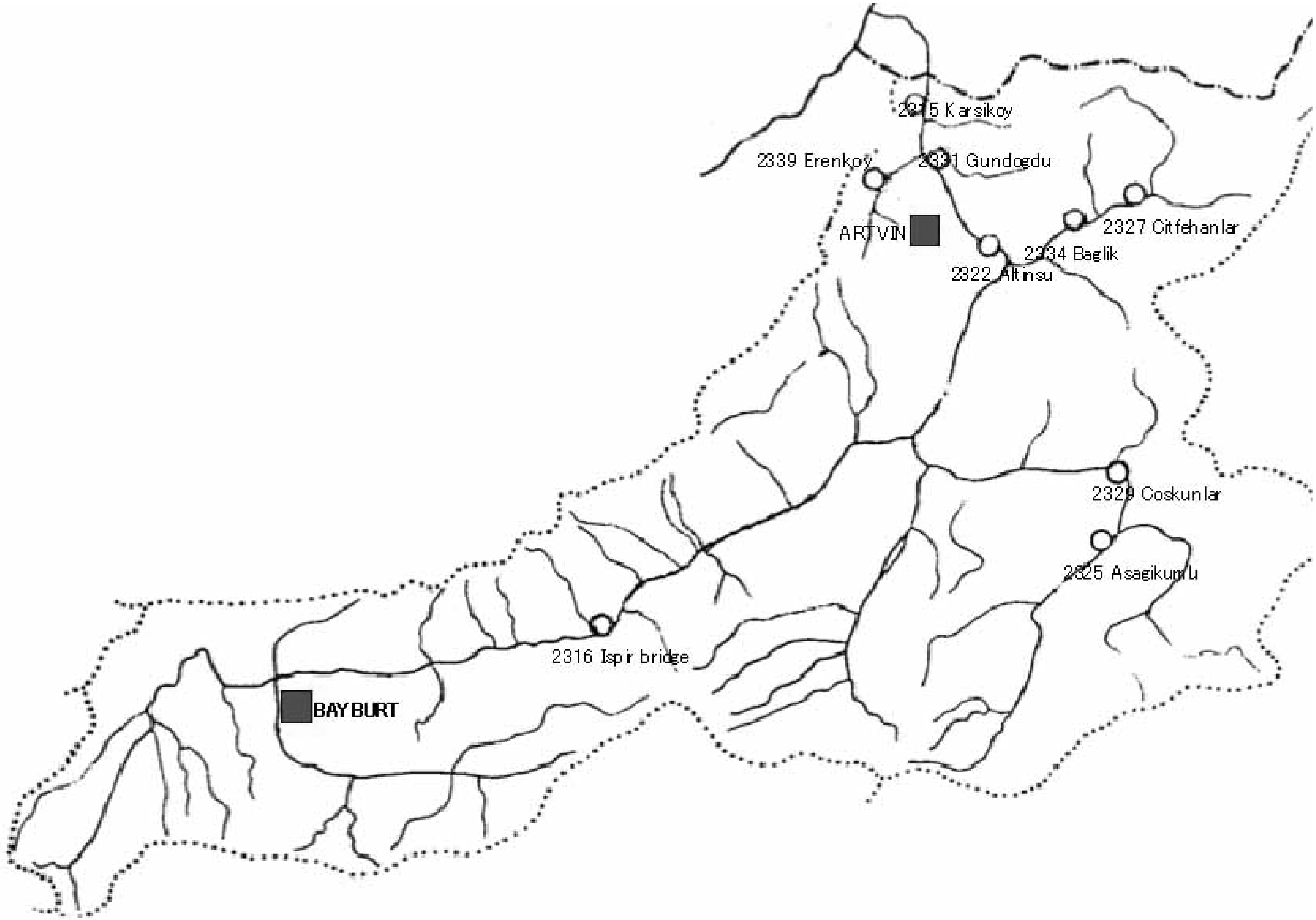
Watershed and Region Number,Name	: 23 Coruh watershed	09 Rize Region
Station number and Name	**: 2329 Oltu Stream - Coskunlar**	
	: 1,004 m,	(42°10' 28"N, 40°45' 58"W)
Elevation and Place	: On the bridge of Coskunlar village that is 20 km from Oltu - Ardahan highway to 19 km of Oltu sub-district highway.	
Gross and Net Perticipation Area	: Gross : 3,538.8 km2	Net : 3,538.8km2
Sedimentation Observation Years	: 1991/1/10 - 1999/9/22 8 year	104 data
Average Sedimentation Distribution	: Sand : 59.7 %	Clay and Silt : 40.3 %
Average Sedimentation and it's Output	: Amount : 1,531,802 ton/year	Output : 433 ton/yr/km2

Watershed and Region Number,Name	: 23 Coruh watershed	09 Rize Region
Station number and Name	**: 2331 Deviskel Stream - Gundogdu**	
	: 560 m,	(41°49' 13"N, 41°18' 09"W)
Elevation and Place	: Near Forest Management Bulding that is on the highway of Borcka district - Deviskel connected to Artvin.	
Gross and Net Perticipation Area	: Gross : 99.7 km2	Net : 99.7km2
Sedimentation Observation Years	: 1988/2/17 - 1999/9/08 11 year	131 data
Average Sedimentation Distribution	: Sand : 20.8 %	Clay and Silt : 79.2 %
Average Sedimentation and it's Output	: Amount : 6,440 ton/year	Output : 65 ton/yr/km2

Watershed and Region Number,Name	: 23 Coruh watershed	09 Rize Region
Station number and Name	**: 2334 Berta Stream - Boglik**	
	: 366 m,	(42°02' 00"N, 41°22' 32"W)
Elevation and Place	: Near Baglik sub-district which is 15 km from Savsat roadjunction on Altvin - Yusufeli highway.	
Gross and Net Perticipation Area	: Gross : 1,472.6 km2	Net : 1,472.6 km2
Sedimentation Observation Years	: 1995/10/12 - 1999/9/23 4 year	48 data
Average Sedimentation Distribution	: Sand : 48.6 %	Clay and Silt : 51.4 %
Average Sedimentation and it's Output	: Amount : 161,152 ton/year	Output : 109 ton/yr/km2

Watershed and Region Number,Name	: 23 Coruh watershed	09 Rize Region
Station number and Name	**: 2339 Murgul Stream - Erenkoy**	
	: 213 m,	(41°37' 26"N, 41°18' 34"W)
Elevation and Place	50 m down from Kemer bridge that is at the 12 km of Borcka - Murgul way connected to Artvin.	
Gross and Net Perticipation Area	: Gross : 297.7 km2	Net : 297.7km2
Sedimentation Observation Years	: 19897/2/26 - 1999/9/09 10 year	121 data
Average Sedimentation Distribution	: Sand : 46.9 %	Clay and Silt : 53.1 %
Average Sedimentation and it's Output	: Amount : 1,944,285 ton/year	Output : 6,531 ton/yr/km2
Explanations	: Materials are cleared by Murgul Copper Managements.	

source : General Directorate of State Hydraulic Work (DSI)


2315 Karsikoy
2339 Erenkoy
2331 Gundogdu
ARTVIN
2327 Citfehanlar
2334 Baglik
2322 Altinsu
2329 Coskunlar
2325 Asagikumlu
2316 Ispir bridge
BAYBURT

The annual transformation of monthly average discharge is increases in the early spring and peak up rise in May. This phenomena cause by melted snow at the early spring.

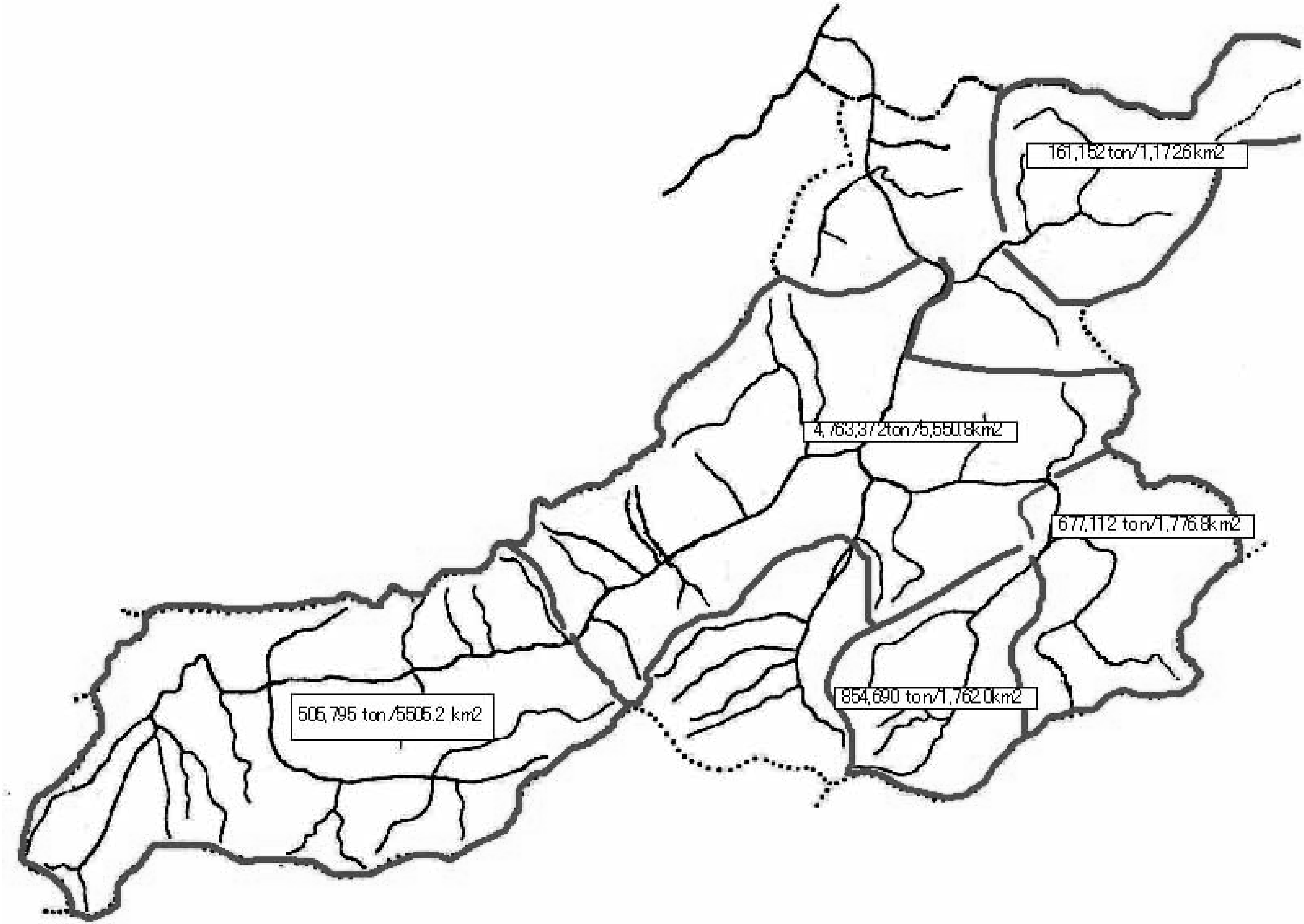
Data in most observatories shows the one peak type discharge curve. However, three observatories were shown the two peak type discharge curve. Peaks are in May and October.

Moreover, regional rainfall will flows out into the river immediately because the maximum flow rate and the minimum flow rate in the year difference is big in the Coruh river and tributaries.

As for this, Most of basin are not covered up by vegetation and will bear testimony that the out flow coefficient is big.

With regard to sedimentation in stream flow, the movement of the sedimentation quantity included in the stream almost ran side by side with the stream flow variability. However, there was an observatory which always included the sedimentation without a small movement of monthly.

It is the next Map that calculated the average soil discharge quantity in the basin of the observatory's data. From the Map, we can understand that there are a lot of quantity of soil discharges from the Tortum river basin and Middle Coruh river basin area, and Oltu river basin.


161,152 ton/1,172.6 km2
4,763,372 ton/5,550.8 km2
677,112 ton/1,776.8 km2
854,690 ton/1,762.0 km2
505,795 ton/5505.2 km2

B.2.2.3 Situation of Natural Disasters

The summary of the situation of various natural disasters in the Study area is Table B.2.2-5.

With regard to the number of outbreak, it is order of Earthquake, Flood, Avalanche, and Landslide in Artvin, and the order of Flood, Earthquake, Landslide, Avalanche in Erzurum, and the order of Flood, Landslide, Fire, and Avalanche in Bayburt.

When Earthquake and Fire are excluded, it is a disaster related to erosion and flood control, and it is thought whether measures and correspondence is inadequacy.

With regard to human suffering, there is more number of the departed by Earthquakes in Artvin, Flood in Erzurum and Avalanche in Bayburt.

Table B.2.2-5(1) Natural Disasters in Artvin

A. Number of Disasters, B. Number of Disasters with deeath reported, C Number of Disasters with damage to property reported

District	Number of Villages	Total			Type of Disaster																	
					Earthquake			Flood			Landslide			Avalanche			Fire			Others		
		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Total	1046	11326	116	739	3713	45	172	3576	33	257	1528	2	71	1703	24	42	480	8	160	326	4	37
Provincial Center	63	280	1	50	143	-	2	57	-	12	3	-	-	1	-	-	59	-	23	17	1	13
AŞkale	68	1535	3	39	855	1	6	342	2	14	152	-	5	147	-	1	37	-	12	2	-	1
Çat	40	1148	5	70	405	1	12	353	1	26	154	1	14	197	2	6	34	-	11	5	-	1
Hınıs	79	307	5	28	22	-	5	149	1	12	35	-	4	99	4	5	1	-	1	1	-	1
Horasan	76	642	33	93	159	23	41	240	10	30	159	-	11	63	-	4	16	-	6	5	-	1
Ilıca	63	416	2	42	149	-	3	123	2	19	35	-	3	79	-	3	29	-	13	1	-	1
İspir	90	1362	13	75	32	-	3	590	6	27	197	-	4	286	2	10	55	4	29	202	1	2
Karaçoban	20	40	-	1	3	-	-	-	-	-	37	-	1	-	-	-	-	-	-	-	-	-
Karayazı	71	44	1	16	-	-	-	36	-	10	1	1	1	-	-	-	5	-	3	2	-	2
Köprüköy	37	461	10	48	138	2	19	104	1	13	100	-	9	112	7	3	6	-	3	1	-	1
Narman	43	584	10	50	223	8	20	123	1	10	90	-	3	55	1	1	60	-	9	33	-	7
Oltu	65	845	2	38	136	-	12	424	2	18	249	-	2	24	-	-	12	-	6	-	-	-
Olur	40	272	2	13	50	-	1	136	1	5	55	-	1	-	-	-	18	1	5	13	-	1
Pasinler	57	1448	8	22	1165	2	3	96	3	10	15	-	1	142	2	3	29	-	4	1	1	1
Parazaryolu	35	61	2	4	2	-	-	4	-	-	-	-	-	47	2	-	8	-	4	-	-	-
Şenkaya	69	642	12	83	152	8	39	230	1	24	95	-	5	107	1	-	31	1	13	27	1	2
Tekman	69	39	1	7	18	-	2	21	1	3	-	-	-	-	-	1	-	-	1	-	-	-
Tortum	51	819	2	41	49	-	4	341	-	15	63	-	5	320	2	5	35	-	10	11	-	2
Uzundere	10	381	4	19	12	-	-	207	1	9	88	-	2	24	1	-	45	2	7	5	-	1

Table B.2.2-5(2) Natural Disasters in Erzurum

A. Number of Disasters, B. Number of Disasters with deeath reported, C Number of Disasters with damage to property reported

	Number				Type of Disaster																
	of	Total			Earthquake			Flood			Landslide			Avalanche			Fire			Others		
District	Villages	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Total	311	1111	18	170	1	-	1	423	9	46	357	2	43	132	5	11	190	2	66	8	-	3
Provincial Center	36	171	4	25	-	-	-	83	2	6	32	-	5	30	2	4	26	-	10	-	-	-
Ardanuç	49	282	3	31	-	-	-	99	2	8	160	1	12	8	-	3	15	-	8	-	-	-
Arnavi	30	151	-	28	-	-	-	60	-	12	53	-	11	25	-	1	13	-	4	-	-	-
Borçka	36	23	2	9	1	-	1	6	1	2	12	-	3	1	1	1	3	-	2	-	-	-
Hopa	30	20	1	9	-	-	-	4	-	1	6	1	3	1	-	-	7	-	5	2	-	-
Murgul	10	8	-	4	-	-	-	3	-	2	3	-	1	-	-	-	2	-	1	-	-	-
Şavşat	61	208	2	32	-	-	-	29	2	5	67	-	4	25	-	-	86	-	22	1	-	1
Yusufeli	59	248	6	32	-	-	-	139	2	10	24	-	4	42	2	2	38	2	14	5	-	2

Table B.2.2-5(3) Natural Disasters in Bayburt

A. Number of Disasters, B. Number of Disasters with deeath reported, C Number of Disasters with damage to property reported

	Number				Type of Disaster																
	of	Total			Earthquake			Flood			Landslide			Avalanche			Fire			Others		
District	Villages	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Total	175	1070	10	96	340	1	12	348	1	32	100	-	2	191	4	10	87	3	39	4	1	1
Provincial Center	123	782	8	78	175	1	10	300	1	28	100	-	2	136	3	8	67	2	29	4	1	1
Aydıntepe	23	81	1	8	16	-	-	-	-	-	-	-	-	55	1	2	10	-	6	-	-	-
Demirözü	29	207	1	10	149	-	2	48	-	4	-	-	-	-	-	-	10	1	4	-	-	-

B.2.3 Forestry

B.2.3.1 Forest Management System

Regional administrative bodies of the Ministry of Forestry in Turkey, organized as follows, are in charge of foresting and forest management in the Study area. Within the Study Area, Artvin and Bayburt, are under the jurisdiction of Eastern Black sea Forestry Regional Directorate located in Trabzon, while Erzurum is managed by the Eastern Anatolia Forestry Regional Directorate located in Erzurum. For the general directorates, the Forestry Regional Directorate Office of OGM and Chief Engineering Offices of AGM, MPG, and ORKOY are bestead in Artvin and Erzurum respectively. Moreover, OGM Forest Enterprise Office and AGM Chief Engineering Office is bestead in Bayburt.

Table B.2.3-1 Institutional Organization of Forestry in the Study area

Unit	Artvin	Erzurum	Bayburt
MOF		Eastern Anatolia Forestry Regional Directorate in Erzurum	
OGM	Forestry Regional Directorate of Artvin	Forestry Regional Directorate of Erzurum	Bayburt Forestry Enterprise
AGM	AGM Chief Engineering in Artvin	AGM Chief Engineering in Erzurum	AGM Chief Engineering in Bayburt
MPG	MPG Chief Engineering in Artvin	MPG Chief Engineering inErzurum	
ORKOY	ORKOY Chief Engineering in Artvin	ORKOY Chief Engineering in Erzurum	

Among the abovementioned, the organizations, whose activities are related to afforestation are OGM and AGM. OGM particularly carries out afforestation activities from the viewpoint of the wood production, and AGM has been allotted the role for soil conservation. The following Table B.2.3-2 shows the number of AGM staffs of each province. Though the Study Area holds vast devastated land needing measures for preventing soil erosion as soon as possible, , the number of staffs are not sufficient for research works nor to carry out actual measures on the site.

Table B.2.3-2 Number of AGM Staffs in Province

	Artvin	Erzurum	Bayburt	Total
AGM Chief Engineer	1	1	-	2
AGM Engineer	3	2	-	5
AGM Technician	1	1	-	2
Other Technician	1	-	-	1
Forest Guard	19	10	3	32
Driver	3	-	-	3
Temporary Employe	1	1	-	2
Paymaster	2	1	-	3
Employee	190	36	19	245
Accountant	2	-	1	3
Total	223	52	23	298

Note: The Nursery Chief Engineer in Bayburt as the AGM Chief Engineer in Bayburt concurrently.
Source: JICA Study Team based on AGM in Artvin, Erzurum and Bayburt

B.2.3.2 Forest Area Category

The configuration of the forest areas in the Study Area by categories defined from the viewpoint of forest management are as shown in the following Table B.2.3-3.

Table B.2.3-3 Forest Area by Category in the Study Area

	Artvin	Erzurum	Bayburt	Total
Conservation forest area	79,912			79,912
Production forest area	295,478		14,163	989,220
National parks	13,910			13,910
Nature parks				0
Nature reserve	1,191			1,191
Natural monument				0
Total	390,490		14,163	1,084,232

Source: JICA Study Team based on OGM in Artvin, Erzurum and Bayburt

The forest area in Turkey is categorized into production forest for industrial woods, conservation forest for soil and water, and protected areas such as National parks, Nature reserve, Nature parks and Natural monument, which are forests managed for scientific values, wilderness, eco-system, history, and culture and recreation purposes. In addition, there are no private forests. In Artvin province, approximately 76% of the forest areas are production forests, 20% are conservation forests, and the remainders are of National parks and Nature reserves. On the other hand, there are scarce production forests in Bayburt, while data of forest area category in Erzurum could not be acquired.

B.2.3.3 Forest Classifications

The classification of the forests in the Study area is shown in Table B.2.3-4.
Data of Bayburt province being unable to acquire, substitute data of Trabzon, which includes Bayburt was used.

Table B.2.3-4(1) Forest Area Classifications (by hectors)

		High Forests				Coppice	Total	Remarks
		Coniferous	Deciduous	Mixed	sub-total			
Artvin	Productive	106,507	38,566	39,856	184,929	6,995	191,924	
	Unproductive	59,861	14,150	18,710	92,721	105,804	198,525	
	Total	166,368	52,716	58,566	277,650	112,799	390,449	
Erzurum	Productive	120,134	115	111	120,360	5,869	126,229	
	Unproductive	53,671	16	31,636	85,323	170,340	255,663	
	Total	173,805	131	31,747	205,683	176,209	381,892	
Trabzon	Productive	95,932	58,826	55,671	210,429	6,597	217,026	
	Unproductive	82,296	65,076	61,670	209,042	96,247	305,289	Bayburt
	Total	178,228	123,902	117,341	419,471	102,844	522,315	
Total	Productive	322,573	97,507	95,638	515,718	19,461	535,179	
	Unproductive	195,828	79,242	112,016	387,086	372,391	759,477	
	Total	518,401	176,749	207,654	902,804	391,852	1,294,656	
Turkey	Normal	5,995,120	1,414,876	632,859	8,042,855	2,545,132	10,547,987	Productive
	Degraded	3,937,335	1,178,461	720,525	5,836,321	4,318,814	10,155,135	Unproductive
	Total	9,932,455	2,593,337	1,353,384	13,879,176	6,863,946	20,703,122	

Source ; Ministry of Forestry, 1997

Table B.2.3-4(2) Forest Area Classifications (by percentage)

		High Forests				Coppice	Total
		Coniferous	Deciduous	Mixed	sub-total		
Artvin	Productive	27.3%	9.9%	10.2%	47.4%	1.8%	49.2%
	Unproductive	15.3%	3.6%	4.8%	23.7%	27.1%	50.8%
	Total	42.6%	13.5%	15.0%	71.1%	28.9%	100.0%
Erzurum	Productive	31.5%	0.0%	0.0%	31.5%	1.5%	33.1%
	Unproductive	14.1%	0.0%	8.3%	22.3%	44.6%	66.9%
	Total	45.5%	0.0%	8.3%	53.9%	46.1%	100.0%
Trabzon	Productive	18.4%	11.3%	10.7%	40.3%	1.3%	41.6%
	Unproductive	15.8%	12.5%	11.8%	40.0%	18.4%	58.4%
	Total	34.1%	23.7%	22.5%	80.3%	19.7%	100.0%
Total	Productive	24.9%	7.5%	7.4%	39.8%	1.5%	41.3%
	Unproductive	15.1%	6.1%	8.7%	29.9%	28.8%	58.7%
	Total	40.0%	13.7%	16.0%	69.7%	30.3%	100.0%
Turkey	Productive	29.0%	6.8%	3.1%	38.8%	12.3%	50.9%
	Unproductive	19.0%	5.7%	3.5%	28.2%	20.9%	49.1%
	Total	48.0%	12.5%	6.5%	67.0%	33.2%	100.0%

Source ; Ministry of Forestry, 1997

As seen from the point of forest resources, forest areas are largely categorized into high forest (Silva forests) and coppice forest (scrub thicket), and each of them are classified into normal forest (Productive forests) and degraded forest (Unproductive forests or Non-productive forests) respectively according to their conditions. This procedure is prescribed by crown density (canopy density). Forests with the crown density of 0-10% are defined as degraded forest, while those with the crown density of 11-100% are normal forest. The forest areas in Artvin spread widely throughout the province, and are dominated by high forest and coppice forest areas (71% and 29% of total forest area, respectively). However, 33% of high forest and 94% of coppice forest is already degraded The forest areas in Erzurum consists of 54% high forest area and 46% coppice forest area, of which 71% and 29% of them are degraded forest, respectively. The ratio of degraded forest is more than 50% of the forest areas in Artvin, Erzurum, Trabzon area, and the ratio is higher than the national average of 49%. It is clear that factors such as moisture (water), light, temperature, oxygen and nourishment (soil) play essential rolls for plant growth. In addition to these factors, soil is also indispensably necessary for securing the root for tree growth. While deforestation, unplanned forest use and so on can be enumerated as one of the reasons for the Study Area being dominated by degraded forests, another important factor is the limitation of basic natural conditions that are indispensable for plant growth. The main natural conditions, working as limiting factors, are as follows.

1) Low annual precipitation (with the exception of the northern part of Artvin, the annual precipitation is equal to or less than 500mm).
2) Serve temperature changes (maximum and minimum temperatures indicating 35 ºC and -25 ºC respectively, and the annual number of days with the average temperatureexceeding 10 ºC, which is the temperature necessary for plant growth, being 150days in Erzurum, and 170days in Oltu and Tortum).
3) Oligotrophic soil and thin top soil layer
4) Steep slopes making the top soil unstable

Unfortunately, changing these natural conditions working as limiting factors if at all possible is clearly unpractical. Furthermore, under the present forest management system and forest utilization, it is anticipated that no matter how much afforestation took place, it will not lead to the recovery forests in the study area. Thus the first step for the recovery of forests would be the complete protection/conservation of the remaining forests, and the improvement of degraded forests, based on appropriate field survey, analysis, and planning, would be to follow.

B.2.3.4 Forest Activities

Table B.2.3-5 shows the forestry activities from 1994 to 2001 years in the national forest in the Study area. Basic forestry activities are afforestation, natural and artificial regeneration, forest protection, forest management prescription (cleaning/weeding/yield, etc), erosion control, and so on. The soil erosion control activity is mainly done in Artvin. However, activities of afforestation, artificial regeneration and establishment of energy forest (coppice forest) are not performed in recent years. Afforestation and erosion control activity are main subject in Erzurum, and all forestry activities are small-scale in Bayburt. With regard to other forestry activities, daily practical activities for maintenance of forest area and/or erosion control works part and the nursing seedling and management in the nursery are thought. In afforestation, planting the most suitable tree species for adapts to leverage purpose on the best habitat by the tree species, cultivate young trees, and yielding in a short term is basic concept. This is said proper tree on proper site. Moreover, choosing an excellent plant species/strain and regenerating efficiently in short period are merit of afforestation.

Turkey has experience and appreciated results of after many years, and hares there are success example in a lots of place. However, the forest management system is considered standardized forestry management and technology system, therefore is considered to inappropriate for severe condition like the Study area. Same thing can be said even by the planting concerning erosion control works. Original planting techniques and management system in the Study area should be necessary to be likely established. Also, breeding by selection and improvement of the tree species which suited to the natural condition in the Study area is included. Table B.2.3-6 shows annual average allowable cutting in the Study area.

Table B.2.3-6 Annual Average Allowable Cutting in the Study Area.

Regional Directorate	High Forest (㎥)					Coppice Forest (㎥)
	Sellective cutting	Regeneration	Management	Clearing	Total	
Artvin	44,567	261,167	110,599	3,632	419,965	2,163
Erzurum	0	157,416	66,947	0	224,363	11,880
Trabzon	6,888	208,566	87,589	1,336	304,379	14,927
Total	51,455	627,149	265,135	4,968	948,707	28,970
	0.12	0.07	0.09	0.04	0.08	0.00
Turkey	417,884	8,541,699	2,960,480	119,655	12,039,718	8,837,705

source; Ministry of Forest, 1997

Table B.2.3-5 Forestry Activities in the Study Area

	years	Forestry Activities (ha)					
		Afforestation	Erosion control	Range improve	Artificial regeneration	Natural regeneration	Establishment of Energy forest
Artvin	1994	55	180	0	384	11	128
	1995	60	215	0	370	0	100
	1996	585	2,441	0	217	0	58
	1997	32	1,707	0	141	0	0
	1998	0	1,485	0	148	0	0
	1999	0	6,028	0	160	0	0
	2000						
	2001						
Erzurum	1994	0	0	0	0	0	0
	1995	0	0	0	0	0	0
	1996	0	0	0	0	0	0
	1997	544	742	0	0	0	0
	1998	610	350	0	0	0	0
	1999	560	320	0	0	0	0
	2000	660	660	0	0	0	0
	2001	107	1,050	0	0	0	0
Bayburt	1994	0	0	0	0	0	50
	1995	0	0	0	0	0	50
	1996	0	0	0	0	0	32
	1997	100	1,853	0	0	0	0
	1998	364	0	0	0	0	20
	1999	464	0	0	0	0	0
	2000						
	2001						

Source: JICA Study Team based on data of MOF and OGM in Artvin, Erzurum, Bayburt, 2002

B.2.3.5 Forest Conditions

Table B.2.3-7 shows the areas of forests consisting of major tree species in the Study area**.**

Coniferous tree species dominate most of the forest areas in the Study Area, with the exception of Artvin where forests with deciduous trees (broad leaf trees) are seen. Regarding tree species, Scotch pine and Spruce are the majority of coniferous species growing to a wide. However, about half of the areas of these forests are degraded. Juniper forests are also seen in small areas, but mostly degraded.

For deciduous trees, Beech, Oak, Alder and Chestnut are seen, but most of the Oak forests are degraded.

Similar tendency is seen in the forest areas of Erzurum and Bayburt. Moreover, there are only limited variations in afforested tree species, and many of them are degraded.

Table B.2.3-8 shows standard cutting age of main tree species in terms of wood production. The site class of the forests in the Study area is assumed to be III for Scotch pine (*Pinus sylvestris*), and the standard cutting age for them are 100 years. The standard cutting age of other tree species in the Study area are also considered to be 100 years.

Table B.2.3-8 Standard Cutting Age

Species Name			Site	Cutting
Turkey	English	Scientific	Class	Age
Karacan	Black pine	***Pinus nigra***	I	80
			II,III,IV,V	100
Sarican	Scot pine	***Pinus sylvestris***	I	80
			II,III	100
Sedir	Sedar	***Cedrus libani***	I, II	80
			III, IV, V	100
Ladin	Spruce	***Pices orientaris***	I	90
			II, III, IV, V	100
Kayin	Beech	***Fagus sp.***	I	100
			II, III, IV, V	120
Kizilcan	Red pine	***Pinus brutia***	I	50
			II, III	60
Goknur	Fir	***Abies sp.***		100

Source: Ministry of Forestry, 20.07.1978

TableB.2.3-9, B.2.3-10 and Figure B.2.3-1 and B.2.3-2 indicates the normal yield table of Scotch pine and Oak. Regarding these data, it may be said that afforestation for industrial wood production in the Study Area is extremely inefficient.

Table B.2.3-9 Normal Yield Table for Scotch pine (*Pinus sylvestris*)

Site I

Stand Age	Number of Trees (/ha)	Top Height (m)	Average Diameter (cm)	Volume of Total Yield (m³/ha)
20	8,052	7.0	3.5	153
25	7,185	6.8	5.2	233
30	6,272	10.5	7.2	305
35	5,307	12.2	9.1	370
40	4,314	13.8	11.1	434
45	3,413	15.4	13.1	492
50	2,776	16.9	14.9	545
55	2,265	18.4	16.8	596
60	1,834	19.8	18.6	645
65	1,488	21.2	20.4	691
70	1,217	22.5	22.1	734
75	995	23.8	23.7	775
80	828	25.0	25.2	811
85	693	26.2	26.8	843
90	586	27.3	28.4	872
95	521	28.4	29.9	894
100	487	29.5	31.2	912

Site II

Stand Age	Number of Trees (/ha)	Top Height (m)	Average Diameter (cm)	Volume of Total Yield (m³/ha)
20	8,484	5.6	2.3	119
25	7,850	7.0	3.7	184
30	7,227	8.4	5.1	245
35	6,619	9.7	6.6	294
40	6,020	11.0	8.2	342
45	5,461	12.2	9.8	386
50	4,914	13.4	11.2	429
55	4,393	14.6	12.7	473
60	3,919	15.8	14.2	516
65	3,481	16.9	15.7	559
70	3,068	17.9	17.1	600
75	2,689	18.9	18.5	641
80	2,348	19.9	20.0	680
85	2,037	20.9	21.5	717
90	1,751	21.8	23.0	751
95	1,510	22.7	24.4	780
100	1,319	23.5	25.7	806

Site III

Stand Age	Number of Trees (/ha)	Top Height (m)	Average Diameter (cm)	Volume of Total Yield (m³)
20	8,917	4.2	1.0	85
25	8,515	5.2	2.1	132
30	8,181	6.2	3.0	176
35	7,931	7.2	4.1	216
40	7,725	8.2	5.3	255
45	7,509	9.1	6.5	290
50	7,052	10.0	7.5	327
55	6,521	10.9	8.6	365
60	6,004	11.7	9.8	402
65	5,473	12.6	11.1	440
70	4,923	13.3	12.2	478
75	4,382	14.1	13.4	517
80	3,867	14.8	14.7	553
85	3,381	15.5	16.1	588
90	2,915	16.2	17.5	622
95	2,499	16.9	18.9	653
100	2,143	17.5	20.2	679

Source: Ministry of Forestry "ORMAN AGACLARIMIZIN BONITE
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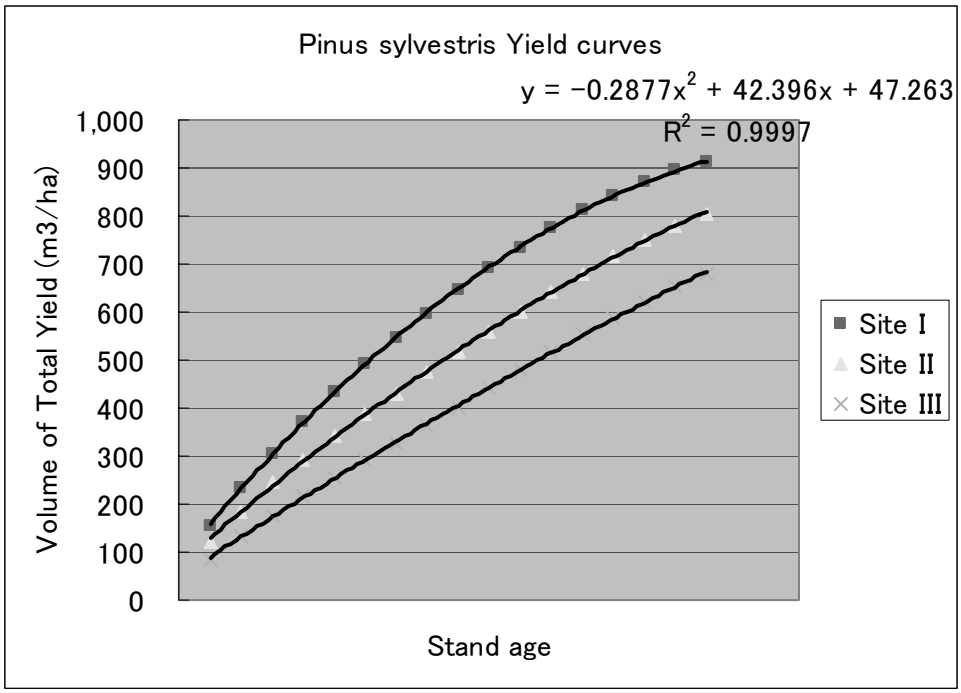


Figure B.2.3-1 Yield Curves for Scotch pine (*Pinus sylvestris*)

Table B.2.3-10 Normal Yield Table for Quercus sp.

Site I

Stand Age	Number of Trees (/ha)	Top Height (m)	Average Diameter (cm)	Volume of Total Yield (m³/ha)
20	4,270	7.5	6.8	18
30	2,070	12.7	10.5	80
40	1,230	16.2	14.0	131
50	809	18.7	17.5	171
60	578	20.7	21.0	204
70	433	22.5	24.5	233
80	338	24.1	28.0	260
90	271	25.5	31.5	283
100	223	26.7	34.9	301
110	187	27.7	38.3	317
120	159	28.5	41.7	331

Site II

Stand Age	Number of Trees (/ha)	Top Height (m)	Average Diameter (cm)	Volume of Total Yield (㎥/ha)
20	–	–	–	–
30	4,710	9.2	6.7	35
40	2,396	12.4	9.6	82
50	1,436	14.9	12.7	122
60	946	17.0	15.8	155
70	670	18.8	19.1	184
80	494	20.3	22.4	207
90	376	21.6	25.9	227
100	297	22.7	29.3	243
110	241	23.7	32.7	258
120	193	24.7	36.2	272

Site III

Stand Age	Number of Trees (/ha)	Top Height (m)	Average Diameter (cm)	Volume of Total Yield (㎥/ha)
20	–	–	–	–
30	14,284	5.8	3.7	6
40	6,154	8.7	5.8	42
50	2,914	11.2	8.6	78
60	1,594	13.3	11.8	111
70	984	15.0	15.3	138
80	674	16.5	18.6	159
90	496	17.8	21.8	178
100	380	18.9	25.1	193
110	297	19.9	28.4	205
120	238	20.9	31.8	217

Source: Ministry of Forestry "ORMAN AGACLARIMIZIN BONITE
HASILAT VE GOVDE HACIM TABLOLARI"

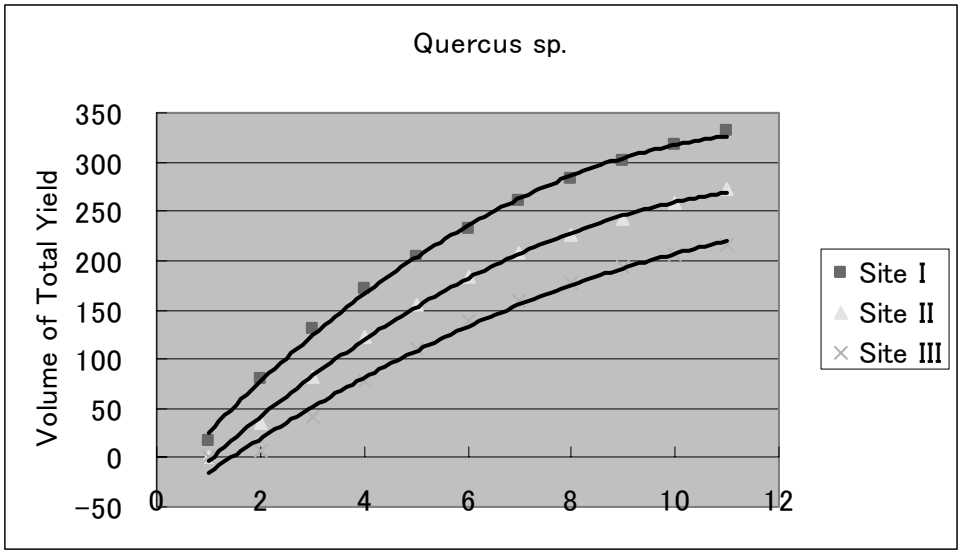


Figure B.2.3-2 Yield Curves for Quercus sp.

Afforestation for industrial wood production in the study area is assumed to be feasible only among the assumption of detailed afforestation plans selecting appropriate areas for tree growth. However, it is even more important to define the precise objectives of the afforestation.

Table B.2.3-11 and B.2.3-12 shows the standing volume of each forest age class in the Study area, and the area of the each forest age class respectively

Moreover, the Table B.2.3-13 shows average standing volume per unit area (m3/ha) of each forest age class.

According to the data indicated in the tables mentioned above, the planted forests of Artvin are dominated by forest age classes of II and IV, while forests in Erzurum only consists of forest age class III. Moreover, it may be noted that these forests has not yet reached the standard cutting age, and that the decrease of planted forests in recent years is salient.

Table B.2.3-14 indicates the forest areas of each site class in the Study area. Even for the normal forests, more than half is site class III or less, and is difficult to say that the Study Area has suitable conditions in terms of afforestation, which should be carried out under the basis of “selecting appropriate areas”.

Table B.2.3-7 Forest Area by Type and Tree Species by Province in the Study Area

	Artvin			Erzurum			Bayburt			Total	
	Normal	**Degraded**	**Total**	**Normal**	**Degraded**	**Total**	**Normal**	**Degraded**	**Total**	**Normal**	**Degraded**
High Forest	**184,929**	**92,721**	**277,650**	**120,360**	**85,323**	**205,683**	**570**	**4,635**	**5,205**	**305,859**	**182,679**
Coniferous	106,507	59,861	166,368	120,134	53,671	173,805	570	4,238	4,808	227,211	117,770
Scotch pine	24,168	16,410	40,578				570	770	1,340	24,738	
Fir	3,529	7,605	11,134				0	0	0	3,529	
Spruce	21,111	23,595	44,706				0	0	0	21,111	
Juniper	0	576	576				0	3,252	3,252	0	
Cluster pine	0	0	0				0	0	0	0	
Stone pine	5	0	5				0	0	0	5	
Mixed	57,694	11,675	69,369				0	216	216	57,694	
Deciduous	38,566	14,150	52,716	115	16	131	0	97	97	38,681	14,263
Beech	10,676	2,258	12,934				0	0	0	10,676	
Oak	2,330	2,482	4,812				0	0	0	2,330	
Hornbeam	0	0	0				0	0	0	0	
Alder	6,267	1,931	8,198				0	0	0	6,267	
Poplar	0	0	0				0	97	97	0	
Chestnut	1,007	10	1,017				0	0	0	1,007	
Maple	0	0	0				0	0	0	0	
Mixed	18,286	7,469	25,755				0	0	0	18,286	
Mixed	39,856	18,710	58,566	111	31,636	31,747	0	300	300	39,967	50,646
Coppice	**6,995**	**105,804**	**112,799**	**5,869**	**170,340**	**176,209**	**3,286**	**5,672**	**8,958**	**16,150**	**281,816**
Oak	1,477	40,502	41,979				2,699	5,393	8,092	4,176	
Beech	0	0	0				0	0	0	0	
Hornbeam	0	0	0				0	0	0	0	
Chestnut	0	0	0				0	0	0	0	
Alder	0	191	191				0	0	0	0	
Rhododendron	0	89	89				0	0	0	0	
Mixed	5,518	65,022	70,540				587	279	866	6,105	
Forest Total	**191,924**	**198,525**	**390,449**	**126,229**	**255,663**	**381,892**	**3,856**	**10,307**	**14,163**	**322,009**	**464,495**

Note: The gap in area between normal forest and total is degraded forest.

Source: JICA Study Team based on data of Ministry of Forestry,1997 and OGM in Artvin, Erzurum and Bayburt, 2002

Table B.2.3-11 Standing Volume according to Age Class in the Study Are

unit; m^3

Regional Directorate	Age class(10 years)								Unknown Age class	Total High Forest
	I	II	III	IV	V	VI	VII	Total		
Artvin	4,828	474,482	14,638,429	6,345,499	12,381,996	5,702,300	583,438	40,130,972	1,102,310	41,233,282
Erzurum	0	0	19,515,424	0	0	0	0	19,515,424	939,775	20,455,199
Trabzon	3,619	590,466	9,257,167	10,537,645	10,318,697	1,712,352	4,513	32,424,459	4,004,637	36,429,096
Total	8,447	1,064,948	43,411,020	16,883,144	22,700,693	7,414,652	587,951	92,070,855	6,046,722	98,117,577
	0.00	0.04	0.18	0.08	0.09	0.03	0.02	0.09	0.10	0.09
Turkey	2,747,216	28,567,370	246,899,577	200,710,669	254,137,662	232,361,991	28,230,352	993,654,837	61,620,652	1,055,275,489

Source; Ministry of Forest, 1997

Table B.2.3-12 Forest Area according to Age Class in the Study Are

unit; ha

Regional Directorate	Age class(10 years)								Unknown Age class	Total High Forest
	I	II	III	IV	V	VI	VII	Total		
Artvin	3,592	4,646	74,674	33,417	47,246	19,740	1,614	184,929	92,721	277,650
Erzurum	0	0	120,360	0	0	0	0	120,360	85,323	205,683
Trabzon	5,284	8,345	64,330	65,130	53,153	14,128	59	210,429	209,042	419,471
Total	8,876	12,991	259,364	98,547	100,399	33,868	1,673	515,718	387,086	902,804
	0.01	0.03	0.14	0.07	0.07	0.02	0.01	0.06	0.07	0.07
Turkey	1,222,528	475,085	1,826,611	1,357,698	1,445,679	1,464,868	210,386	8,002,855	5,836,321	13,839,176

Source; Ministry of Forest, 1997

Table B.2.3-13 Average Standing Volume per Hectares in the Study Are

unit; ㎥/ha

Regional Directorate	Age class(10 years)								Unknown Age class	Total High Forest
	I	II	III	IV	V	VI	VII	Total		
Artvin	1.3	102.1	196.0	189.9	262.1	288.9	361.5	217.0	11.9	148.5
Erzurum	0.0	0.0	162.1	0.0	0.0	0.0	0.0	0.0	11.0	99.5
Trabzon	0.7	70.8	143.9	161.8	194.1	121.2	76.5	154.1	19.2	86.8
Total	1.0	82.0	167.4	171.3	226.1	218.9	351.4	178.5	15.6	108.7
Turkey	2.2	60.1	135.2	147.8	175.8	158.6	134.2	124.2	10.6	76.3

Source; JICA study team besed on data by Ministry of Forest, 1997

Table B.2.3-13 Site Class Classification of Forest Area in the Study Are

unit;ha

Regional Directorate	Normal Forest						Degraded Forest	Total High Forest
	I	II	III	IV	V	Total		
Artvin	7,185	59,344	83,083	24,334	9,983	183,929	92,721	277,650
	0.03	0.21	0.30	0.09	0.04	0.66	0.33	1.00
Erzurum	0	0	120,360	0	0	120,360	85,323	205,683
	0.00	0.00	0.59	0.00	0.00	0.59	0.41	1.00
Trabzon	4,747	29,776	134,955	31,876	9,075	210,429	209,042	419,471
	0.01	0.07	0.32	0.08	0.02	0.50	0.50	1.00
Total	11,932	89,120	338,398	56,210	19,058	514,718	387,086	902,804
	0.01	0.10	0.37	0.06	0.02	0.57	0.43	1.00
Turkey	540,222	2,402,853	3,389,254	1,006,270	664,256	8,002,855	5,836,321	13,839,176
	0.04	0.17	0.24	0.07	0.05	0.58	0.42	1.00

Source; Ministry of Forest, 1997

B.2.3.6 Forest Products and Non-Wood Products

Table B.2.3-14 and B.2.3-15 shows the production situation of forest products in the Study area, while Table B.2.3-16 shows the production situation of non-wood products.

Table B.2.3-14 Forest Products in the Study Area

				1995	1996	1997	1998	1999	Average
Artvin	Industry Wood (1000m3)	Production	MOF(OGM)	176.6	134.6	114.5	122.9	92.4	128.2
			Private sector	0.0	0.0	0.0	0.0	0.0	0.0
			sub total	176.6	134.6	114.5	122.9	92.4	128.2
	Fuel Wood (1000m3)	Production	MOF(OGM)	110.3	73.5	88.4	73.4	109.9	90.9
			Private sector	0.0	0.0	0.0	0.0	0.0	0.0
			Unrecorded	60.0	50.0	55.0	45.0	60.0	54.0
			sub total	170.3	123.5	143.4	118.4	169.9	144.9
	Total (1000m3)	Production	MOF(OGM)	286.9	208.1	202.9	196.3	201.4	219.1
			Private sector	0.0	0.0	0.0	0.0	0.0	0.0
			Unrecorded	60.0	50.0	55.0	45.0	60.0	54.0
			Total	346.9	258.1	257.9	241.3	261.4	273.1
Erzurum	Industry Wood (1000m3)	Production	MOF(OGM)						
			Private sector						
			sub total	0.0	0.0	0.0	0.0	0.0	0.0
	Fuel Wood (1000m3)	Production	MOF(OGM)						
			Private sector						
			Unrecorded						
			sub total	0.0	0.0	0.0	0.0	0.0	0.0
	Total (1000m3)	Production	MOF(OGM)						
			Private sector						
			Unrecorded						
			Total	0.0	0.0	0.0	0.0	0.0	0.0
Bayburt	Industry Wood (1000m3)	Production	MOF(OGM)	0.0	0.0	0.0	0.0	0.0	1.500 ster
			Private sector	0.0	0.0	0.0	0.0	0.0	0.0
			sub total	0.0	0.0	0.0	0.0	0.0	1.500 ster
	Fuel Wood (1000m3)	Production	MOF(OGM)	0.0	0.0	0.0	0.0	0.0	0.0
			Private sector	0.0	0.0	0.0	0.0	0.0	0.0
			Unrecorded	0.0	0.0	0.0	0.0	0.0	0.0
			sub total	0.0	0.0	0.0	0.0	0.0	0.0
	Total (1000m3)	Production	MOF(OGM)	0.0	0.0	0.0	0.0	0.0	0.0
			Private sector	0.0	0.0	0.0	0.0	0.0	0.0
			Unrecorded	0.0	0.0	0.0	0.0	0.0	0.0
			Total	0.0	0.0	0.0	0.0	0.0	0.0

Note:Private sector's figures are estimateed. 1 ster=0.6~0.7ton
source ; JICA Stady Team based on General Directorate of Forestry

Table B.2.3-15 Industrial Wood Products from State Forest in the Study Area

unit : m3

	Year	Sawlogs	Pulp wood	Other industrial	Total
Artvin	1995	96,900	47,900	31,800	176,600
	1996	78,800	39,600	16,200	134,600
	1997	76,300	33,600	4,600	114,500
	1998	78,800	24,000	20,100	122,900
	1999	61,214	26,155	5,095	92,464
Erzurum	1995				
	1996				
	1997				
	1998				
	1999				
Bayburt	1995	0	0	0	0
	1996	0	0	0	0
	1997	0	0	0	0
	1998	0	0	0	0
	1999	0	0	0	0

source : General Directorate of Forestry

Table B.2.3-15 Non Wood Products in the Study Area

	Year	Rhodedendron flower
		tons
Artvin	1995	20
	1996	17
	1997	11
	1998	8
	1999	3

Source; JICA Study Team based on General Directorate of Forestry

The production of industrial wood products in Artvin once reaching more than 100,000 ㎥ per year during the period of 1995 - 1998, showed sudden decrease in 1999.

On the other hand, production of fuel wood products has increased in the same year, particularly for those cut with out the permission of MOF (illegal logging by residents around forest areas). Approximately 20% of the consumed fuel wood is assumed to be supplied by illegal logging.

In Bayburt, record of industrial production of forest product is not recorded due to its small scale. The annual fuel wood production in Bayburt has been reported to have the average of approximately 1,500sters (1ster=0.6~0.7 ton. Calculated on the assumption of specific gravity of the Oak wood being adjusted to approximately 0.9ton/㎥ in Japan, and 1,500ster being nearly equal to1,000 ㎥).

However, the actual amount of production and consumption of fuel wood are assumed to be more than the recorded amount judging from the case in Artvin.

According to FAO, the total forest area of the world was 4.1 billion ha in 1993, and the amount of harvest was 34 billion ㎥ in the same year. The usage of the harvested wood was bisected into industrial use such as lumber and pulp material, and domestic use such as fuels for heating and cooking, with the ratio of 45:55. And, though having regional differences, there was a tendency of domestic consumption showing higher ratios in regions where infrastructure relevant to energy are not sufficient.

Presumption of amounts of fuel wood consumed (amount of harvesting for fuel wood) in the Study Area was done as follows.

The monthly amount of consumption of fuel wood for cooking and heating was postulated to be about 25sters for one family (average household size: Artvin=4.7, Erzurum=6.4, Bayburt=5.8) though depending on weather.

When assumed that the consumption of fuel wood for heating starts when the monthly average temperature drops to 10ºC or less, fuel wood will be consumed for five months

(Nov. – Mar.) in Artvin, and 7 months (Oct. – Apr.) in other areas.

The estimated finding is shown Table B.2.3-16, while the amount of increment of coppice forest (mainly used for harvesting fuel wood) is shown in the B.2.3-17.

Table B.2.3-16 Estimated Finding of Fuel Wood Consumption in the Study Area

SC	Forest Village Population(2000)	Household number (Population/4 person)	Heating period (monthes)	Consumption of Fuel wood in heating period (㎥)
Berta	31,550	6,713	7	822,343
Lower Coruh	22,949	4,883	5	427,263
Middle Coruh	20,873	4,441	7	544,023
Oltu	46,319	7,238	7	886,655
Tortum	16,564	2,589	7	317,153
Upper Coruh	17,645	2,893	7	354,393
Total	155,900	38,978		3,351,830

Source: JICA Study Team

Table B.2.3-17 Estimation of Amount of Increment of Coppice per Year in the Study Area

SC	Forest area (ha ; 2001)	Ratio of Coppice forest (%)	Average Annual Growing (㎥/ha)	Annual Growing (㎥)
Berta	190,528	28.9	1.1	60,569
Lower Coruh	164,587	28.9	1.1	52,322
Middle Coruh	171,796	28.9	1.1	54,614
Oltu	114,561	46.1	1.1	58,094
Tortum	36,315	46.1	1.1	18,415
Upper Coruh	61,696	54.6	1.1	37,055
Total	739,482			281,069

Berta, Lowe Coruh & Middle Coruh ; apply an Artvin data
Oltu & Tortum ; apply an Erzurum data
Upper Coruh ; apply Average of Bayburt & Erzurum data
Source: JICA Study Team

These figures bring in to relief the existence of the type of forestry depriving from forest resources.

Forestry is an industry of which utilizes the products produced by the forest, and if the forest is not continuously kept, this industry is cannot exist. The best answer from the viewpoint of environmental conservation, in such severe natural condition like the Study Area, is sustain the presence of the forest. There are no results besides decreased or destroyed forests if the usage of forest products continues to exceed the amount of increment.

Under this situation, the environment of Coruh river basin will be destroyed, and disasters such as soil erosion, floods, slope collapses and landslides will increase; also water level of the river will decrease.

For Non-wood products, the collection of Rhododendron flowers is the only activity being recorded. Table B.2.3-15 shows the recorded Non-wood products in the Study area.

B.2.3.7 Nursery Practices

There are 6 nurseries established in the Study area and its vicinity, where two is in Artvin (Harmanli, Susuz), three is in Erzurum (Erzurum, Horasan, Sarikamis)and one in Bayburt. The current state of the nurseries is described as follows.

As for the scale of the nursery, the capacity of seedling production is from 1,000,000 seedlings per year at Harmanli up to 5,000,000 seedlings per year at Bayburt. However, the actual production has stayed at about 1/3-1/20 of the capacities.

The reasons are thought as follows.
1. Facilities are out of date, and the facilities maintenance is insufficient.
2. Insufficient annual budget.
3. Decrease of demand due to stagnation of forestry activity

Furthermore, new research activities such as introduction of new species or adaptability of tree species to devastated land, etc. are hardly done.

The demands for seedling are assumed to rise as environmental improvements, activation of forestry, erosion control, and energy forest improvements are carried out in the Study area. Thus the Nursery, which is the basic facility to answer these demands、 should be firstly enhanced of its facilities and seedling production capacity.

Memo 1 Ardanac Gecici Harmanli Nursery

1. Location

Longitude : E 42 15' 32" Latitude : N 41 35' 42"
Altitude : 700m
Direction : West
Address : Selimoglu, Harmanli koyu, Ardanac district, Artvin city

2.Organization

Regional Directorate : Eastern Black Sea forestry Regional Directrate in Trabson
Nursery Directorate :
Head Engineering : Artvin
Engineering : Ardanuc

3.Area of the Nursery

Total area : 39,463㎡
Seedling area : 26,100㎡ Net seedling apace : 18,350㎡
Bulb plant production area : 900㎡ Net apace : 750㎡
Building & Settlement area : 1,800㎡
Road : 3,000㎡

4. Distributed plants species & numbers (Nursery production capability : 1,000,000~1,500,000 seedlings)

unit : seedling

Plant name	1993	1994	1995	1996	1997	1998	1999	Total	Turkish name
Fagus orientalis	758,410	291,000	445,000	205,000	30,000	38,500	6,000	1,773,910	Kayin
Robinia pseudacacia	158,300	139,500	131,600	261,000	287,400	84,100	221,000	1,282,900	Y.Akasya
Tilia orientia	7,500	5,600	15,000	2,000	-	8,000	89,300	127,400	Ihlamur
Juglars regia	20	1,000	3,000	29,550	17,500	5,000	4,400	60,470	Ceviz
Castanea safira	-	-	-	-	-	4,000	7,700	11,700	Kestane
Cappry	-	-	-	6,000	15,600	12,400	17,450	51,450	Kapari (Tuplu)
Almond	600	-	7,950	3,300	2,700	1,800	-	16,350	Badem
Picea orientalis	-	6,000	2,050	5,100	-	100	-	13,250	Ladin
Pinus sylvestris	-	-	-	-	3,600	-	-	3,600	saricam
Populus nigra	-	100	-	-	-	-	-	100	Kavak
Picea Argentaris	30	35	190	-	-	-	-	255	Mavi Ladin
Pinus pnea	1,880	-	-	-	-	-	-	1,880	F. Cami
Picea orientalis	2,610	-	-	-	-	-	-	2,610	D. Ladini
Quercus sp.	-	-		3,300	-	19,500	35,000	57,800	Mesa
Total	929,350	443,235	604,790	515,250	356,800	173,400	380,850	3,403,675	

5. Distribution schedule

unit : seedling

Organization	tree type	1993	1994	1995	1996	1997	1998	1999	Total
OGM	Coniferis	5,990	400	50	3,450	-	-	-	9,890
	Broadleaf	923,330	294,100	504,000	202,050	15,000	29,000	12,550	1,980,030
AGM	Coniferis	-	5,635	1,940	1,650	3,600	-	-	12,825
	Broadleaf	-	143,000	98,000	308,100	338,200	133,200	359,250	1,379,750
Association	Coniferis	-	-	-	-	-	100	-	100
	Broadleaf	-	-	-	-	-	334	-	334
School	Coniferis	-	-		-	-	-	-	0
	Broadleaf	-	-	450	-	-	-	-	450
Other Establishment	Coniferis	30	-	250	-	-	-	-	280
	Broadleaf	-	100		-	-	10,776	9,050	19,926
Total		929,350	443,235	604,690	515,250	356,800	173,410	380,850	3,403,585

6. Future plan

unit : seedling

Plant name	2000	2001	2002	2003	2004	2005	Total
Robinia pseudacacia	489,000	500,000	462,000	516,000	500,000	506,000	2,973,000
Tilia orientia	-	40,000	40,000	52,000	40,000	52,000	224,000
Quercus sp.	65,000	60,000	60,000	90,000	54,000	90,000	419,000
Castanea safira	7,000	10,000	10,000	12,000	10,000	12,000	61,000
Juglars regia	13,200	20,000	20,000	26,400	20,000	26,400	126,000
Almond (Baden)	-	10,000	10,000	15,000	10,000	15,000	60,000
Cappry	60,000	60,000	60,000	60,000	60,000	60,000	360,000
Total	634,200	700,000	662,000	771,400	694,000	761,400	4,223,000

Memo 2 Savsat Susuz Nursery

1. Location

Longitude : E 42 20' 00"～42 20'30" Latitude : N 41 14' 30"～41 15'00"

Altitude : 1,100m

Direction : West

Address : Velta, Sususz koyu, Merkez sub-district, Savsat district, Artvin city

2.Organization

Regional Directorate : Eastern Black Sea forestry Regional Directrate in Trabson

Nursery Directorate :

AGM Head Engineering : Artvin

AGM Engineering : Savsat

3.Area of the Nursery

Total area : 81,684㎡

Seedling area : 53,925㎡ Net seedling apace : 35,950㎡

Bulb plant production area : 0㎡

Building & Settlement area : 7,140㎡

Road : 3,600㎡

Other open space : 17,019㎡

4. Distributed plants species & numbers (Nursery production capability : 2,500,000 seedlings)

unit : seedling

Plant name	1996	1997	1998	1999	2000	Total	Turkish name
Fagus orientalis	1,151,000	980,000	685,000	500,000	-	3,316,000	Kayin
Abies sp	100,000	520,000	80,000	-	-	700,000	Goknar
Cedrus libani	90,000	-	72,000	-	-	162,000	Sedir
Pinus sylvestris	937,500	2,212,500	512,500	-	-	3,662,500	Cs
Robinia pseudacacia	450,000	508,500	550,000	-	337,500	1,846,000	Y.Akasya
Rosa canina	4,500	9,000	-	-	-	13,500	Kasburnu
Alnus glutinosa	22,500	35,000	18,500	150,000	52,500	278,500	Kz
Juglars regia	-	-	-	-	15,000	15,000	Ceviz
Total	2,755,500	4,265,000	1,918,000	650,000	405,000	9,993,500	

5. Distribution schedule

unit : seedling

Plant name	1996	1997	1998	1999	2000	Total	Turkish name
Fagus orientalis	938,500	401,000	251,500	298,500	165,500	2,055,000	Kayin
Abies sp	123,000	39,000	5,000	-	-	167,000	Goknar
Cedrus libani	18,000	20,500	29,500	-	-	68,000	Sedir
Pinus sylvestris	642,000	703,000	780,000	910,000	-	3,035,000	Cs
Robinia pseudacacia	432,000	487,500	480,000	-	323,000	1,722,500	Y.Akasya
Rosa canina	-	3,500	1,100	1,200	-	5,800	Kasburnu
Alnus glutinosa	18,000	10,500	13,500	10,000	-	52,000	Kz
Juglars regia	-	-	-	-	13,000	13,000	Ceviz
Total	2,171,500	1,665,000	1,560,600	1,219,700	501,500	7,118,300	

6. Future plan

unit : seedling

Plant name	2001	2002	2003	2004	2005	Total
Fagus orientalis	610,000	600,000	700,000	600,000	600,000	3,110,000
Robinia pseudacacia	250,000	400,000	400,000	350,000	400,000	1,800,000
Alnus glutinosa	60,000	100,000	100,000	150,000	100,000	510,000
	-	200,000	300,000	250,000	350,000	1,100,000
	-	-	100,000	50,000	50,000	200,000
Total	920,000	1,300,000	1,600,000	1,400,000	1,500,000	6,720,000

Memo 3 Erzurum Nursery

1. Location
   - Longitude : E 41°15'29" Latitude : N 39°55'25"
   - Altitude : 1,843m
   - Direction : North west
   - Address : Terminal mahallesi, Merkez, Erzurum
2. Organization
   - Regional Directorate : Eastern Anatolia Forestry Regional Directorate in Erzurum
   - Nursery Directorate : Erzurum
   - AGM Head Engineering : Erzurum
   - AGM Engineering : Erzurum
3. Area of the Nursery
   - Total area : 445,884㎡
   - Plant growing area : 325,120㎡ Net seedling apace : 13,200㎡
   - Bulb plant production area : 39,000㎡ Transplanting area : 173,100㎡ Poplar production area : 173,100㎡
   - Building & Settlement area : 71,557㎡
   - Road : 36,900㎡
   - Other open space : 12,007㎡
4. Distributed plants species & numbers (Nursery production capability : 3,730,000 seedlings)

unit : seedling

Plant name	1996	1997	1998	1999	2000	Total	Turkish name
Pinus sylvestris	2,311,000	1,950,000	2,100,000	1,470,036	1,985,000	9,816,036	Saricam
Robinia pseudacacia	35,850	19,800	40,500	27,307	42,000	165,457	Akasya
Salix caucasia	6,550	4,500	6,000	7,160	6,400	30,610	Kafkas Sogudu
Salix viminalis	1,000	1,650	2,200	2,270	2,450	9,570	Sepetci Sogududur
Ulmus sp.	36,377	30,500	35,000	14,560	16,650	133,087	Disbudak
Flaxinus angustifolia	4,300	2,900	3,700	17,200	10,700	38,800	Igde
Betula sp	166,494	172,000	1,287,500	136,183	433,800	2,195,977	Hus
Acer saccharinum	35,250	30,900	24,500	38,392	30,300	159,342	Akcaagac
Acer sp.	1,000	150				1,150	C.Y.Akccgac
Popluu nigra	112,200	94,000	80,500	48,998	38,500	374,198	Kavak
Tulia sp.	61,320	61,000	42,000	27,885	25,550	217,755	Karaagac
Various Ornamental plants			3,600	4,910	32,650	41,160	
Total	2,771,341	2,367,400	3,625,500	1,794,901	2,624,000	13,183,142	

Memo4 Horasan Nursery (outside of the Study area)

1. Location
   - Longitude : E 40° 01' 55" Latitude : N 42° 10' 58"
   - Altitude : 1,540m
   - Direction : North west
   - Address : Sariyer, Tunpalti ve Cukurlar, Horasan, Erzurum
2. Organization
   - Regional Directorate : Eastern Anatolia Forestry Regional Directorate in Erzurum
   - Nursery Directorate : Erzurum
   - Nursery Engineer Horasan
3. Area of the Nursery
   - Total area : 870,817㎡
   - Plant growing area : 584,800㎡ Net seedling apace : 29,400㎡
   - Bulb plant production area : 2,000㎡ Transplanting area : 158,400㎡ Poplar production area : 395,000㎡
   - Building & Settlement area : 20,000㎡
   - Road : 49,600㎡
   - Other open space : 216,470㎡
4. Distributed plants species & numbers (Nursery production capability : 3,730,000 seedlings)

unit : seedling

Plant name	1994	1995	1996	1997	1998	Total	Turkish name
Coniferous	4,000	-	-	9,300	5,000	18,300	Ibreli
Deciduous	243,500	108,500	50,900	33,470	75,970	512,340	Yaprakli
Populus nigra	72,000	75,000	74,700	64,000	66,000	351,700	Kavak
Bulb plants	4,000	3,700	300	1,500	-	9,500	Tuplu
Total	323,500	187,200	125,900	108,270	146,970	891,840	

5. Income

unit : 1000TL

Plant name	1994	1995	1996	1997	1998	Total	Turkish name
Coniferous	4,000	-	-	7,252	3,299	14,551	Ibreli
Deciduous	165,705	124,364	18,282	21,999	28,977	359,327	Yaprakli
Populus nigra	62,443	-	62,607	70,709	69,353	265,112	Kavak
Bulb plants	3,788	3,512	-	-	-	7,300	Tuplu
Others	280,356	316,720	3,317,834	2,655,589	8,240,984	14,811,483	
Total	516,292	444,596	3,398,723	2,755,549	8,342,613	15,457,773	

Memo 5 Sarikamis

1. Location

Longitude : E 42° 33' 45" Latitude : N 42° 19' 35"
Altitude : 2,092m
Direction : South
Address : Besevler, Sarikamis, Kars

2.Organization

Regional Directorate : Eastern Anatolia Forestry Regional Directorate in Erzurum
Nursery Directorate : Erzurum
Nursery Engineering Sarikamis

3.Area of the Nursery

Total area : 67,000㎡
Plant growing area : 48,400㎡ Net seedling apace : ㎡
Bulb plant production area : ㎡ Transplanting area : ㎡ Poplar production area : ㎡
Building & Settlement area : 7,037㎡
Road : 6,297㎡
Other open space : 5,266㎡

4. Produced plants species & numbers (Nursery production capability : 3,200,000 seedlings)

unit : seedling

Plant name	1996	1997	1998	1999	2000	Total
Pinus sylvestris	520,000	350,000	410,000	410,000	600,000	2,290,000
Bulb plants	45,000	48,000	42,000	44,000	68,000	247,000
Total	565,000	398,000	452,000	454,000	668,000	2,537,000

5. Income : none

6. Future plan

Plant name	2001	2002	2003	2004	2005	Total
Pinus sylvestris	1,100,000	3,900,000	5,900,000	6,300,000	610,000	17,810,000 0
Total	1,100,000	3,900,000	5,900,000	6,300,000	610,000	17,810,000

Memo6 Bayburt

1. Location

Longitude : E 40 16' Latitude : N 40 16'
Altitude : 1,550m
Direction : East-West
Address : Merkez, Bayburt

2.Organization

Regional Directorate : Eastern Black Sea forestry Regional Directrate in Trabson
Nursery Directorate : Bayburt
AGM Head Engineering :
AGM Engineering :

3.Area of the Nursery

Total area : 535,780 ㎡
Seedling area : 439,049㎡ Net seedling apace : 24,500㎡ Transplantation area : 20,000㎡
Bulb plant production area : 4,000㎡ Poplar production area : 390,459㎡
Building & Settlement area : 17,768㎡
Road : 56,640㎡
Other open space : 22323㎡

4. Produced plants species & numbers (Nursery production capability : 5,000,000 seedlings)

unit : seedling

Plant name	1996	1997	1998	1999	2000	Total	Turkish name
Coniferous Pinus sylvestris	5,000	28,000	-	250,000	100,000	350,000	Ibreli
Deciduous Robinia pseudacacia Acer negund Rosa canina Betula sp. Tilia sp.	101,000	127,000	145,000	103,600	88,400	565,000	Yaprakli
Populus nigra	62,000	55,000	39,000	46,000	60,000	262,000	Kavak
Bulb plants	-	6,000	35,000	57,000	15,200	113,200	Tuplu
Total	168,000	216,000	219,000	456,600	263,600	1,290,200	

5. Distributed plants species & numbers with income

unit : seedling

Plant name	1996	1997	1998	1999	2000	Total	Turkish name
Coniferous	-	-	-	150,000	-	150,000	
Pinus sylvestris							
Deciduous	27,305	114,370	183,000	214,000	99,021	637,696	
Robinia pseudacacia							
Acer negund							
Rosa canina							
Betula sp.							
Tilia sp.							
Populus nigra	46,352	61,524	38,911	52,032	51,455	250,274	
Bulb plants	1,908	27,205	38,416	57,170	18,784	143,483	
Total	75,565	203,099	260,327	473,202	169,260	1,181,453	

5-1. Income

unit : 1000TL

Plant name	1996	1997	1998	1999	2000	Total	Turkish name
Coniferous	-	-	-	-	-	-	
Pinus sylvestris							
Deciduous	2,975	376,000	225,000	17,500	443,000	1,064,475	
Robinia pseudacacia							
Acer negund							
Rosa canina							
Betula sp.							
Tilia sp.							
Populus nigra	1,758,530	2,002,760	4,667,100	7,253,280	8,828,000	24,509,670	
Bulb plants	61,497	895,250	461,280	711,250	2,153,000	4,282,277	
Total	1,823,002	3,274,010	5,353,380	7,982,030	11,424,000	29,856,422	

6. Distributed plants according to distributed organization

unit : seedling

Plant name	AGM/OGM	Public service	Millitary service	Schools	Individuals	Total
Coniferous	150,000	-	-	-	-	150,000
Pinus sylvestris						
Deciduous	620,890	14,780	-	375	1,651	637,696
Robinia pseudacacia						
Acer negund						
Rosa canina						
Betula sp.						
Tilia sp.						
Populus nigra	1,900	2,800	-	-	245,573	250,273
Bulb plants	100,000	32,221	-	4,255	4,007	140,483
Total	872,790	49,801	-	4,630	251,231	1,178,452

6. Future plan

unit : seedling

Plant name	2001	2002	2003	2004	2005	Total
Pinus sylvestris	122,000	182,000	225,000	225,000	255,000	1,009,000
Populus nigra	120,000	50,000	80,000	50,000	80,000	380,000
Robinia pseudacacia	220,000	200,000	250,000	300,000	300,000	1,270,000
Rosa canina	-	50,000	50,000	50,000	50,000	200,000
Tilia sp	20,000	-	10,000	-	-	30,000
Betula sp.	3,000	3,000	3,000	3,000	3,000	15,000
Ulmus sp.	1,000	1,000	1,000	1,000	1,000	5,000
Salix sp.	2,000	-	-	-	1,000	3,000
Quercus sp.	-	10,000	20,000	20,000	20,000	70,000
Acer negurud	20,000	20,000	50,000	50,000	50,000	190,000
Total	508,000	516,000	689,000	699,000	760,000	3,172,000

B.2.3.8 Forest Diseases and Pests

Table B.2.3-18 shows unexpectedly large amounts of tree harvesting in the Study area. Insect damage is a crucial problem in Artvin, and OGM has been slaved away for measures as 42% of the gross production in 2001 was from felling forced by insect damage.

The followings are harms caused by bark beetles (Dendroctonus micans, Ipis typographus) in Spruce forests. The imago, after passing winter, appears in around May and punches the under barks of Spruce trees for ovipositor. The hatched larva gives insect damage to periphery material by making larva holes. The larva hole is made almost right-angled or in diagonal direction. When maturing, the larva becomes a chrysalis at the end part of the larva hole, becomes an imago, and will emerge to open air.

Organ phosphorus pesticides or carbonate pesticides are commonly used as pest control measures.

The following measures are also often adopted.

1. Mechanical pest control measures
   percussion, and trap by the bait log etc.

2. Physical pest control measures
   sonic wave method etc.

3. Forestry pest control measures
   transition from mono-specie forest to mixed forest, consideration for afforesting, thinning/improvement cutting/and removal of damaged tree

4. Biological control methods
   protection /breeding of birds as natural enemy, use of counter-pest

However, the results of these measures do not come out in short terms, and continuation of execution and prevention of transmission to other regions are indispensable.

Table B.2.3-18(1) Unexpected Harvest types & Amounts

Unit : ㎥

Name of Regional Directorate	Years	Fire Damage	Storm Damage	Deficit Damege	Road Construction / Others	Insect Damage	Fungi Damage	Others	Total	Total Production	Unscheduled Harvest
Artvin	1997	0	9,538	28,265	5,135	***46,189***	-	24,725	113,852	165,218	69%
	1998	0	0	10,226	11,817	***36,228***	0	3,955	62,226	168,341	37%
	1999	0	2,674	6,452	7,535	***52,485***	0	2,870	72,016	133,831	54%
	2000	32	3,855	10,779	8,084	***54,774***	0	2,063	79,587	151,148	53%
	2001	0	13,612	6,247	9,207	***63,292***	0	4,816	97,174	149,203	65%
Erzurum	1997	0	***2,585***	332	930	0	-	1,834	5,681	56,187	10%
	1998	0	***200***	4,457	2,942	0	0	117	7,716	62,766	12%
	1999	450	***1,651***	121	164	0	0	798	3,184	51,787	6%
	2000	1,472	***1,133***	784	315	151	0	638	4,493	56,618	8%
	2001	3,602	***3,948***	0	0	0	3,664	0	11,214	78,708	14%
Trabson (Bayburt)	1997	0	3,436	1,931	***8,221***	1,408	-	4,347	19,343	87,556	22%
	1998	0	2,020	2,404	***4,634***	1,013	0	3,638	13,709	97,625	14%
	1999	380	2,150	0	***5,183***	1,117	0	2,386	11,216	97,476	12%
	2000	343	11,532	0	***2,352***	2,353	0	4,458	21,038	96,075	22%
	2001	0	1,324	0	***5,695***	3,298	0	3,680	13,997	78,824	18%
Turkey	1997	223,290	158,371	264,860	***488,060***	324,038	-	16,050	1,474,669	7,256,297	20%
	1998	225,171	223,800	127,257	***571,144***	197,233	2,911	242,671	1,590,187	7,434,225	21%
	1999	284,692	241,009	134,591	***401,387***	162,987	10,365	160,724	1,395,755	7,926,822	18%
	2000	1,136,516	331,638	144,276	***310,665***	203,377	8,221	121,132	2,255,825	8,548,653	26%
	2001	302,663	225,200	60,830	***285,961***	204,128	13,830	144,293	1,236,905	7,666,305	16%

Table B.2.3-18(2) Unexpected Harvest types & Amounts in Districts in 2000

Unit : ㎥

Name of Regional Directorate	Name of Working District	Fire Damage	Storm Damage	Deficit Damege	Road Construction / Others	Insect Damage	Fungi Damage	Others	Total
Artvin	Artvin	0	2,038	4,382	1,563	***35,022***	0	1,072	44,077
	Ardanuc	0	2,356	539	1,113	***10,164***	0	1,070	15,242
	Borcka	0	430	416	3,954	***11,276***	0	1,582	17,658
	Murgul	0	0	0	264	***2,631***	0	152	3,047
	Savsat	0	***8,491***	910	638	4,158	0	940	15,137
	Yusufeli	0	***297***	0	339	41	0	0	677
Erzurum	Senkaya	***3,552***	2,829	0	0	0	1,736	0	8,117
	Oltu	0	282	0	0	0	***1,642***	0	1,924

source; Ministry of Forest

B.2.3.9 Roads Networks

The current state of the roads condition in the Study area is showed Table B.2.3-19 to B.2.3-21. About 30% of roads is asphalt or concrete paving, but 70% of the remainder is still under unpavement (stabilized and grading) in the provincial roads. Moreover, density of road network of the provincial roads in the Study area makes3.79m/ha almost equal 3.74km/ha of whole Turkey average, and rate of road improvement in Artvin far higher than Erzurum and Bayburt. On the other hand, Erzurum has vastly wide area and there are many restrictions in geographical features, so density of the road network in Erzurum has stayed in 2.74km/ha. With regard to village road under the administration of GDRS, extension of village road is 11.8km by one village in Artvin, Bayburt is 8.2km, and Erzurum is 6km.The average extension of road of Turkey is about 7.8km, and Erzurum has not improved to the value in Turkey yet.

Table B.2.3-19 Province Roads Inventory

unit; km

Province	Asphalt Road	Concrete Road	Stabilized Road	Grading Road	Expected Road	Total Extension
ARTVIN	96	123	3,046	426	1,447	5,138
ERZURUM	386	0	3,318	2,603	633	6,940
BAYBURT	164	0	905	365	83	1,517
TOTAL	646	123	7,269	3,394	2,163	13,595
	4.8%	0.9%	53.5%	25.0%	15.9%	100.0%
Turky	85,563	1,717	131,817	60,623	11,497	291,217
	29.4%	0.6%	45.3%	20.8%	3.9%	100.0%

source; Service Implementations General Inventory (CDRS, 01/01/2002)

Table B.2.3-20 Province Road Network Density

Province	Area (ha)	Total Extension	Density (m/ha)
ARTVIN	685,600	3,691	7.48
ERZURUM	2,532,300	6,307	2.74
BAYBURT	373,900	1,434	4.06
TOTAL	3,591,800	11,432	3.79
Turky	77,945,000	291,217	3.74

source; Service Implementations General Inventory (CDRS, 01/01/2002)

Table B.2.3-21 Village Road Density

Province	Village	Road Extention (km)	Density of Villege Road (km)
ARTVIN	314	3,691	11.75
ERZURUM	1,050	6,307	6.01
BAYBURT	175	1,434	8.19
TOTAL	1,539	11,432	7.43
	4.14%	3.93%	
Turky	37,170	291,217	7.83

source; Service Implementations General Inventory (CDRS, 01/01/2002)
; Statistical Yearbook of Turkey,2001

B.2.4 Fresh water fisheries

B.2.4.1 Fishery products

Turkey has rich inland resources, with over 1,300 ha of lakes and 177,714 km river. However, fisheries do not have an adequate share in agriculture and national economy yet, with0.3% in GNP and 2.7% in agriculture sector. The fisheries production was 636,824 tons in 1999, of which 50,190 tons from freshwater fisheries. Despite Turkey's vast resources for freshwater fisheries, it accounted for only 7.9% of the total fish production in 1999. The most important species are common carp to a lesser extent catfish and mullet. Common carp is distributed throughout the country. Stocking activities have been carried out to enhance freshwater resources by Ministry of Agriculture and Rural Affairs (MARA), MOF, General Directorate of State Hydraulic Works, Ministry of Energy and Natural Resources. The main species used for stocking are common carp and other carp species and to a lesser extent trout, wells and perch.

Table B.2.4-1 Freshwater Fisheries Products

units:tons

Year	Rainbow Trout	Karabalik	Cyprinids	Mullet	Common carp	Northern pike	European catfish	European eel	Others	Total
1993	479	759	544	1,067	16,035	304	723	261	21,403	41,575
1994	554	859	640	1,312	15,900	406	857	329	21,981	42,838
1995	594	866	669	1,337	17,081	453	896	390	22,697	44,983
1996	395	905	475	952	15,631	225	705	342	22,572	42,202
1997	200	1,200	700	1,000	16,000	350	1,000	400	29,610	50,460
1998	200	1,200	600	1,200	20,000	200	1,000	300	29,800	54,500
1999	263	516	449	752	17,396	276	958	200	29,380	50,190
2000	277	576	323	698	14,137	224	1,019	176	25,394	42,824

Karabalik : Local water product, like type ofcarp. There is no English equivallent
Source : Ministry of Forestry

With regard to freshwater fisheries in the Study area is showing following table. There are 12 places of fish farms in the Coruh river watershed, and rainbow trout of 175 tons a year are produced. There is a small-scale production system by the home management though most fish farms are located around the Tortum lake in Uzundere in Erzurum. According to ORKOY, a trout necessity of the region is 350-400 tons, therefore, consumption has been established by the selling to the road user guest, so not becoming an overproduction at the current state. In general, distribution and sales are in the hands of the private sector. Advantage of freshwater fishery in around the Tortum lake is following.

1. Water sources of the region will be used
2. It will be a good business opportunity for family management
3. It will stimulate for new investments
4. It will improve the socio-economic structure of the region.
5. Stocking, feeding, maintenance and harvesting is easy

Moreover, the production method of the trout at present is as follows.

1. Fly (young fish) of 50g standard size are bought in Erzurum.
2. Cultivates for about six months and the fish grow up to 200-250g is sold.
3. Food (Pellet, Bite) is the purchase or homemade.
4. The survival rate is 50-60%

Table B.2.4-2 Amount of Freshwater Fisheries Product in Fishfarm in the Coruh river

Name of river basin	Number of establishments	Rainbow Trout (tons/year)
Coruh	12	175

source : River basin statistics 1995

B.2.4.2 Potential of freshwater fisheries

The Study area has rich freshwater resources、with about 450 km Coruh river and Tortum lake. The following fish species are captured which make inhabitant in the Coruh river according to the study of the Fishery Faculty, Ataturk University in Erzurum.

1. Salmo trutta labrax
2. Salmo trutta magrostigma (Trout species)
3. Alburnoides bipunctatus (French name: Spirlin)
4. Scardinus erythrophthalmus (English name: Rudd)
5. Leuciscus cephalus (English name: Chub)
6. Chondrostroma regium
7. Barbus pelebejus escherichi
8. Barbus capito capito
9. Capoeta capoeta
10. Capoeta capoeta seiboldi
11. Capoeta tinca
12. Orthrias (Nemacheilus)angorate (English name: Angora loanch)

With regard to the river water condition is shown.
These data is both the results and observation of previous researchers were taken directly, or their findings were interpreted in the light of other references .

Table B.2.4-3 Temperature in the Oltu river

	Temperature(°C)		Water temperature(°C)	
	1994 - 1995	1995 - 1996	1994 - 1995	1995 - 1996
Aug.	27	34	25	26
Sep.	24	22	21	18
Oct	22	15	19	13
Nov	18	16	12	11
Dec	12	10	6	6
Jan	11	9	6	6
Feb	12	14	8	9
Mar	18	13	11	11
Apr	18	14	12	11
May	27	28	14	17
Jun	28	17	16	16
Jul	25	29	18	25

Note: Observation value of 12:00～14:00
Source: Water and water potential of Oltu, 1998, Ataturk University

Table B.2.4-4 Chemical properties of the Oltu and Tortum river water

Month	Ca2+ (mg/l)	Mg2+ (mg/l)	pH	Sertlic (FrS)	Total Alkaline (Mg/l CaCO3)	Organic matter (mg/l)	Electrical conductivity (µmhos/cm)
Sep. 94	70.4	21.68	7.95	26.80	200	1.76	415
Oct. 94	36.0	30.24	8.27	21.52	110	2.32	330
Nov. 94	54.4	22.56	7.65	23.08	160	3.36	400
Mar. 95	48.0	47.40	8.15	31.58	200	3.20	550
May 95	27.2	30.20	8.25	19.26	176	1.92	340
Jun. 95	48.0	14.40	8.22	18.12	160	2.80	215
Jul. 95	41.6	6.24	7.93	13.15	80	1.20	350
Aug. 95	40.0	16.80	8.15	19.28	150	6.24	280
Sep. 95	56.0	9.80	8.20	18.25	160	4.40	160
Jan. 96	52.0	21.91	7.87	22.20	142	2.72	230
Feb. 96	54.4	22.40	7.29	23.01	138	2.00	240
Mar. 96	28.0	38.40	8.12	22.81	248	3.68	790
Apr. 96	38.4	19.20	8.32	17.63	548	6.32	380
May 96	25.6	20.16	8.12	17.63	194	6.32	220
Jun. 96	41.6	37.44	8.23	25.88	165	1.20	280
Jul. 96	48.0	6.72	7.93	14.98	180	0.48	450
Average	44.35±0.01	22.84±2.88	8.04±0.06	20.89±1.17	188.18±25.8	3.12±0.46	351.87±38.6

Source: Water and water potential of Oltu, 1998, Ataturk University

Table B.2.4-5 Degree of Transparency in the Oltu river

	1994 - 1995(cm	1995 - 1996(cm)
Aug.	22	28
Sep.	34	3
Oct	37	19
Nov	22	17
Dec	22	22
Jan	19	100
Feb	29	19
Mar	10	21
Apr	10	3
May	3	5
Jun	36	22
Jul	42	100

Note: transparent board use for 10cm in diameter
Source: Water and water potential of Oltu, 1998, Ataturk University

Contents can be summarized shortly as follow;

1. The one of important water source is Oltu river with an 32.79 ± 1.69 m^3/s average annual flow rate. This water source appeared suitable for salmonid fish culture from September 15 to June 15 that is 9 months, if some precautions are taken against to floods and erosion turbidity.
2. It is determined that there were an indigenous fish species (Salmo trutta labrax) living in the 6 of 9 stream. Therefore these streams are appearing suitable for salmonid fish culture in the certain areas in summer months.
3. Starting points of the all streams is appearing suitable for the brood trout culture.
4. In terms of naturally consideration, Oltu river are carrying an importance only for sport fishing.

It is considered that being possible to judging of freshwater fishery in Oltu river or/and circumferential area from the above data about natural condition. However, enough consideration might be necessary for an increase in the turbidity by the soil erosion, and cultivation in the fish pound and lakes are more suitable than cultivation in the river.

The policies concerning Freshwater Fishery in the 8th Five Year Development Plan, 2001-2005 is summarized as follows.

1. Protecting water resources within the framework of suitable utilization principle shall the fishery production.
2. In order to increase production, the natural environment of our seas and inland waters shall be protected controlled and improved. Importance shall be attached on improving and spreading cultivation activities, by taking into account interactions among environment, tourism, forestry, transport and other related sectors.
3. In order to provide rational utilization of inland waters, ecological and limnological features shall be determined. Furthermore, fishery activities shall be oriented towards cultivating species that having high economic value and appropriate to the environment.
4. Research activities, aiming at determining the stock size and annual fishing amount shall be carried out continuously and towards implementation, in order to prevent decreasing trend in the production obtained from our seas and to increase production by preserving the resources

B.2.5 Tourism

B.2.5.1 Present situation of tourism

Table B.2.5-1 shows the number of foreign tourists visiting the tree provinces of the Study area. Domestic tourist's trend is not recorded.

Table B.2.5-1 Foreigners Arriving Number

Year	Artvin	Erzurum	Bayburt	Turkey
1993	521,411	-		6,525,202
1994	316,954	-		6,695,705
1995	206,734	-		7,747,389
1996	173,425	-		8,536,778
1997	177,123	1,647		9,712,510
1998	199,609	1,538		9,431,280
1999	187,808	2,085		7,487,365
2000	175,202	1,348		10,428,153

*Data was obtained from General directrate of Public Security

source : Statistical Yearbook of Turkey 2001(Artvin,Erzurum)

In the Study area has severe factors for tourism business such as might be not found of the tourist attraction of an international class, location on the northeast edge of Turkey, and

inconvenience of a traffic access, and the accommodations maintenance might be insufficient, and so on. Therefore, visited foreign tourists were only 1.6% of the tourist to the entire Turkey.

B.2.5.2 Tourism resources and facilities

Recently, tourism development in world wide is remarkable in the background of globalization on all respects economic and politics etc, the development of communication system and traffic system, and changes people's outlook on value and lifestyles, etc.

Than before, the role of public site is growing in tourism promotion though the administration such as the private organization, governments, and municipalities becomes a big pillar.

However, the following problems will be face when the locality deems to develop by tourism.

1. Posture that country and municipality work on tourism promotion
2. Securing of budget and talent
3. Establishment of regional identity
4. Location of tourism as key industry in region
5. Promotion activity which clarifies object
6. Wide-area cooperation and cancellation of regional egoism
7. Consideration to senior citizen, physically handicapped person, and foreigner, etc.
8. Continued tourism promotion

When thinking about the direction of tourism of the 21st century, the direction of the sustainable tourism style (alternative tourism) is forecast, such as eco-tourism, heritage tourism, and ethnical tourism, so on.

It is assumed to be the following items to be requested to tourism spot.

1. Making to individuality
2. Host and guest's familiarities
3. Necessity of interpreter of different culture
4. Environment and cultural creation peculiar to locality
5. Creation of entertainment culture

Following resources may find in the Study area when searching with such criteria.

1. Unique scenery (bare land which goes to ruin is one unique individuality, too.)
2. Peculiar culture and environment to the Study area

It is hoped that the area is activated by planning the tourism promotion thereafter inhabitant become richen and nature is abundant, green is abundant by whole Study area is networking done and improving software.

B.3 IDENTIFYING CORE ISSUES

B.3.1 Watershed problems and their causes

Previous activities led by the Ministry of Forestry lead to a various good results in a field of forestry. However, it has a bunch of very real issues from the present conditions of watershed and forest area in the Study area. That is, the defective cadastre of forest area, break into forest area, illegal cutting, and the poverty of forest villagers. Therefore, soil erosion, flood, and environmental deterioration, etc. are problems in various locations. Way of dealing with such issues, afforestation, soil control and other measures go on in OGM and AGM in the Ministry of Forestry. In those various measures, high priority is given to the soil erosion control and the flood prevention measures. The forest degradation in watershed is remarkable like the Coruh watershed, the decision of an overall watershed management plan may be requested about the soil and the water conservation in the watershed which is based on the adjustment with the relating agencies and ministries.

Impeding Factors

1. Policy and Institutional Aspects
   (1) Lack of Planning and Management system of whole watershed
   (2) Lack of adequate land management system
   (3) Lack of support system by the country and/or the local administration
   (4) Lack of adequate water resources management

2. Human Aspects
   (1) Lack of recognition of whole watershed management
   (2) Lack of development human resources and research system
   (3) Lack of recognition of security in life

3. Natural Environmental Aspects
   (1) Low productive land and harsh climate conditions
   (2) Extensiveness denuded land

4. Technical Aspects
   (1) Lack of valuable information about water resources
   (2) Lack of valuable information about source origin of soil disaster in the catchment
   (3) Lack of valuable information concerning a rainfall and soil disaster

B.3.2 Impeding factors for Forestry

The forest consisting on a delicate balance under very harsh natural conditions (e.g. altitude roughly from 600m to 3000m, annual average participation from 300mm at Yusufeli to

600mm at Artvin, lowest temperature becomes -30ºC while the highest exceeds 35ºC) had disappeared. The factors leading to this situation were deforestation caused by excessive grazing and firewood collection, and thereby bare land and/or grass land spreads out. Moreover, the soil is poor in nutrients and most of the hillsides have steep slope inclinations. For these reasons, the forests are only growing in little areas where only several tree species are seen. A large quantity of time and expenditure are necessary for re-greening under such conditions, and still yet, it may be difficult to get results of satisfactory. Most of the river water became turbid with soil and sand, considered as the influence of surface soil erosion. The water of the Coruh river is utilized for irrigation, fresh water fishery and the electric power generation use in the downstream area. The afforestation of the Study area serves as soil erosion control measures on the hillside. It is either used alone, or in coordination with other physical measures. Tree species are used for erosion control measures, and the usage of shrub is seen here and there. However, the usage of grass is not seen for these objects. The typical tree species used for erosion control projects are as follows.

Pinus sylvestris,
Picea orientalis,
Robinia pseudacacia,
Qurcus sp.,
Carpinus sp.

The growth modes of the trees are not good due to severe natural conditions.

Key Issues

1. Recognition of the effects of deforestation under harsh natural condition
2. Proper forest management is necessary in the Study area
3. Various schemes for forest reproduction suitable for the Study area are necessary.
4. Integration of vegetation use in measures for erosion control
5. Understand natural environmental conditions on a scientific base
6. Measures based on the results of continuous monitoring are necessary.
7. Measures for preventing inflow of sedimentation into gullies and rivers are necessary.
8. The plant species for reforestation and/or the soil conservation measures are researched and it is necessary to maintain production and supply of the necessary amount seedling.
9. It is necessary to examine adequate erosion control measures (engineering works and vegetation) which suites the Study area.
10. It is necessary to examine an adequate measure for preventing outflow of the sedimentation in the gully and riverbed
11. It is necessary to examine the capability of fresh water fishery
12. It is necessary to examine the tourism plan for the huge area of the catchment for income-level improvement

Impeding Factors

1. Policy and Institutional Aspects

(1) Inappropriate forest management plan、such as lack of recognition of between natural environment and plant growth,
(2) Deficiency of evaluation of measures effort
(3) Lack of support system by the country and/or the local administration

2. Human Aspects

(1) Lack of personal training
(2) Lack of number of field worker
(3) Lowness of skill level

3. Natural Environmental Aspects

(1) Low productive land and harsh climate conditions
(2) Extensiveness denuded land

4. Technical Aspects

(1) Breakaway from the forest management system of exclusive devotion to wood production
(2) Necessity of a forest management system based on multiple forests function
(3) Necessity of a forest management system as ecosystem
(4) Necessity of a forest management system in consideration of soil conservation
(5) Necessity of a forest management system in consideration of water resources cultivation and conservation
(6) Necessity of a forest management system in consideration of landscape and scenery
(7) The selection of tree species and/or measurement method which matched a local characteristic
(8) Necessity of forest and environmental education
(9) Necessity of sustainable data collection system

B.3.3 Impeding factors for Freshwater fisheries

1.Policy and Institutional Aspects

(1) Lack of support system by the local administration

2. Human Aspects

(1) Lack of personal training and research facilities

3. Natural Environmental Aspects

(1) Extensiveness catchment
(2) Potential depending on view of the habits of freshwater fish

4. Exogenous Aspects
(1) Unestablished market
(2) Ambiguity of a quantity of demand
(3) Handy of distance to a main market

5. Technical Aspects
(1) Unfamiliar culture technology

B.3.4 Impeding factors for Tourism

1. Policy and Institutional Aspects
(1) Lack of support system by the country and/or the local administration

2. Human Aspects
(1) Lack of gain momentum of build a tourist industry
(2) Lack of human resources and tourism technology

3. Natural and Cultural Resources Aspects
(1) Extensiveness area
(2) Scattering / dispersion of tourist attractions
(3) Insufficient quality, quantity of tourist attractions
(4) Unimproved sightseeing-related institution and facilities
(5) Absence of tourist attractions known by the world

4. Exogenous Aspects
(1) Difficulty of a network with other sightseeing spots
(2) Access problem
(3)Lack of local identity

5. Technical Aspects
(1) Lack of tourism analysis

B.4 BASIC CONCEPTS AND PROPOSED ACTIVITIES

B.4.1 Basic concepts of Rehabilitation and Management of Natural Resources

B.4.1.1 Key Issues and basic idea concerning Vegetation and Forest

(1) It is a given fact that is conserved existing vegetation. Because, the existing vegetation are lived on a delicate balance under very harsh natural conditions.
(2) Forest conservation & erosion control measures is taken account of financial efficiency by using forest function.
(3) It is a cardinal rule of preventing soil erosion to cover the ground with vegetation as early as possible.
(4) Re-greening plan to bring interest and profit to the villagers

B.4.1.2 Concept plan for appropriate forest management

(1) Normal forest;
Restriction of forest resources use & Reconsideration of the Forest Management system
(2) Degraded forest;
Improvement of Forest composition and Reconsideration of the Forest Management system
(3) Severely degraded forest;
Concentrate working to soil erosion conservation
(4) Related issues

- Expansion & Improvement of the Nursery
- Practice of Scientific research of natural conditions (e.g. Micro-meteorological condition, Soil erodibility, Plant community and Right planting condition)
- Establishment of Scientific monitoring system
- Proposition as to appropriate erosion and torrent control works
- Proposal of Ornamental plant and floriculture product for new income source
- Adequate measure for preventing outflow of the sedimentation in the gully and riverbed
- Stabilized River channel by planting tree (e.g. Poplars, Salix)

B.4.1.3 Criteria for Rehabilitation and Management of the Natural Resources

With regard to selection and apply of kind of activities to area have dealt consideration of Table B.4.1-1, basically. In the case, have made reference the Slope Map, Vegetation Coverage Map, Re-vegetation Potential Map and the Forest Management Map which attached to Appendix.

Table B.4.1-1 Criteria for Rehabilitation and Management of the Natural Resources

	Altitude/ Timber line (m)	Actual Land use	Inclination	Soil Erodibility	Imaginable Re-greening Action
SOIL EROSIN CONTROL (Fall off the mountainside)	<2400	Normal high forest	0-45%	Severe erodibility	Forest conservation Natural regeneration
				Moderate erodibility	Adequate Forest management Natural regeneration
			>45%	Severe erodibility	Forest conservation Natural regeneration
				Moderate erodibility	Forest conservation Natural regeneration
		Degraded high forest land	0-45%	Severe erodibility	Forest conservation Natural regeneration
				Moderate erodibility	Adequate Forest management Artificial seeding regeneration
			>45%	Severe erodibility	Forest conservation Natural regeneration
				Moderate erodibility	Forest conservation Natural regeneration
		Degraded coppice land	0-45%	Severe erodibility	Forest conservation Natural regeneration
				Moderate erodibility	Coppice rehabilitation & management Enrichement planting
			>45%	Severe erodibility	Forest conservation Natural regeneration
				Moderate erodibility	Forest conservation Natural regeneration
SOIL EROSIN CONTROL (Fall off the mountainside)	<2400	Unwooded land	0-12%	Severe erodibility	Pasuture improvement with soil erosion control measures
				Moderate erodibility	Pasuture improvement Afforestation by conventional method
			12-30%	Severe erodibility	Silvi-Pastral / Fruits culture with soil erosion control measures
				Moderate erodibility	Silvi-Pastral / Fruits culture / Afforestation (hole+forest species planting) Afforestation (hole+local species mixed planting)
			30-45%	Severe erodibility	Grazing control Natural regeneration
				Moderate erodibility	Grazing control / Pasture improvement Re-greening (hole+shurub,harbaceous) Re-greening (nursing block method)
			>45%	Severe erodibility	Grazing control by fencing Natural regeneration
				Moderate erodibility	Grazing control Natural regeneration
		Arable land	0-12%		Agriculture
			12-30%		Uplandcrops with soil erosion control measures
			30-45%		Silvi-Pastral / Fruits culture
			>45%		Grazing control Natural regeneration

SOIL EROSIN CONTROL (Fall off the mountainside)	<2400	Randeland	0-45%	Severe erodibility	Adequate Rangeland rehabilitation with soil erosion control measures by fencing
				Moderate erodibility	Adequate Rangeland management Pasture improvement
			>45%	Severe erodibility	Grazing control by fencing Natural regeneration
				Moderate erodibility	Adequate Rangeland management Pasture improvement
		Others	0-45%	Severe erodibility	Agriculture / Pasuture with soil erosion control measures
				Moderate erodibility	Agriculture / Pasuture
			>45%	Severe erodibility	Protected actual land condition
				Moderate erodibility	Natural regeneration Protected actual land condition
	>2400				
UNFIXWD RIVER CHANNEL		Unfixed River channel			Riverside plantation
SHELTER BELT (anti-avalanche, windbreak, etc)		Hazard area			Zonary plantation around settlement

B.4.2 Proposed Activities

-Vegetative Works-

I. Soil Conservation

I-1 Natural Regeneration

Appropriate sites

- The sites of more than 45% inclination.
- The sites that has severe erodibility at less than 45% inclination.

Applications

- To eliminate all interference by humankind and barn animal and entrust recovery of vegetation to the nature power.
- To establish a fence in the outskirts of a site if it is necessary.

I-2Afforestation (type-1)

Appropriate sites

- The sites of less than 30% inclination and the surface soil layer are comparatively thick.
- The moderate erodibility sites.

Applications.

- To planting seedling of forest tree species (e.g. *Pinus sylvestris, Quercus sp., Robinia psedoacacia*) on conventional terrace along contour line.
- Planting density is 1,500 seedlings/ha.

I-3 Afforestation (type-2)

Appropriate sites

- The sites of less than 30% inclination and the surface soil layer are moderately thin.
- The moderate erodibility sites.

Applications.

- To planting seedling of local tree species (e.g. *Betula sp., Carpinus sp., Fraxinus sp.,Jugras sp., Quercus sp.,Ostrya carpinifolia, Populus tremula*).
- Planting density is 2,000 seedlings/ha.
- Key point of planting.
  1. To remove stone, about 60~70cm diameter fringe on planting point.
  2. To dig 30cm diameter and a planting hole of around 25cm deep
  3. To launder root and stone in a hole, and making flake a soil lump.
  4. To rake soil in planting hole.
  5. To widen a seedling root and put it in planting hole to moderately deepen.
  6. To support a seedling in the left hand and put the soil which scraped out by the right hand around a root.
  7. In this time, do not put a stone or a root in planting hole.
  8. To plow slant of planting hole newly and give soil to a seedling.
  9. To stamp around a seedling moderately.

Mostly use plants

The following trees can be regarded as main species in the Coruh catchment.

Picea orientalis	*Juniperus feetidissima*
Pinus sylvestris	*Ostrya carpinifelia*
Alnus glutinosa	*Populus tremula*
Betula pendula	*Quercus robur*
Betula medwediewii	*Quercus petraea*
Carpinus betulus	*Quercus cerris*
Carpinus orientalis	*Quercus vulcanica*
Celtis graglabrata	*Quercus ilex*
Fraxinus excelsior	*Robinia pseudoacacia*
Fraxinus augustifola	*Tilia tomentosa*
Fraxinus ornus	*Tilia platyphllos*
Jugras regia	*Tilia rubra*
Juniperus oxycedrus	

I-4 Re-greening (type-1)

Appropriate sites

- The sites of between 30% to 45% inclination and the surface soil layer are comparatively thin.
- The moderate erodibility sites.

Applications.

- To planting seedling of local shrubs and grass species (e.g. *Astragalus gummifer, Berberis sp., Crataegus sp., Ribes sp., Calicotome sp., Vicia sp.*).
- Planting density is 3,000 seedlings/ha.
- Key point of planting.

1. To remove stone, about 60~70cm diameter fringe on planting point.
2. To dig 30cm diameter and a planting hole of around 25cm deep
3. To launder root and stone in a hole, and making flake a soil lump.
4. To rake soil in planting hole.
5. To widen a seedling root and put it in planting hole to moderately deepen.
6. To support a seedling in the left hand and put the soil which scraped out by the right hand around a root.
7. In this time, do not put a stone or a root in planting hole.
8. To plow slant of planting hole newly and give soil to a seedling.
9. To stamp around a seedling moderately.

Mostly use plants

The following trees can be regarded as main species in the Coruh catchment.

Shrubs

Amelanchiere rotundifolis subs. rotundifolia
Amelanchiere rotundifolis subs. integrifolia
Amygadalus fenzliana
Astragalus microcephalus
Astragalus gummifer
Astraphaxis spinosa
Berberis vulgaris
Berberis nummularia
Berberis crategia
Berberis integerrima
Cerasus mahaleb
Cistus creticus
Cistus salvifolia
Colutea armene
Cornus mas
Cornus sangninea
Cotinus coggygria
Cotoneaster integerrimus
Cotoneaster nummularia
Crataegas pentagyna
Crataegus pontica
Genista albida
Genista tinctria
Genista pentica
Irex colchica
Paliurus aculatus
Paliurus spinacristi
Prunus spinosa
Pyracantha coccinea
Pyrus eleagnifolia
Pyrus salicifolia
Pyrus amygdaliformis
Ribes biebersteinii
Ribes kusnetzorii
Rhamnnus pallasii
Rhus coriaria
Rubus canascens
Rosa canina
Sorbus kusnetzorii
Sorbus roopiana
Sorbus umbellate var. cretica
Zyzyphus jujube

Herbage

Avwna sterilis
Bromus sp.
Calicotome villosa
Calicotome spinosa
Cytisus villosus
Cynodon dactylon
Eleagnus angustifolia
Madicago sativa
Vicia sp.

I-5 Re-greening (type-2)

"Nurse Block" is the soil block which has penetrated hole centrally for extend a root system of tree to deepening in the ground, like a natural growing. And this block dig in a ground for do it a growing up base of tree. "Nurse Block" is made by soil + organic materials + anionic coagulant + resin.

Appropriate sites

- The sites of between 30% to 45% inclination and the surface soil layer are comparatively thin.
- The moderate erodibility sites.
- In particular, climate condition and soil condition are severe sites.

Applications

- To planting seed is Quercus species.
- Density is 3,000 "Nurse Block" /ha.
- Key point of planting.
  1. To remove stone, about 60~70cm diameter fringe on planting point.
  2. To dig 30cm diameter and a planting hole of around 25cm deep
  3. To launder root and stone in a hole, and making flake a soil lump.
  4. To rake soil in planting hole.
  5. To put "Nurse Bloch" in hole, and sawing 3~5 seeds in each hole of "Nurse Block".
  6. To plow slant of planting hole newly and give soil to a seedling.

Characteristic of Nurse Block methods

- Surface water is maintained by block; therefore survival ration of plant will be increased.
- Bring up drought resistant of plant due to extend root system to deepening in the ground by penetration hole of block.
- The block is lightweight and hard to fail, and has advantage of carrying, application is easy

Production method of Nurse Block.

(1) To mix the soil and organic materials (e.g. marc of sugar beet, goat feces) in a ratio of 2:1.
(2) To mix fertilizer of around 15g to soil 1 liter.
(3) To mix 3g of anionic coagulant with 3g of resin, after that combine it and 20 liter's water.
(4) To mix 1.2 liter's (3) solution and 10 liter's soil.
(5) To make block by the use of simple press machine and dry it on 2 ~ 3 days.

II. Afforestation

Appropriate sites

- The sites of less than 30% inclination and the surface soil layer are comparatively thick.
- The moderate erodibility sites.

Applications

- To planting seedling of tree species (e.g. *Pinus sylvestris, Quercus sp., Robinia psedoacacia*) on conventional terrace along contour line.
- May plant of suitable other trees species, if possible.
- Planting density is 1,500 seedlings/ha.

III. Rehabilitation of Degraded High Forest

III-1 Natural Regeneration

Appropriate sites

- The sites of more than 45% inclination.
- The sites that has severe erodibility at less than 45% inclination.

Applications

- To eliminate all interference by humankind and barn animal and entrust recovery of vegetation to the nature power.
- To establish a fence in the outskirts of a site if it is necessary.

III-2 Rehabilitation

Appropriate sites

- The sites of less than 45% inclination.

Applications

- Rejuvenation cutting
- Thinning
- Enrichment by planting seedlings

IV. Rehabilitation of Degraded High Forest

IV-1 Natural Regeneration

Appropriate sites

- The sites of more than 45% inclination.
- The sites that has severe erodibility at less than 45% inclination.

Applications

- To eliminate all interference by humankind and barn animal and entrust recovery of vegetation to the nature power.
- To establish a fence in the outskirts of a site if it is necessary.

IV-2 Rehabilitation

Appropriate sites

- The sites of less than 45% inclination.

Applications

- Rejuvenation cutting
- Thinning
- Distribute seed for enrichment

V. Energy Forest Planting

Appropriate sites

- The sites of less than 30% inclination and the surface soil layer are comparatively thick, if possible.
- The moderate erodibility sites.

Applications

- To planting seedling of first growing tree species (e.g. *Poplus nigra, Eucalyptus sp., Acacia sp.*) on a planting hole.
- May plant of suitable other trees species, if possible.
- Planting density is 1,500 seedlings/ha.

VI. Rangeland Rehabilitation

VI-1 Natural Regeneration

Appropriate sites

- The sites of more than 45% inclination.
- The sites that has severe erodibility at less than 45% inclination.

Applications

- To eliminate all interference by humankind and barn animal and entrust recovery of vegetation to the nature power.
- To establish a fence in the outskirts of a site if it is necessary.

VI-2 Rangeland Improvement

Appropriate sites

- The sites of less than 45% inclination.

Applications

- Control grazing, to establish a fence in the outskirts of a site if it is necessary.
- Fertilizer application
- Pasture grass seed sowing
- Setting of water troughs and salt throus

VII. Riverside Plantation

Applications.

- Zigzag planting of *Poplus nigra, Salix sp*. and other suitable species to stabilize soils.

-Physical Works-

I. Gully Protection (Gabion type Gully Plug)

Gully plug is one of the sediment control barrier that is meant to mitigate gully erosion, by using a gabion (cage type mat). Gully plug can filter out permeating water freely. The function of Gully Plug is follow;

1. To prevent landslide
2. To control erosion and water/soil run-off
3. To improve the surrounding environment

Technical consideration of Gully Plug construction

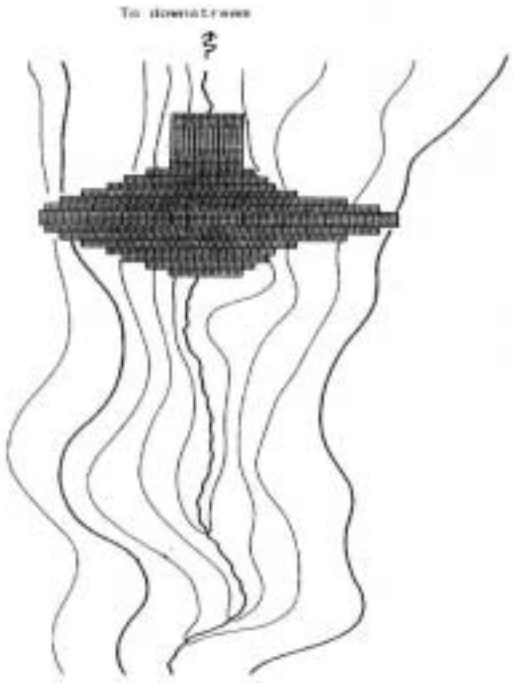
1. Circumferential land slope is less than 30%
2. Senseful catchments area is smaller than 10 ha
3. Maximum width and depth is 3m respectively
4. Length of plot is maximally 250 meters
5. Maximum plot slope gradient is 5%
6. To select suitable place for construction, such as tight shores, bed rock comes out at river bed, and narrowing place of river
7. To select the adequate construction site this is just downward meeting point with tributaries
8. To select the adequate construction site this is just downward slope collapse point or slope collapse hazard area
9. To select the adequate construction site this is downward of debris flow deposition zone
10. With regard to direction of dam, the outlet center should be at right angle to center

line of downstream

11. With regard to the proposed slope of deposition surface, if river is composed from fine sand and gravel, the slope surface should be almost horizontal.
12. To have anchor for fixing gabions and prevention film of soil draw-out in place, if needed.

Standard Design

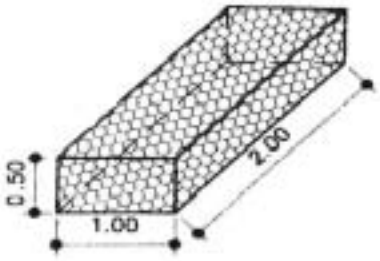
Cross section of Gully Plug
(Gabion type)
H=1.5m



Over view of Gully Plug

Standard Design of Gully Plug (Gabion type)

Fill up stone in cage



Standard Design of
Gabion (Cage type mat)

B.4.3 Unit Cost

Table B.4.3-1 Unit Cost for Rehabilitation and Management of the Natural Resources

ACTIVITY	UNIT	COST (Mil TL)
1. Soil Conservation		
1.1 Natural regeneration	Ha	64
1.2 Afforestation (type-1)	Ha	1,806
1.3 Afforestation(type-2)	Ha	2,060
1.4 Re-greening (type-1)	Ha	2,892
1.5 Re-greening (type-2)	Ha	2,615
1.6 Gully protection (Gabion type)	10 Units	5,418
1.7 Gully protection (Brush type)	10 Units	3,628
2. Rehabilitation of Degraded High Forest		
2.1 Natural regeneration	Ha	64
2.2 Rehabilitation	Ha	1,254
3. Rehabilitation of Degrade Coppice Forest		
3.1 Natural regeneration	Ha	64
3.2 Rehabilitation	Ha	1,096
4. Energy Forest Plantation	Ha	1,686
5. Rangeland Rehabilitation		
5.1 Natural regeneration	Ha	64
5.2 Rangeland improvement	Ha	520
5.3 Gully protection (Gabion type)	10 Units	5,418
5.4 Gully protection (Brush type)	10 Units	3,628
6. Riverside Plantation	Ha	6,610

B.4.4 Proposed relevant Activities

Table B.4.4-1 Training, Awareness, Capability Raising, Research, Demonstration, Technical Assistance

ACTIVITY
1. Research of Disaster Mechanism
1.1 Meteorological Observation (Precipitation, Temperature)
1.2 Water Level Observation (Flow velocity, Flow volume, Water level)
1.3 Monitoring of Sedimentation Quantity, Quality ()
2. Research of Local Species which for suited Erosion Control
2.1 Technical Assistance and Facilities Improvement of Nursery Works
3. Evaluation of Past Erosion Control Works
4. Formulation of Erosion Control Manual for Coruh catchment
5. On the Job Training of Erosion Control Planning and Technique
6. Environmental Education Local People and Students

B.4.5 Freshwater fisheries

Concept plan

- Practice of Scientific research of natural conditions (Water temp. & Water quality)
- Selection of ideal fish species and to make fly production and distribution plan
- Establishment of technical advice system
- Marketing & Proposition of direct sales method involved with tourism

Proposed Activities

By socio-economic survey, the demand of refrigeration system of fresh fish and market development were given, but are hard to meet an activity of this study purpose.

B.4.6 Tourism

Concept plan

- Establishment of Eco-museum plan in the Study area & precinct
- Establishment of Regional center (Information function, relaxation function, Regional products sales function and Snack function) & Network plan of truism resources in the Study area
- Proposal of public information

Proposed Activities

- Research for Eco-truism potential
- Research for Wildlife inventories

B.5 Watershed Rehabilitation and Management Activities for Selected Micro-Catchments

B.5.1 The Micro-Catchment BT-04 Rehabilitation and Management Project

B.5.1.1 Condition of Micro-Catchments

(1) Location and Geographical Conditions of the MC

The micro-catchments BT-04 (hereinafter to as the MC) is located in the north-eastern of the Coruh river basin, and constitutes the upper most catchments of the Berta river which is one of the major tributaries of the Coruh river. Total area of the MC is some 18,600 hectares. The MC is triangular shape with the apex in the north. The base length is approximately 15 km east to west and the height is some 20 km north to south. The MC consists of one tributary to the Berta river, the Hanli stream, the flow of which originates from the southern mountain range with its highest peak of 3,000m above sea level. The Hanli stream flows from south to north with the average incline of 1:10, and join the Berta river at some 7km west of Savsat municipality which is the main administrative center for the MC.

There is one notable tributary to the Hanli stream, the Cavdarli stream, the flow of which originates from the back of the Cevdarli village and joins the Hanli stream before it conjoins the Berta river. The altitude of the MC is between 800m and 3,000m above sea level. The MC is largely characterized by gentle topography with 30% of the land being between 0% and 12% of slope and 50% of the land between 12% and 30%. The climate in the MC is characteristically hot in summer and cold with snowfall in winter, and the mean annual rainfall is about 660 mm in Artvin, which is located about 50km south-western from Savsat and the provincial capital of Artvin to which the MC belongs. Despite of the relatively short distance from the main road D010 running along the northern border of the MC to Savsat, access to most of the villages in the MC is relatively hard due to narrow and poor condition of the road.

(2) Natural Resources and Present Land Use

For the land use pattern of the MC, the dominant land use is transitional woodland and shrub (36%), followed by rangeland (30%), forest (26%), and arable land (7%) based on 2001 satellite image analysis data. According to the management plan, degraded high forest (BK) and degraded coppice forest (BBt) are dominant. The MC, located in the area with rather rich of natural habitats compared to the other areas of the Coruh catchments has no officially-designated Protected Areas within.

The dominant geological type is Upper Creatceous Volcanic Fcies, but in the southern part is dominantly A. The most common soils are Brown forest, high mountain pasture land soils, which are generally infertile and shallow. Based on the GDRS digital data, about 46% of the MC has Class 3 soil erosion (Severely), and most of the rest of the MC is in Class 2 (Moderately). Most areas needing rehabilitation for rangeland and degraded coppice forest have good potential, and some limited areas need erosion control. About 80% of the MC is in Land Capability Classes VI, VII and VIII by GDRS.

B.5.1.2 Major problems, Development needs, Constraints and Opportunities

(1) Major problems:

- Destruction/degradation of forests by local people to meet their energy needs for heating and cooking.

Priority problems identified and possible solutions as suggested by villagers

Problems	Solutions
1. Illicit cuttings and degradation of forests. 2. High costs and inadequate knowledge of alternative energy sources.	• Improvement and reforestation of degraded forests, establishment of village energy forests on suitable sites. • Provision of fuelwood needs of local people to the extent possible, within the capacity of forests. • Provision of coal at suitable prices. • Assistance in testing/development of other energy sources, such as bio-energy, solar energy.

(2) Constrains on conservation, rehabilitation and suitable use of natural resources:

- High dependency on excessive utilizations of upland resources.
- Inadequate attention on local needs during preparation of forest
- management plans.
- Lack of confidence between villagers and governmental agencies.
- Insufficient staff capacities of the MEF and other relevant government
- agencies.
- Insufficient collaboration among different government agencies.
- Lack of adequate awareness of local communities about causes and consequencies of natural resources degradation and disasters.
- Incomplete cadastral surveys and vague borders of the forests and rangelands. Unclear rights of AGM for working on OT (Forest soil without trees- Forest management plan) areas.

(3) Opportunities for conservation, rehabilitation and sustainable use of natural resources:

- Most areas needing rehabilitation have good potential.
- The potential for better maintenance of standing coniferous forests and oak coppice forests depends on cooperation by villagers
- The potential for better rangeland management will depend on MARA, and on cooperation between MARA, MEF and villagers.
- Natural resources degradation is reversible by adopting appropriate approaches and methods.
- There is growing interest in the MC villagers for collaborating with MEF-AGM for undertaking collaborative in conducting soil conservation and afforestation activities.
- Existence of wide variety of multipurpose local tree, shrub and grass species for undertaking technically successful and socially acceptable rehabilitation activities.

(4) Level of interest in natural resources conservation: Medium

(5) Current strategies and contributions of the government agencies:

- Forest villagers in the MC are permitted to collect fuelwood from the forests depending on their capacity in the village area by paying modest charges to MEF-OGM.
- MEF-ORKOY provides low interest credit support to forest villagers and cooperatives for increasing their income and for improving relations with the forest organization.
- AGM, OGM and MPG contract protection of forest and wildlife conservation areas to forest village communities by making certain payments to village budget. AGM has also started recently contracting of soil conservation works and tending of such areas to the village communities that have interest and capacity for undertaking such activities.
- Cadastre and border delineation works for range areas are being undertaken by MARA.
- Stream bed and bank rehabilitation activities are being taken by GDRS and DSI.
- Increased interest and efforts to involve local people in natural resources conservation and rehabilitation in combination with livelihood development among different units of MEF.

B.5.1.3 Proposed activities

ACTIVITY	LOCATION	APPROX. AREA	COMMENTS
1. Afforestation	Cavdarli stream	133 ha	
2. Rehabilitation of Degraded Coppice Forest			
(Activity 1): Natural regeneration	Aradall stream (Hanli)	50 ha	Implement Activities 1 and 2
(Activity 2): Rehabilitation	Aradall stream (Kirecli)	52 ha	Implement Activities 1 and 2
	Civik, Karaagac strem	171 ha	Implement Activities 1 and 2
3. Energy Forest Plantation	Cavdarli stream (Ciftik)	150 ha	
	Aradall stream (Kirecli)	40 ha	
4. Rangeland Rehabilitation			
(Activity 1): Natural regeneration	Aradall stream (Kirecli)	269 ha	Implement Activities 1,2,3 and 4
(Activity 2): Rangeland improvement			
(Activity 3): Gully protection (gabion type)			
(Activity 4): Gully protection (brush type)			
5. Riverside Plantation	Cavdarli stream (Cavdarli)	0.4 ha	
	Aradall stream (Hanli)	0.4 ha	

DEFINITION OF ACTIVITIES;	
1.Soil Conservation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Afforestation (type-1)	Conventional terracing and planting of forest tree species
Afforestation (type-2)	Plant local tree species, usually in a planting hole
Re-greening (type-1)	Plant local shrub and grass species, usually in a planting hole
Re-greening (type-2)	Plant *Quercus* species seed in a block
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
2. Afforestation	Conventional terracing and planting of forest tree species
3. Rehabilitation of Degraded High Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and enrich by planting Seedlings
4. Rehabilitation of Degraded Coppice Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and distribute seed for Enrichment
5. Energy Forest Plantation	Planting of fast-growing species for fuelwood production
6. Rangeland Rehabilitation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rangeland improvement	Controlled grazing, fertilizer applications, seed sowing and water troughs
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
7. Riverside Plantations	Zigzag planting of poplars, willows and other suitable species to stabilize soils

B.5.1.4 Activities, Effects, Benefits, Inputs and Cost for Project

ACTIVITY	QUANTIFIED BENEFITS FOR VILLAGERS & OTHER STAKEHOLDERS	QUANTITY OF INPUTS	COST OF INPUTS	COMENTS
Natural Resources				
1. Afforestation	-Declining soil erosion -Increasing both quality and -quantity of tree growing stock -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetics value of the landscape	133 ha	240 BTL	
3. Rehabilitation of Degraded Coppice Forest	-Decreasing soil erosion -Increasing both quality and quantity of tree growing stock -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape	273 ha	189 BTL	Activities include: 1. Rehabilitation 2. Natural regeneration
3.Energy Forest Plantation	-Decreasing soil erosion -Increasing vegetation coverage -Increasing both quality and quantity of tree stock -Increasing quantity of firewood subsidy -Decreasing illicit cutting for firewood -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of the landscape.	190 ha	613 BTL	
4. Rangeland Rehabilitation	-Declining soil erosion -Increasing vegetation coverage -Increasing fodder production -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape	269 ha	219 BTL	Activities include: 1. Natural regeneration 2. Rangeland improvement 3. Gully plugging 4. Watering troughs
5. Riverside Plantation	-Protection of inhabitant's livelihood and farmland -Environmental improvement -Ensuring employment -Increasing aesthetics value of the landscape.	0.8 ha	5 BTL	
6.Riverbank Protection	-Protection of inhabitants' livelihood and farmland -Ensuring satisfactory and secured living conditions.	2,050 m	1,374 BTL	Activity includes: Construction of Riverbank protection (Gabion type). H=1.0m
Sub-total cost			2,640 BTL	

B.5.2 The Micro-Catchment MC-03 Rehabilitation and Management Project

B.5.2.1 Condition of Micro-Catchment

(1) Location and Geographical Conditions of the MC

The micro-catchments MC-03 (hereinafter to as the MC) is located in the central part of the Coruh river basin with the area of some 21,600 hectares. It extends in the south of the Yusufeli municipality which is the center of the Yusufeli district to which the MC belongs. The MC is approximately 22 km long east to west and 23 km wide north to south. The Coruh river forms the northern boundary of the MC, which is characterized by extremely rocky and steep topography, especially along the gorge of the Coruh river. The Coruh river moderately flows down at the mean incline of 1:85. The altitude of the MC is between 600m and 3,000m above sea level. There are 8 significant tributaries in the MC: the Kavus, Buyukkotenek, Vardenet, Sekisel, Balsuyu, Kilickaya, Ardere, and Hapishor streams, which often cause floods, are fast forming deeply dissected valleys. For example, the Hapishor stream, which originates near the southern border of the MC, flows down to the north and join the Coruh river with average incline of 1:5.

The MC is largely characterized by very steep topography with 20% of the land being over 45% of slope and less than 10% of the land between 0% - 12%. The climate in the MC varies according to the altitude. Lower area along the Coruh river is very hot and very dry in summer and relatively warm in winter due to the micro climate, which allows local people to grow various kinds of crops in winter. The mean annual temperature is 15.0℃, the mean maximum temperature is 26.3 ℃ (August), the mean minimum temperature is 3.8℃ (January) and the mean annual rainfall is about 300 mm in Yusufeli (Elevation, 611m). Access to Kilickaya and Celtikduzu is good or adequate as the villages located relatively near the asphalted road D050, but most on the other villages in the MC is difficult in general due to the steep topography, for example, the road is long and terrible to access Bakietepe, and inferior to Alanbasi.

(2) Natural Resources and Present Land Use

For the land use pattern of the MC, the dominant land use is forest (44%), followed by rangeland (21%), arable land (18%), and others (14%) based on 2001 satellite image analysis data. According to the management plan, xx% is high forest (type NK), and most of the remaining area is degraded high forest (BK). There is some degraded coppice forest (BBt) area. The northern end of the MC, starting from around Irmakyani, which is slightly out of the MC, is designated as a wild life conservation area spreading northward beyond the MC and border forming a habitat for hooked horn wild goats.

The dominant geological type is Eocene Volcanic Fcies and Eocene Flysh, but in the northern part is dominantly Y. The most common soils are Brown forest soils, which are generally infertile and shallow. Based on the GDRS digital data, about 65% of the MC has Class 3 soil erosion (severely), and most of the rest of the MC is in Class 2 (Moderately). Potential for rehabilitation of soil disasters are generally poor, due to the severe constrains. All streams are delivering large quantities of debris to the Coruh

and Tortum River, and the streams join the Tortum river are generally turbid. About 96% of the MC is in Land Capability Classes VI, VII and VIII by GDRS.

B.5.2.2 Major problems, Development needs, Constraints and Opportunities

(1) Major problems:

- Natural disaster (e.g. floods) and soil erosion due to fragile site (e.g. geology, soil, topography) and over-use/degradation of forest and range resources.
- Destruction/degradation of forests by local people to meet their energy needs for heating and cooking.

Priority problems identified and possible solutions as suggested by villagers

Problems	Solutions
1. Natural disasters (e.g. floods, avalanches, landslides). 2. Soil erosion, de-regulation and losses of water resources.	• Soil conservation measures on degraded area.
3. Illicit cuttings and degradation of forests. 4. High costs and inadequate knowledge of alternative energy sources.	• Improvement and reforestation of degraded forests, establishment of village energy forests on suitable sites. • Provision of fuelwood needs of local people to the extent possible, within the capacity of forests. • Provision of coal at suitable prices. • Assistance in testing/development of other energy sources, such as bio-energy, solar energy.
5. Degradation, low productivity, under-utilization of range resources.	• Range improvement measures (e.g. water troughs, re-seeding, fertilization). • Development of forage production on suitable lands. Supporting/development of stall-feeding.

(2) Constrains on conservation, rehabilitation and suitable use of natural resources:

- Extremely steep and unstable slopes, especially in the gorge of the Coruh River.
- Shallow soils and very dry climates.
- Variable, but often severe, village opposition to involvement in erosion control work.
- Degraded conditions and low productivity of the significant parts of the forest resources.
- High dependency on excessive utilizations of upland resources.
- Inadequate attention on local needs during preparation of forest management plans.
- Lack of confidence between villagers and governmental agencies.
- Insufficient staff capacities of the MEF and other relevant government agencies.
- Insufficient collaboration among different government agencies.
- Lack of adequate awareness of local communities about causes and consequencies of natural resources degradation and disasters.
- Incomplete cadastral surveys and vague borders of the forests and rangelands. Unclear rights of AGM for working on OT (Forest soil without trees- Forest management plan) areas.

(3) Opportunities for conservation, rehabilitation and sustainable use of natural resources

- The potential for rehabilitation is restricted by the extremely harsh conditions and by opposition from villagers.
- Some potential for oak coppice treatments, improved grazing control.
- There is growing interest in the MC villagers for collaborating with MEF-AGM for undertaking collaborative in conducting soil conservation and afforestation activities.
- Existence of wide variety of multipurpose local tree, shrub and grass species for undertaking technically successful and socially acceptable rehabilitation activities.

(4) Level of interest in natural resources conservation: Medial Low

(5) Current strategies and contributions of the government agencies:

- Forest villagers in the MC are permitted to collect fuelwood from the forests depending on their capacity in the village area by paying modest charges to MEF-OGM.
- MEF-ORKOY provides low interest credit support to forest villagers and cooperatives for increasing their income and for improving relations with the forest organization.
- AGM, OGM and MPG contract protection of forest and wildlife conservation areas to forest village communities by making certain payments to village budget. AGM has also started recently contracting of soil conservation works and tending of such areas to the village communities that have interest and capacity for undertaking such activities.
- Cadastre and border delineation works for range areas are being undertaken by MARA.
- Stream bed and bank rehabilitation activities are being taken by GDRS and DSI.
- Increased interest and efforts to involve local people in natural resources conservation and rehabilitation in combination with livelihood development among different units of MEF.

B.5.2.3 Proposed activities

ACTIVITY	LOCATION	APPROX. AREA	COMMENTS
1. Soil Conservation			
(Activity 1): Natural regeneration	Selisel, Balsuyu stream	150 ha	Implement Activities 1,4,5,6 and 7
(Activity 2): Afforestation, (Type 1)	Hapisor stream	531 ha	Implement Activities 1,3,4,5,6 and 7
(Activity 3): Afforestation, (Type 2)	Kilickaya stream	150 ha	Implement Activities 1,4,5,6 and 7
(Activity 4): Re-greening (Type 1)			
(Activity 5): Re-greening (Type 2)			
(Activity6): Gully protection (gabion type)			
(Activity 7): Gully protection (brush type)			
2. Rehabilitation of Degraded High Forest			
(Activity 1): Natural regeneration	Hapisor stream	838 ha	Implement Activities 1 and 2
(Activity 2): Rehabilitation			
3. Rangeland Rehabilitation			
(Activity 1): Natural regeneration	Hapisor stream	394 ha	Implement Activities 1,2,3 and 4
(Activity 2): Rangeland improvement			
(Activity 3): Gully protection (gabion type)			
(Activity 4): Gully protection (brush type)			

DEFINITION OF ACTIVITIES;	
1.Soil Conservation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Afforestation (type-1)	Conventional terracing and planting of forest tree species
Afforestation (type-2)	Plant local tree species, usually in a planting hole
Re-greening (type-1)	Plant local shrub and grass species, usually in a planting hole
Re-greening (type-2)	Plant *Quercus* species seed in a block
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
2. Afforestation	Conventional terracing and planting of forest tree species
3. Rehabilitation of Degraded High Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and enrich by planting Seedlings
4. Rehabilitation of Degraded Coppice Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and distribute seed for Enrichment
5. Energy Forest Plantation	Planting of fast-growing species for fuelwood production
6. Rangeland Rehabilitation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rangeland improvement	Controlled grazing, fertilizer applications, seed sowing and water troughs
	Gully plugging using gabion walls
Gully plugging (gabion type)	Gully plugging using brush walls
Gully plugging (brush type)	
7. Riverside Plantations	Zigzag planting of poplars, willows and other suitable species to stabilize soils

B.5.2.4 Activities, Effects, Benefits, Inputs and Cost for Project

ACTIVITY	QUANTIFIED BENEFITS FOR VILLAGERS & OTHER STAKEHOLDERS	QUANTITY OF INPUTS	COST OF INPUTS	COMENTS
Natural Resources				
1. Soil Conservation	-Decreasing soil erosion -Increasing vegetation coverage -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of the landscape.	831 ha	1,063 BTL	Activities include: 1. Natural regeneration 2. Afforestation 3. Re-greening 4. Gully plugging
2. Rehabilitation of Degraded High Forest	-Decreasing soil erosion -Increasing both quality and quantity of tree growing stock -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of the landscape.	838 ha	352 BTL	Activities include: 1. Rehabilitation 2. Natural regeneration
3. Rangeland Rehabilitation	-Declining soil erosion -Increasing vegetation coverage -Increasing fodder production -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape	394 ha	269 BTL	Activities include: 1. Natural regeneration 2. Rangeland improvement 3. Gully plugging 4. Watering troughs
Sub-total cost			1,684 BTL	

B.5.3 The Micro-Catchment TR-06 Rehabilitation and Management Project

B.5.3.1 Condition of Micro-Catchment

(1) Location and Geographical Conditions of the MC

The micro-catchments TR-06 (hereinafter to as the MC) is located roughly south-eastern of the Coruh river basin, and constitutes a part of the middle catchments of the Tortum river which is one of the major tributaries of the Coruh river, and the Tortum lake adjoin with the west boundary of the MC. Total area of the MC is some 30,700 hectares. The main administrative center for the MC is Uzundere municipality, it is located roughly south-west in the MC. The MC is approximately 21 km long east to west and 36 km wide north to south. The Tortum river forms the western boundary of the MC, which is characterized by extremely steep bald mountains, especially along the Torutum lake. The Tortum river moderately flows down at the mean incline of 1:55. The altitude of the MC is between 800m and 3,000m above sea level. The MC consists of 5 significant tributaries to the Tortum river: the Cevizli, Kilizli, Sapaca, Uzun, and Tasbasi streams.

The MC is characterized by extremely steep bare rocky slopes with active natural erosion and slides, especially along the Cevizli, Kilizli, and Sapaca streams. The MC has 33% of severe slope land and 26% of very severe slope land. There is 30% of Moderate slope land, too. The climate is characteristically hot in summer and cold with snowfall in winter. The mean annual temperature is 8.3℃, the mean maximum temperature is 19.6 ℃ (July), the mean minimum temperature is -3.4℃ (January) and the mean annual rainfall is about 430 mm. Access to most of the villages in the MC is good or adequate as the villages located relatively near the asphalted road D950, which runs north and south along the Coruh river, but very poor to Cevizli.

(2) Natural Resources and Present Land Use

For the land use pattern of the MC, the dominant land use is rangeland (37%), followed by forest (28%), arable land (19%), and others (14%) based on 2001 satellite image analysis data. According to the management plan, xx% is high forest (type NK), and most of the remaining area is degraded high forest (BK). There is seldom normal coppice forest (Bt) and some area of degraded coppice forest (BBt) are present. The Tortum lake consists a feature of the MC with its relatively large area of still water and Tortum fall, being a major tourist/recreational spot of the area. There are no officially-designated Protected Areas in the MC at present, but area Tortum lake along with its surroundings has been recently applied for its registration as a nature park, and is deemed to be designated in the near future.

The dominant geological type is Eocene Volcanic Fcies, but in the eastern part is dominantly Malm and in the western part is dominated K. The most common soils are Brown forest, which are generally infertile and shallow. Based on the GDRS digital data, about 40% of the MC has Class 4 soil erosion (Very severely), and most of the rest of the MC is in Class 3 (Severely). Potential for rehabilitation of soil disasters are generally poor, due to the severe constrains. The Cevizli, Kilizli, ans Sapaca streams are

delivering large quantities of debris to the Tortum River, and the streams are generally clear. About 97% of the MC is in Land Capability Classes VI, VII and VIII by GDRS.

B.5.3.2 Major problems, Development needs, Constraints and Opportunities

(1) Major problems:

- Natural disaster (e.g. floods, avalanche) and soil erosion due to fragile site (e.g. geology, soil, topography) and over-use/degradation of forest and range resources.
- Destruction/degradation of forests by local people to meet their energy needs for heating and cooking.
- Insufficient rangeland

Priority problems identified and possible solutions as suggested by villagers

Problems	Solutions
1. Natural disasters (e.g. floods, avalanches). 2. Soil erosion, de-regulation and losses of water resources.	• Soil conservation measures on degraded area.
3. Illicit cuttings and degradation of forests. 4. High costs and inadequate knowledge of alternative energy sources.	• Improvement and reforestation of degraded forests, establishment of village energy forests on suitable sites. • Provision of fuelwood needs of local people to the extent possible, within the capacity of forests. • Provision of coal at suitable prices. Assistance in testing/development of other energy sources, such as bio-energy, solar energy.
5. Degradation, low productivity, under-utilization of range resources.	• Range improvement measures (e.g. water troughs, re-seeding, fertilization). • Development of forage production on suitable lands. Supporting/development of stall-feeding.

(2) Constrains on conservation, rehabilitation and suitable use of natural resources:

- Extremely steep bare rocky slopes with active natural erosion and landslides.
- Frequent severe flash floods and considerable movement of coarse rocky debris in streambed.
- Degraded conditions and low productivity of the significant parts of the forest resources.
- High dependency on excessive utilizations of upland resources.
- Inadequate attention on local needs during preparation of forest management plans.
- Lack of confidence between villagers and governmental agencies.
- Insufficient staff capacities of the MEF and other relevant government agencies.
- Insufficient collaboration among different government agencies.
- Lack of adequate awareness of local communities about causes and consequencies of natural resources degradation and disasters.

- Incomplete cadastral surveys and vague borders of the forests and rangelands. Unclear rights of AGM for working on OT (Forest soil without trees- Forest management plan) areas.

(3) Opportunities for conservation, rehabilitation and sustainable use of natural resources

- Reversibility of natural resources degradation is generally poor, due to the severe constrains.
- Need for civil works to prevent gully erosion in selected area.
- There is growing interest in the MC villagers for collaborating with MEF-AGM for undertaking collaborative in conducting soil conservation and afforestation activities.

(4) Level of interest in natural resources conservation: Medium

(5) Current strategies and contributions of the government agencies:

- MEF-AGM has conducted some soil conservation activities on modest scale in the MC areas, including Sapaca, Altincanak, Kirazli, Cagalyan and Cevizli villages during previous years.
- Forest villagers in the MC are permitted to collect fuelwood from the forests depending on their capacity in the village area by paying modest charges to MEF-OGM.
- MEF-ORKOY provides low interest credit support to forest villagers and cooperatives for increasing their income and for improving relations with the forest organization.
- AGM, OGM and MPG contract protection of forest and wildlife conservation areas to forest village communities by making certain payments to village budget. AGM has also started recently contracting of soil conservation works and tending of such areas to the village communities that have interest and capacity for undertaking such activities.
- Cadastre and border delineation works for range areas are being undertaken by MARA.
- Stream bed and bank rehabilitation activities are being taken by GDRS and DSI.
- Increased interest and efforts to involve local people in natural resources conservation and rehabilitation in combination with livelihood development among different units of MEF.

B.5.3.3 Proposed activities

ACTIVITY	LOCATION	APPROX. AREA	COMMENTS
1. Soil Conservation			
(Activity 1): Natural regeneration	Near Caglayan	405 ha	Implement Activities 1,3,6 and 7
(Activity 2): Afforestation, (Type 1)	Upper Kilizli stream	111 ha	Implement Activities 1,5,6 and 7
(Activity 3): Afforestation, (Type 2)	Near Altincanak	279 ha	Implement Activities 1,3,6 and 7
(Activity 4): Re-greening (Type 1)	Near Sapaca	365 ha	Implement Activities 1,3,6 and 7
(Activity 5): Re-greening (Type 2)			
(Activity6): Gully protection (gabion type)			
(Activity 7): Gully protection (brush type)			
2. Rehabilitation of Degraded High Forest			
(Activity 1): Natural regeneration	Upper Armust stream	172 ha	Implement Activities 1 and 2
(Activity 2): Rehabilitation			
3. Rangeland Rehabilitation			
(Activity 1): Natural regeneration	Upper Kilizli stream	175 ha	Implement Activities 1,2,3 and 4
(Activity 2): Rangeland improvement			
(Activity 3): Gully protection (gabion type)			
(Activity 4): Gully protection (brush type)			
4. Riverside Plantation	Kilizli stream	0.2 ha	
	Sapaca stream	0.2 ha	
	Cevizli stream (Cevizli)	0.2 ha	

DEFINITION OF ACTIVITIES;	
1.Soil Conservation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Afforestation (type-1)	Conventional terracing and planting of forest tree species
Afforestation (type-2)	Plant local tree species, usually in a planting hole
Re-greening (type-1)	Plant local shrub and grass species, usually in a planting hole
Re-greening (type-2)	Plant *Quercus* species seed in a block
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
2. Afforestation	Conventional terracing and planting of forest tree species
3. Rehabilitation of Degraded High Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and enrich by planting Seedlings
4. Rehabilitation of Degraded Coppice Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and distribute seed for Enrichment
5. Energy Forest Plantation	Planting of fast-growing species for fuelwood production
6. Rangeland Rehabilitation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rangeland improvement	Controlled grazing, fertilizer applications, seed sowing and water troughs
	Gully plugging using gabion walls
Gully plugging (gabion type)	Gully plugging using brush walls
Gully plugging (brush type)	
7. Riverside Plantations	Zigzag planting of poplars, willows and other suitable species to stabilize soils

B.5.3.4 Activities, Effects, Benefits, Inputs and Cost for Project

ACTIVITY	QUANTIFIED BENEFITS FOR VILLAGERS & OTHER STAKEHOLDERS	QUANTITY OF INPUTS	COST OF INPUTS	COMENTS
Natural Resources				
1. Soil Conservation	-Decreasing soil erosion -Increasing vegetation coverage -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of the landscape.	1,160ha	1,105 BTL	Activities include: 1. Natural regeneration 2. Afforestation 3. Re-greening 4. Gully plugging
2. Rehabilitation of Degraded High Forest	-Decreasing soil erosion -Increasing both quality and quantity of tree growing stock -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of the landscape.	172ha	93 BTL	Activities include: 1. Rehabilitation 2. Natural regeneration
3. Rangeland Rehabilitation	-Declining soil erosion -Increasing vegetation coverage -Increasing fodder production -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape	175ha	189 BTL	Activities include: 1. Natural regeneration 2. Rangeland improvement 3. Gully plugging 4. Watering troughs
4. Riverside Plantation	-Protection of inhabitant's livelihood and farmland -Environmental improvement -Ensuring employment -Increasing aesthetics value of the landscape.	0.6 ha	4 BTL	
5. Riverbank Enforcement	-Protection of inhabitants' livelihood and farmland -Ensuring satisfactory and secured living conditions.	3,000 m	2,010 BTL	Activity includes: Construction of Riverbank protection (Gabion type). H=1.0m
Sub-total cost			3,401 BTL	

B.5.4 The Micro-Catchment UC-14 Rehabilitation and Management Project

B.5.4.1 Condition of Micro-Catchment

(1) Location and Geographical Conditions of the MC

The micro-catchments UC-14 (hereinafter referred to as the MC) is located south of Ispir municipality, which is the main administrative centre for the MC. The MC is approximately 20 km long east to west and 27 km wide north to south. Total area of the MC is some 31,200 hectares. The Coruh River forms the northwestern boundary of the MC, which is characterized by extremely steep land around most villages, except the rolling rangelands at Numanpasa. The Chorh river serenely flows down at the mean incline of 1:110. The altitude of the MC is between 1,000m and 3,100m above sea level. The MC consists of 6 significant tributaries to the Coruh river: the Goc, Gurulek, Bulanik, Asagullubag, Sehir and Kopruk streams. The MC has 43% of moderate land, and most of the rest is steep. There are few areas of flat colluvial soils. The climate is characteristically hot in summer and cold with snowfall in winter. Access to most of the villages in the MC is poor without to Koprukpoy, from the asphalted road D050, which runs north-eastern and south-western along the Coruh river.

(2) Natural Resources and Present Land Use

For the land use pattern of the MC, the dominant land use is rangeland (44%), followed by arable land (22%), forest (16%), transitional woodland and shrub (8%), and others (10%) based on 2001 satellite image analysis data. According to the management plan, xx% is high forest (type NK), and most of the remaining area is degraded high forest (BK). There are small areas of normal coppice forest (Bt) and degraded coppice forest (BBt) at the back of Kockoy. The northern end of the MC, starting from the north of Gockoy is designated as the Ispir-Vercenik Dagi wild life protection area, spreading northward beyond the MC and border forming a habitat for hooked-horn wild goats.

The predominant geological type is Eocene, Volcanic Facies except in the southern part, which is predominantly Lias and Malm. The most common soils are chestnut soils, Brown forest soils, and Basaltic soils, which are generally infertile and shallow. Based on the GDRS digital about 43% of the MC has Class 2 soil erosion (moderately), and most of the rest of the MC is in Class 3 (severely). The visible soil erosion is reversible using conventional techniques, except on steep slopes. Moreover, very little may be done to avoid or mitigate mass movements. With regard to large areas of rangelands, effective grazing control may certainly mitigate erosion on moderate and even steep slopes. About 87% of the MC is in Land Capability Classes VI, VII and VIII by GDRS.

B.5.4.2 Major problems, Development needs, Constraints and Opportunities

(1) Major problems:

- Natural disaster (e.g. floods) and landslide due to fragile site (e.g. geology, soil, topography) and over-use/degradation of forest and range resources.
- Destruction/degradation of forests by local people to meet their energy needs for heating and cooking.

Priority problems identified and possible solutions as suggested by villagers

Problems	Solutions
1. Natural disasters (e.g. floods, landslides). 2. Soil erosion, de-regulation and losses of water resources.	• Soil conservation measures on degraded area. • Riverbed rehabilitation (civil engineering measures), river bank rehabilitation (civil engineering structures, gulley plantation).
3. Illicit cuttings and degradation of forests. 4. High costs and inadequate knowledge of alternative energy sources.	• Improvement and reforestation of degraded forests, establishment of village energy forests on suitable sites. • Provision of fuelwood needs of local people to the extent possible, within the capacity of forests. • Provision of coal at suitable prices. Assistance in testing/development of other energy sources, such as bio-energy, solar energy.
5. Degradation, low productivity, under-utilization of range resources.	• Range improvement measures (e.g. water troughs, re-seeding, fertilization). • Development of forage production on suitable lands. Supporting/development of stall-feeding.

(2) Constrains on conservation, rehabilitation and suitable use of natural resources:

- Extremely steep land around most villages, except the rolling rangelands at Numanpasa.
- Generally erodible soils if bad managed.
- Degraded conditions and low productivity of the significant parts of the forest resources.
- High dependency on excessive utilizations of upland resources.
- Inadequate attention on local needs during preparation of forest management plans.
- Lack of confidence between villagers and governmental agencies.
- Insufficient staff capacities of the MEF and other relevant government agencies.
- Insufficient collaboration among different government agencies.
- Lack of adequate awareness of local communities about causes and consequencies of natural resources degradation and disasters.
- Incomplete cadastral surveys and vague borders of the forests and rangelands. Unclear rights of AGM for working on OT (Forest soil without trees- Forest management plan) areas.

(3) Opportunities for conservation, rehabilitation and sustainable use of natural resources

- Quite promising nature disaster conservation by using conventional methods.
- Need for civil works to prevent stream bank enforcement in selected area.
- Need for effective grazing control.
- Villagers' eagerness to tackle with natural disasters.
- There is growing interest in the MC villagers for collaborating with MEF-AGM for undertaking collaborative in conducting soil conservation and afforestation activities.

- Existence of wide variety of multipurpose local tree, shrub and grass species for undertaking technically successful and socially acceptable rehabilitation activities.

(4) Level of interest in natural resources conservation: High

(5) Current strategies and contributions of the government agencies:

- MEF-AGM has conducted some soil conservation activities on modest scale in the MC areas, along the Kopru stream during previous years.
- Forest villagers in the MC are permitted to collect fuelwood from the forests depending on their capacity in the village area by paying modest charges to MEF-OGM.
- MEF-ORKOY provides low interest credit support to forest villagers and cooperatives for increasing their income and for improving relations with the forest organization.
- AGM, OGM and MPG contract protection of forest and wildlife conservation areas to forest village communities by making certain payments to village budget. AGM has also started recently contracting of soil conservation works and tending of such areas to the village communities that have interest and capacity for undertaking such activities.
- Cadastre and border delineation works for range areas are being undertaken by MARA.
- Stream bed and bank rehabilitation activities are being taken by GDRS and DSI.
- Increased interest and efforts to involve local people in natural resources conservation and rehabilitation in combination with livelihood development among different units of MEF.

B.5.4.3 Proposed activities

ACTIVITY	LOCATION	APPROX. AREA	COMMENTS
1. Soil Conservation			
(Activity 1): Natural regeneration	Middle Goc stream	100 ha	Implement Activities 1, 3,4, 6 and 7
(Activity 2): Afforestation, (Type 1)	Upper Goc stream	126 ha	Implement Activities 1, 3,4, 6 and 7
(Activity 3): Afforestation, (Type 2)	Middle Kopruk stream	396 ha	Implement Activities 1, 2, 3, 6 and 7
(Activity 4): Re-greening (Type 1)	Near Koprukoy	106 ha	Implement Activities 1, 2, 3, 6 and 7
(Activity 5): Re-greening (Type 2)			
(Activity6): Gully protection (gabion type)			
(Activity 7): Gully protection (brush type)			
2. Afforestation	Near Durukoy	93 ha	Pine plantation
3. Rehabilitation of Degraded High Forest			
(Activity 1): Natural regeneration	Upper Kopruk stream	157 ha	Implement Activities 1 and 2
(Activity 2): Rehabilitation			
4. Rehabilitation of Degraded Coppice Forest			
(Activity 1): Natural regeneration	Middle Kopruk stream	108 ha	Implement Activities 1 and 2
(Activity 2): Rehabilitation	Upper Kopruk stream	99 ha	Implement Activities 1 and 2
5. Energy Forest Plantation	Deglirmexli stream (Durkoy)	140 ha	
	Bulanik stream (Numanpasa)	186 ha	
	Yayla stream (Kockoy)	93 ha	
6. Rangeland Rehabilitation			
(Activity 1): Natural regeneration	Upper Kopruk stream	558 ha	Implement Activities 1, 2, 3 and 4
(Activity 2): Rangeland improvement	Bulanik stream	100 ha	Implement Activities 1, 2, 3 and 4
(Activity 3): Gully protection (gabion type)			
(Activity 4): Gully protection (brush type)			

DEFINITION OF ACTIVITIES;	
1.Soil Conservation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Afforestation (type-1)	Conventional terracing and planting of forest tree species
Afforestation (type-2)	Plant local tree species, usually in a planting hole
Re-greening (type-1)	Plant local shrub and grass species, usually in a planting hole
Re-greening (type-2)	Plant *Quercus* species seed in a block
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
2. Afforestation	Conventional terracing and planting of forest tree species
3. Rehabilitation of Degraded High Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and enrich by planting Seedlings
4. Rehabilitation of Degraded Coppice Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and distribute seed for Enrichment
5. Energy Forest Plantation	Planting of fast-growing species for fuelwood production
6. Rangeland Rehabilitation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rangeland improvement	Controlled grazing, fertilizer applications, seed sowing and water troughs
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
7. Riverside Plantations	Zigzag planting of poplars, willows and other suitable species to stabilize soils

B.5.4.4 Activities, Effects, Benefits, Inputs and Cost for Project

ACTIVITY	QUANTIFIED BENEFITS FOR VILLAGERS & OTHER STAKEHOLDERS	QUANTITY OF INPUTS	COST OF INPUTS	COMENTS
Natural Resources				
1. Soil Conservation	-Decreasing soil erosion -Increasing vegetation coverage -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape.	728 ha	817 BTL	Activities include: 1.Natural regeneration 2. Afforestation 3. Re-greening 4. Gully plugging
2. Afforestation	-Decreasing soil erosion -Increasing vegetation coverage -Increasing both quality and quantity of tree stock -Increasing biodiversity -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape.	93 ha	168 BTL	
3. Rehabilitation of Degraded High Forest	-Decreasing soil erosion -Increasing both quality and quantity of tree growing stock -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape.	157ha	48 BTL	Activities include: 1. Rehabilitation 2. Natural regeneration
4. Rehabilitation of Degraded Coppice Forest	-Decreasing soil erosion -Increasing both quality and quantity of tree growing stock -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape	207ha	57 BTL	Activities include: 1. Rehabilitation 2. Natural regeneration
5. Energy Forest Plantation	-Decreasing soil erosion -Increasing vegetation coverage -Increasing both quality and quantity of tree stock -Increasing quantity of firewood subsidy -Decreasing illicit cutting for firewood -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape.	225 ha	726 BTL	
6. Rangeland Rehabilitation	-Declining soil erosion -Increasing vegetation coverage -Increasing fodder production -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape	658ha	374 BTL	Activities include: 1. Natural regeneration 2. Rangeland improvement 3. Gully plugging 4. Watering troughs
Sub-total cost			2,190 BTL	

B.5.5 The Micro-Catchment UC-03 Rehabilitation and Management Project

B.5.5.1 Condition of Micro-Catchment

(1) Location and Geographical Conditions of the MC

The micro-catchments UC-03 (hereinafter to as the MC) is located roughly western part and near the riverhead of the Coruh river basin. Total area of the MC is some 21,900 hectares. It extends in the east of the Bayburt municipality which is the capital of the Bayburt province to which the MC belongs. The MC is approximately 34 km long east to west and 10 km wide north to south. The Coruh river and it's tributary Masat river forms the southern border of the MC, which serenely flows down at the mean incline of 1:140. The altitude of the MC is between 1,300m and 2,700m above sea level.

The MC consists of 5 significant tributaries to the Coruh and Masat river: the Buyuk, Latrans, Kuru, Gez, and Ahsunicler streams. The MC is characterized by relatively gentle topography, especially near the northern boundary of the MC forme huge extents of alpine pasture land with better conditions. . However, along the southern boundary of the MC consists of south facing large-scale bald mountains with the relative height of about 500m. The MC has 41% of moderate slope land and 25% of severe slope land. There is 8% of Steep slope land, too.

The climate is characteristically moderate in summer and very cold with snowfall in winter. The mean annual temperature is 6.5℃, the mean maximum temperature is 18.8 ℃ (July), the mean minimum temperature is -7.1 ℃ (January) and the mean annual rainfall is about 420 mm based on metrological record in Bayburt. Access to most of the villages in the MC is good and adequate as the villages located relatively near the asphalted road D915, which runs west and east along the Coruh river.

(2) Natural Resources and Present Land Use

For the land use pattern of the MC, the dominant land use is rangeland (74%), followed by arable land (11%), forest (6%) and transitional woodland and shrub (6%) based on 2001 satellite image analysis data. According to the management plan, there is seldom high forest (type NK), and most of the remaining area is degraded high forest (BK). There are some areas of normal coppice forest (Bt) or degraded coppice forest (BBt). There are no officially-designated Protected Areas in the MC at present, but a forest recreation area is planned to be established southeast of Gezkoy. The existence of wild boars is indicated by the villagers as they harm agricultural production by crop fields.

The predominant geological type is Lower Cretaceous, except in the northern part, which are predominantly Lias and Malm. The most common soils are Brown forest soils, which are generally infertile and shallow. Based on the GDRS digital data, about 62% of the MC has Class 3 soil erosion (Severely), and most of the rest of the MC is in Class 2 (Moderately). Most of the area under the good condition but grazing control will be needed due to shallow soils, in particular, for predominant south-facing slopes along the

southern boundary. About 89% of the MC is in Land Capability Classes VI, VII and VIII by GDRS.

B.5.5.2 Major problems, Development needs, Constraints and Opportunities

(1) Major problems:

- Natural disaster (e.g. floods) and soil erosion due to fragile site (e.g. geology, soil, topography) and over-use/degradation of forest and range resources.
- Destruction/degradation of forests by local people to meet their energy needs for heating and cooking.

Priority problems identified and possible solutions as suggested by villagers

Problems	Solutions
1. Natural disasters (e.g. floods). 2. Soil erosion, de-regulation and losses of water resources.	• Soil conservation measures on degraded area.
3. Illicit cuttings and degradation of forests. 4. High costs and inadequate knowledge of alternative energy sources.	• Improvement and reforestation of degraded forests, establishment of village energy forests on suitable sites. • Provision of fuelwood needs of local people to the extent possible, within the capacity of forests. • Provision of coal at suitable prices. • Assistance in testing/development of other energy sources, such as bio-energy, solar energy.
5. Degradation, low productivity, under-utilization of range resources.	• Range improvement measures (e.g. water troughs, re-seeding, fertilization). • Development of forage production on suitable lands. Supporting/development of stall-feeding.

(2) Constrains on conservation, rehabilitation and suitable use of natural resources:

- A predominance of south facing slopes and shallow soils.
- The large flocks of sheep owned by nomads.
- Designless sand mining at foot of unstable and unreached repose angle mountains.
- Degraded conditions and low productivity of the significant parts of the forest resources.
- High dependency on excessive utilizations of upland resources.
- Inadequate attention on local needs during preparation of forest management plans.
- Lack of confidence between villagers and governmental agencies.
- Insufficient staff capacities of the MEF and other relevant government agencies.
- Insufficient collaboration among different government agencies.
- Lack of adequate awareness of local communities about causes and consequencies of natural resources degradation and disasters.
- Incomplete cadastral surveys and vague borders of the forests and rangelands. Unclear rights of AGM for working on OT (Forest soil without trees- Forest management plan) areas.

(3) Opportunities for conservation, rehabilitation and sustainable use of natural resources

- Mostly very good, provided villagers are interested and able to act.
- The out-migration appears to have had positive effects on the intensity of erosion, and the apparent success of natural regeneration in many places.
- Knowledgeness sand mining by TCK.
- Natural resources degradation is reversible by adopting appropriate approaches and methods.
- There is growing interest in the MC villagers for collaborating with MEF-AGM for undertaking collaborative in conducting soil conservation and afforestation activities.
- Existence of wide variety of multipurpose local tree, shrub and grass species for undertaking technically successful and socially acceptable rehabilitation activities.

(4) Level of interest in natural resources conservation: Medium High

(5) Current strategies and contributions of the government agencies:

- MEF-AGM has conducted some soil conservation activities on modest scale in the MC areas, along the Latrans stream in Yaylapinar villages during previous years.
- Forest villagers in the MC are permitted to collect fuelwood from the forests depending on their capacity in the village area by paying modest charges to MEF-OGM.
- MEF-ORKOY provides low interest credit support to forest villagers and cooperatives for increasing their income and for improving relations with the forest organization.
- AGM, OGM and MPG contract protection of forest and wildlife conservation areas to forest village communities by making certain payments to village budget. AGM has also started recently contracting of soil conservation works and tending of such areas to the village communities that have interest and capacity for undertaking such activities.
- Cadastre and border delineation works for range areas are being undertaken by MARA.
- Stream bed and bank rehabilitation activities are being taken by GDRS and DSI.
- Increased interest and efforts to involve local people in natural resources conservation and rehabilitation in combination with livelihood development among different units of MEF.

B.5.5.3 Proposed activities

ACTIVITY	LOCATION	APPROX. AREA	COMMENTS
1. Soil Conservation			
(Activity 1): Natural regeneration	Upper Kuru, Latrans stream	193 ha	Implement Activities1,3,4,5,6 and 7
(Activity 2): Afforestation, (Type 1)	Upper Ahsunicler stream	150 ha	Implement Activities1,3,4,6 and 7
(Activity 3): Afforestation, (Type 2)	Middle Gez strem	100 ha	Implement Activities1,3,4,6 and 7
(Activity 4): Re-greening (Type 1)	Downstream of Mitibey stream	350 ha	Implement Activities1,3,4,6 and 7
(Activity 5): Re-greening (Type 2)	Downstream of Buyuk stream	200 ha	Implement Activities1,3,4,6 and 7
(Activity6): Gully protection (gabion type)			
(Activity 7): Gully protection (brush type)			
2. Riverside Plantation	Masat stream	1.4 ha	

DEFINITION OF ACTIVITIES;	
1.Soil Conservation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Afforestation (type-1)	Conventional terracing and planting of forest tree species
Afforestation (type-2)	Plant local tree species, usually in a planting hole
Re-greening (type-1)	Plant local shrub and grass species, usually in a planting hole
Re-greening (type-2)	Plant *Quercus* species seed in a block
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
2. Afforestation	Conventional terracing and planting of forest tree species
3. Rehabilitation of Degraded High Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and enrich by planting Seedlings
4. Rehabilitation of Degraded Coppice Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and distribute seed for Enrichment
5. Energy Forest Plantation	Planting of fast-growing species for fuelwood production
6. Rangeland Rehabilitation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rangeland improvement	Controlled grazing, fertilizer applications, seed sowing and water troughs
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
7. Riverside Plantations	Zigzag planting of poplars, willows and other suitable species to stabilize soils

B.5.5.4 Activities, Effects, Benefits, Inputs and Cost for Project

ACTIVITY	QUANTIFIED BENEFITS FOR VILLAGERS & OTHER STAKEHOLDERS	QUANTITY OF INPUTS	COST OF INPUTS	COMENTS
Natural Resources				
1. Soil Conservation	-Decreasing soil erosion -Increasing vegetation coverage -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of the landscape.	993 ha	1,220 BTL	Activities include: 1. Natural regeneration 2. Afforestation 3. Re-greening 4. Gully plugging
2. Riverside Plantation	-Protection of inhabitant's livelihood and farmland -Environmental improvement -Ensuring employment -Increasing aesthetics value of the landscape.	1.4 ha	9 BTL	
Sub-total cost			1,229 BTL	

B.5.6 The Micro-Catchment OL-04 Rehabilitation and Management Project

B.5.6.1 Condition of Micro-Catchment

(1) Location and Geographical Conditions of the MC

The micro-catchments OL-04 (hereinafter to as the MC) is located roughly south-eastern of the Coruh river basin, and constitutes a part of the upper most catchments of the Oltu river which is one of the major tributaries of the Coruh river. Total area of the MC is some 38,500 hectares. The main administrative center for the MC is Oltu municipality, it is located roughly east and northeast in the MC. The MC is approximately 31 km long east to west and 25 km wide north to south. Near the center of the MC, the Sivri river passes out from east to west, and flow into the Oltu river at Oltu municipality. The Sirvi river rapidly flows down at the mean incline of 1:35. The altitude of the MC is between 1,300m and 2,900m above sea level. The MC consists of 11 significant tributaries to the Sivri river: the Buyuk, Cevizli, Igdelinin, Dagin, Dagun, Karantas, Ayarin, Sivri, Sidigin, Sekincukin, and Kadaagach streams.

The MC is characterized by relatively gentle topography, especially along the Kadaagach, Dagin, Igdelinun, and Sivri streams as they are forming a huge active colluvial fan. However, the Dagin stream consists of wide variety of rock types and topography. The MC has 42% of moderate slope land and 29% of gentle slope land. There is 22% of Steep slope land, too.
The climate is characteristically hot in summer and cold with snowfall in winter. The mean annual temperature is 10.2℃, the mean maximum temperature is 22.8 ℃ (August), the mean minimum temperature is -4.0 ℃ (March) and the mean annual rainfall is about 380 mm. Access to most of the villages in the MC is good as the villages located relatively near the asphalted road No.25-03, which runs north-eastern and south-western along the Sivri river.

(2) Natural Resources and Present Land Use

For the land use pattern of the MC, the dominant land use is rangeland (48%), followed by arable land (21%), forest (16%), and transitional woodland and shrub (8%) based on 2001 satellite image analysis data. According to the management plan, xx% is high forest (type NK), and most of the remaining area is degraded high forest (BK). There are no areas of normal coppice forest (Bt) or degraded coppice forest (BBt). There are no officially-designated Protected Areas within the MC. However, a wild life conservation area is located adjacent to the western end of the MC. Wildlife species such as bears and wild boars are indicated by the villagers as they harm agricultural production by raiding beehives and crop fields.

The predominant geological type is Upper Cretaceous, Flysh, except in the northern part, which is predominantly Upper Cretaceous, Volcanic Facies. The most common soils are Brown soils, Brown forest soils and Colluvial soils, which are generally infertile and shallow. Based on the GDRS digital data, about 58% of the MC has Class 3 soil erosion (Severely), and most of the rest of the MC is in Class 4 (Very severely). Perhaps most of the visible soil erosion is reversible using conventional techniques, except in and around Orcuk. Removal of coarse rocky debris would be extremely expensive. The Kadaagach, Dagin, Igdelinun, and Sivri streams are delivering large quantities of debris to the Oltu River, and the streams are generally clear. About 88% of the MC is in Land Capability Classes VI, VII and VIII by GDRS.

B.5.6.2 Major problems, Development needs, Constraints and Opportunities

(1) Major problems:

- Natural disaster (e.g. floods) and soil erosion due to fragile site (e.g. geology, soil, topography) and over-use/degradation of forest and range resources.
- Destruction/degradation of forests by local people to meet their energy needs for heating and cooking.

Priority problems identified and possible solutions as suggested by villagers

Problems	Solutions
1. Natural disasters (e.g. floods, avalanches, landslides). 2. Soil erosion, de-regulation and losses of water resources.	• Soil conservation measures on degraded area. • Riverbed rehabilitation (civil engineering measures), river bank rehabilitation (civil engineering structures, gulley plantation).
3. Illicit cuttings and degradation of forests. 4. High costs and inadequate knowledge of alternative energy sources.	• Improvement and reforestation of degraded forests, establishment of village energy forests on suitable sites. • Provision of fuelwood needs of local people to the extent possible, within the capacity of forests. • Provision of coal at suitable prices. • Assistance in testing/development of other energy sources, such as bio-energy, solar energy.
5. Degradation, low productivity, under-utilization of range resources.	• Range improvement measures (e.g. water troughs, re-seeding, fertilization). • Development of forage production on suitable lands. • Supporting/development of stall-feeding.

(2) Constrains on conservation, rehabilitation and suitable use of natural resources:

- Naturally unstable rocks and soils, harsh topographical conditioned.
- Degraded conditions and low productivity of the significant parts of the forest resources.
- High dependency on excessive utilizations of upland resources.
- Inadequate attention on local needs during preparation of forest management plans.
- Lack of confidence between villagers and governmental agencies.
- Insufficient staff capacities of the MEF and other relevant government agencies.
- Insufficient collaboration among different government agencies.
- Lack of adequate awareness of local communities about causes and consequencies of natural resources degradation and disasters.
- Incomplete cadastral surveys and vague borders of the forests and rangelands. Unclear rights of AGM for working on OT (Forest soil without trees- Forest management plan) areas.

(3) Opportunities for conservation, rehabilitation and sustainable use of natural resources:

- Natural resources degradation is reversible by adopting appropriate approaches and methods.
- There is growing interest in the MC villagers for collaborating with MEF-AGM for undertaking collaborative in conducting soil conservation and afforestation activities.
- Existence of wide variety of multipurpose local tree, shrub and grass species for undertaking technically successful and socially acceptable rehabilitation activities.

(4) Level of interest in natural resources conservation: Medium

(5) Current strategies and contributions of the government agencies:

- MEF-AGM has conducted some soil conservation activities on modest scale in the MC areas, including Ballica, Basakli, and Ozdere villages during previous years.
- Forest villagers in the MC are permitted to collect fuelwood from the forests depending on their capacity in the village area by paying modest charges to MEF-OGM.
- MEF-ORKOY provides low interest credit support to forest villagers and cooperatives for increasing their income and for improving relations with the forest organization.
- AGM, OGM and MPG contract protection of forest and wildlife conservation areas to forest village communities by making certain payments to village budget. AGM has also started recently contracting of soil conservation works and tending of such areas to the village communities that have interest and capacity for undertaking such activities.
- Cadastre and border delineation works for range areas are being undertaken by MARA.
- Stream bed and bank rehabilitation activities are being taken by GDRS and DSI.
- Increased interest and efforts to involve local people in natural resources conservation and rehabilitation in combination with livelihood development among different units of MEF.

B.5.6.3 Proposed activities

ACTIVITY	LOCATION	APPROX. AREA	COMMENTS
1. Soil Conservation			
(Activity 1): Natural regeneration	Upper Sirvi Stream	683 ha	Implement Activities 1,3,6 and 7
(Activity 2): Afforestation, (Type 1)	Upper Dagin Stream	407 ha	Implement Activities 1,3,6 and 7
(Activity 3): Afforestation, (Type 2)			
(Activity 4): Re-greening (Type 1)			
(Activity 5): Re-greening (Type 2)			
(Activity6): Gully protection (gabion type)			
(Activity 7): Gully protection (brush type)			
2. Afforestation	Upper Sekincukin Stream	126 ha	
3. Energy Forest Plantation	Upper Sirvi Stream	300 ha	
	Upper Sekincukin	100 ha	
4. Rangeland Rehabilitation			
(Activity 1): Natural regeneration	Upper Sirvi Stream	1,632 ha	Implement Activities 1,2,3 and 4
(Activity 2): Rangeland improvement	Upper Dagin	190 ha	Implement Activities 1,2,3 and 4
(Activity 3): Gully plugging (stone walls)	Upper Igdelinin	358 ha	Implement Activities 1,2,3 and 4
(Activity 4): Gully plugging(brush walls)	Upper Sekincukin	461 ha	Implement Activities 1,2,3 and 4
5. Riverside Plantation	Upper Sirvi Stream	0.2 ha	L= 500m x 2
	Upper Dagin	0.4 ha	L=1,000m x 2

DEFINITION OF ACTIVITIES;	
1.Soil Conservation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Afforestation (type-1)	Conventional terracing and planting of forest tree species
Afforestation (type-2)	Plant local tree species, usually in a planting hole
Re-greening (type-1)	Plant local shrub and grass species, usually in a planting hole
Re-greening (type-2)	Plant *Quercus* species seed in a block
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
2. Afforestation	Conventional terracing and planting of forest tree species
3. Rehabilitation of Degraded High Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and enrich by planting Seedlings
4. Rehabilitation of Degraded Coppice Forest	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rehabilitation	Rejuvenation cutting, thinning and distribute seed for Enrichment
5. Energy Forest Plantation	Planting of fast-growing species for fuelwood production
6. Rangeland Rehabilitation	
Natural Regeneration	Encourage natural regeneration, if necessary with fencing
Rangeland improvement	Controlled grazing, fertilizer applications, seed sowing and water troughs
Gully plugging (gabion type)	Gully plugging using gabion walls
Gully plugging (brush type)	Gully plugging using brush walls
7. Riverside Plantations	Zigzag planting of poplars, willows and other suitable species to stabilize soils

B.5.6.4 Activities, Effects, Benefits, Inputs and Cost for Project

ACTIVITY	QUANTIFIED BENEFITS FOR VILLAGERS & OTHER STAKEHOLDERS	QUANTITY OF INPUTS	COST OF INPUTS	COMENTS
Natural Resources				
1. Soil Conservation	-Decreasing soil erosion -Increasing vegetation coverage -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of the landscape.	1,090ha	1,770 BTL	Activities include: 1. Afforestation 2. Re-greening 3. Gully plugging 4. Natural regeneration
2. Afforestation	-Declining soil erosion -Increasing both quality and quantity of tree growing stock -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetics value of the landscape	126ha	228 BTL	*Pinus sylvestris*
3.Energy Forest Rehabilitation	-Declining soil erosion -Increasing vegetation coverage -Increasing both quality and quantity of tree stock -Increasing quantity of firewood subsidy	300	968 BTL	
4. Rangeland Rehabilitation	-Declining soil erosion -Increasing vegetation coverage -Increasing fodder production -Ensuring better conditions for wildlife -Ensuring employment -Improving water balance -Increasing aesthetic value of landscape	2,641ha	1,538 BTL	Activities include: 1. Natural regeneration 2. Rangeland improvement 3. Gully plugging 4. Watering troughs
5.Riverside Plantation	-Declining soil erosion -Increasing both quality and quantity of tree growing stock	0.6 ha	4 BTL	
Sub-total cost		4,158 ha	4,508 BTL	

B.5.7 Proposed Activities Expenditure for Rehabilitation and Management of Natural Resources

Table B.5.7-1 Summary of Proposed Activities

Activities	BT-04 (Savsat)		MC-03 (Yusufeli)		TR-06 (Uzundere)		UC-14 (Ispir)		UC-03 (Bayburt)		OL-04 (Oltu)		Total	
	Scale (ha)	Cost (BTL)	Scale (ha)	Cost (BTL)	Scale (ha)	Cost (BTL)	Scale (ha)	Cost (BTL)	Scale (ha)	Cost (BTL)	Scale (ha)	Cost (BTL)	Scale (ha)	Cost (BTL)
1. Soil Conservation	-	-	831	1,063	1,160	1,105	728	817	993	1,220	1,090	1,770	4,802	5,975
2. Afforestation	133	240	-	-	-	-	93	168	-	-	126	228	352	636
3. Rehabilitation of Degraded High Forest	-	-	838	352	172	93	157	48	-	-	-	-	1,167	493
4. Rehabilitation of Degraded Coppice Forest	273	189	394	269	-	-	207	57	-	-	-	-	874	515
5. Energy Forest Plantation	353	613	-	-	-	-	419	726	-	-	558	968	1,330	2,307
6. Rangeland Rehabilitation	269	219	-	-	175	189	658	374	-	-	2,641	1,538	3,743	2,320
7. Riverside Plantation	0.8	5	-	-	0.6	4	-	-	1.4	9	0.6	4	3.4	22
Total	1,028.8	1,266	2,063	1,684	1,508	1,391	2,262	2,190	994	1,229	4,416	4,508	12,271.4	12,268