(unit : ha)

Name of River		less than El 80 m	El 80 - 100 m	El 100 - 120 m	El 120 - 140 m	El 140 -	El 160 - 180 m	more than El 180 m
Trotus								
	Area	119	1,368	590	872	909	221	166
	Cumulative	119	1,487	2,077	2,949	3,858	4,079	4,245
Carecna	Avg. Slope	0.62%	1.05%	2.50%	1.00%	1.00%	4.00%	5.74%
	Area	896	908	772	774	516	533	558
	Cumulative	896	1,804	2,576	3,350	3,866	4,399	4,957
Zabraut	Avg. Slope	0.82%	1.10%	2.11%	2.22%	3.08%	3.06%	4.00%
	Area	169	1,423	1,389	958	644	466	572
	Cumulative	169	1,592	2,981	3,939	4,583	5,049	5,621
Susita	Avg. Slope	1.25%	1.25%	1.11%	2.00%	2.67%	2.86%	3.08%
	Area	579	1286	1104	613	360	52	-
	Cumulative	579	1,865	2,969	3,582	3,942	3,994	-
Putna	Avg. Slope	0.67%	0.69%	0.77%	1.38%	1.54%	1.00%	-
	Area	1,443	2,969	2,353	861	56	-	-
	Cumulative	1,443	4,412	6,765	7,626	7,682	-	-
Milcov	Avg. Slope	0.67%	0.69%	0.77%	1.38%	1.54%	-	-
	Area	3,206	7,954	6,208	4,078	2,485	1,272	1,296
Total	Cumulative	3,206	11,160	17,368	21,446	23,931	25,203	26,499

On the other hand, SCSA mainly locates on the eastern slope of Sub-carpathian Mountains with elevation more than 200 m. Plateau ,with rather gentle slope, of these hills are vineyard and the slope between the tributaries or depressions are partially eroded seriously. They are divided into the following sub-areas:

Zone	Location	Block	Major Land Use
A	Area between the Trotus and Carecna rivers	A-1	Vineyard & pasture
		A-2	Vineyard & pasture
		A-3	Vineyard & pasture
		A-4	Vineyard & pasture
		A-5	Vineyard
B	Area between the Carcuna and Zabrut rivers	B-1	Vineyard & pasture
		B-2	Vineyard & pasture
		B-3	Vineyard & upland crop
C	Area between the Zabraut and Susita rivers	C-1	Vineyard & pasture
		C-2	Vineyard & pasture
		C-3	Vineyard
		C-4	Vineyard
D	Area between the Susita and Putna rivers	D-1	Vineyard & pasture
		D-2	Vineyard & pasture
		D-3	Vineyard & upland crop
E	Area between the Putna and Milcov rivers	E-1	Vineyard & pasture
		E-2	Vineyard & pasture

Topographic maps at scales of 1 to 50,000 and 25,000 covering all the territory of Romania were prepared by the Romanian Military in 1977. Sheet numbers covering the Study Area are shown in **Fig 3.2.1-A2**. MAF prepared the topographic map covering the Study Area at a scale of 1 to 5,000 in 1986 and 1988.

3.2.2 Meteorology

(1) General

Mean monthly precipitation and temperature at major meteorological stations in Romania between 1901 and 1990 are shown in **Tables 3.2.2-A1** and **-A2** and **Figs 3.2.2-A1** and **-A2**. Within the last decade, large scale rainfall caused flood in May 1991, and year of 1993 and

year of 1992 were drought years. The Study Area is in the climate characteristics of dry-cold and few snow winter, and dry-hot and occasional shower summer.

(2) Meteorological Network

The National Institute of Hydrology and Meteorology (INMH) has responsibility to collect all national meteorological observation data. There are three categories of meteorological stations; 1) Primary Stations (about 100 stations) with complete data with automatic recorders operated by the INMH directory, 2) Secondary Stations (about 900 stations) operated by manual under INMH and 3) Temporally (Pilot) Stations which are temporary installed and observed by organizations or institutes for certain purposes such as agricultural research stations with 5 to 6 years. Meteorological stations in and around the Study Area are shown in **Fig 3.2.2-A3**. Meteorological data collected through the Field Survey are shown in **Fig 3.2.2-A4**.

(3) Precipitation

The annual precipitation in the Study Area ranges between 400 and 500 mm as shown in **Fig 3.2.2-A5**. Annual precipitation at Focsani Station from 1962 to 1993 and average mean monthly precipitation are shown in **Figs 3.2.2-A6** and **-A7**. The rainfall during irrigation period, April and September, occupies more than 61% of annual rainfall in Focsani. The probable annual drought precipitation at Focsani and Adjud are estimated as follows;

Return period (year)	Annual Precipitation (mm)		Precipitation during Apr. to Sep. (mm)	
	Focsani	Adjud	Focsani	Adjud
2	530	522	319	337
5	433	417	250	255
10	387	367	217	217
20	350	328	192	189
50	312	286	165	160

(4) Temperature

Mean, absolute maximum and minimum monthly temperatures between 1977 and 1992 at Focsani Station are shown in **Table 3.2.2-A3** and **Fig 3.2.2-A8**. In winter between December and February, the monthly mean temperature becomes below 0 °C. And absolute maximum and minimum temperature is 38.5 °C and -28 °C, respectively.

(5) Frost and Snowfall

The first and last frost day is middle of October and early April in the Study Area, respectively. Annual number of snowfall day and snow coverage day in the Study Area are 15 to 25 and 30 to 60 days, respectively. Recently snowfall has been reducing and the maximum thickness in Focsani is 30 to 40 cm recently.

(6) Relative Humidity

The mean monthly relative humidity at Adjud Station, which locates at the northern border of the Study Area, together with other adjacent stations is shown in **Table 3.2.2-A3** and **Fig 3.2.2-A8.** The relative humidity of annual average and the monthly average between April and September, shows 78% and 72%, respectively. Comparing with other areas adjacent to the Study Area, the northern part of Siret Ialomita Agriculture Development Project Area shows higher humidity.

(7) Evaporation

Annual mean evapotranspiration at Adjud Station is estimated at 674 mm. The evapotranspiration during April to September is 605 mm or 90% of the annual. The balance between the evapotranspiration and precipitation at Adjud Station is shown below:

Period	Precipitation (mm)	Evapotranspiration (mm)	Balance (mm)
January	27.2	0.4	26.8
February	27.5	1.4	26.1
March	25.4	12.1	13.3
April	44.6	49.0	-4.4
May	70.0	94.3	-24.3
June	75.8	122.3	- 46.5
July	63.4	136.5	- 73.1
August	50.8	122.9	- 72.1
September	41.9	79.5	- 37.6
October	30.2	41.2	- 11.0
November	35.4	13.3	22.1
December	28.5	1.2	27.3
Annual Total	520.8	674.2	- 153.4
April - September	349.2	604.5	- 255.3

(8) Sunshine Duration

Annual total sunshine duration at Focsani is shown in **Figs 3.2.2-A8**.

(9) Wind

The wind observation data at Adjud Station is shown in **Data Book**.

3.2.3 Hydrology

(1) General

Hydrologically, Romania can be divided into 12 river basins. The Siret River basin is the largest river basin in Romania with the area of 42,830 km^2 (after including area in Ukraine, the total catchment area becomes approx. 45,110 km^2). Data on the Romanian river basins are shown in **Table 3.2.3-A1**. Major rivers in Romania can be said to be the continental rivers with rather gentle slope and formulate many meandering during the floods.

The hydrological observation in Romania started 1) water level observation from 1890, 2) the discharge recording started from 1920 at the important rivers such as in the Danube and 3) the detailed observation started after the world war II. Operation and maintenance of national gauging stations are managed by INMH. and their data are kept also by INMH. Usually, the measurement of each gauging station is made every 1 or 2 months. The hydrological data collected during the field survey on their duration is shown in **Fig 3.2.3-A1** and their locations are shown in **Fig 3.2.2-A3**. The summary of monthly mean discharge for the Siret, Putna Buzau and Ialomita rivers is shown in **Table 3.2.3-A2**.

(2) The Siret River at Calimanesti

As stated in the previous paragraph, the Siret River is the largest river in Romania. It has following other major rivers:

Reg. No.	Name of River	River Length (km)	Catchment Area (km^2)
17	Suceava	170	2,280
40	Moldova	216	4,315
53	Bistrita	290	6,974
69	Trotus	158	4,440
75	Susita	68	410
78	Birlad	253	7,330
79	Putna	144	2,720
79-9	Zabala	64	559
79-18	Milcov	68	(498)
80	Rimnicu Sarat	123	(1,010)
82	Buzau	308	5,505
	Others	12,454	17,456
XII	Siret	14,063	45,110

Note : river portion in Ukraine is included

The main water resource of the Project is the Calimanesti Dam, which locate at 108 km upstream the Siret River confluence with the Danube with catchment area of 25,355 km^2. The Cosmesti gauging station locates about 15 km downstream the Dam with catchment area of 27,946 km^2. Between the Calimanesti Dam and Cosmesti gauging station, there is no major tributaries and only one pumping station for Nicoresti-Tecuci-Movileni Irrigation Project at the maximum intake of 11 m^3/s. Mean monthly discharge at the Cosmesti gauging station between 1972 and 1993 is shown in **Fig 3.2.3-A2**, and average mean monthly discharge is shown in **Fig 3.2.3-A3**. Present situation of water extraction and dams in the main course of the Siret River are shown in **Fig 3.2.3-A4**. Water extraction from the Siret River below the Calimanesti Dam is estimated about 22 m^3/s based on the data collected in this stage. The probable drought discharge at Calimansti, Racatau and Lungoci Stations in the Siret River are estimated as follows;

(Unit : m^3/s)

Gauging Station		Racatau	Cosmesti	Lungoci
Catchment Area (km2)		19,492	25,666	36,036
Annual	2 years	45.1	46.5	59.0
	5 years	28.8	31.2	41.5
	10 years	22.3	24.9	34.1
	20 years	17.8	77.2	28.8
Period during Apr. to Sep.	2 years	72.6	49.1	88.9
	5 years	48.5	49.1	57.9
	10 years	39.3	39.1	46.7
	20 years	33.1	32.5	39.4

(3) The Putna River

The Putna River is the largest river in the Study Area and it has the 25th largest catchment area and the 31st longest river in Romania. This river is expected to be a supplemental irrigation water supplier for the Siret Baragan Canal (the Main Canal). According to the hydrological observation data at the Colacu with catchment area of 665 km^2, the lowest monthly discharge through the year was observed at 0.9 m^3/s in January 1964, and one in the period between April and September was 1.1 m^3/s in September 1963. At the downstream area, at Botrlau, near the confluence with the Siret River, the minimum discharge was recorded at 3.73 m^3/s in December 1993. On the other hand, the maximum discharge was recorded 882 m^3/s at Botrlau, near the confluence with the Siret River, in February 1988.

(4) Water Quality in the Study Area

The Study Team conducted the simple water quality test in the field. The locations of the testing and their results are shown in **Fig 3.2.3-A5**. According to these tests, the water quality in the Study Area is summarized as follows:

Items	Range	Remarks
pH	7.0 to 8.5	slightly alkalinity
Electric Conductivity	330 - 1,800 µS	in the Study Area
Electric Conductivity	more than 20,000 µS	drainage in Maicanesti

The water quality in the Calimanesti Dam shows pH 7.7-8.0 and Electric Conductivity at 700 µS. This means that there will be no trouble in using this water as the irrigation water for the Project.

3.2.4 Geology

(1) General

The geological maps at a scale of 1/200,000 were prepared covering whole Romania by Institute of Geology in 1968. Their coverage of the Study Area is shown in **Fig 3.2.4-A1**.

(2) Seismicity

The epicenter of earthquakes in 1940 (7.8 at Richter Scale) and 1977 (7.2 at Richter Scale) were in Vrancea. It can be said that the Study Area is located in the center of earthquake in Moldavice Seismic area. The design criteria prepared by the National Institute of Science and Technology, the Study Area is defined as the highest earthquake potential area ("A" zone), which shall be considered the largest earthquake load in Romania for structure design..

3.2.5 Soil

(1) Soil characteristics in the Study Area

Based on existing pedology and agro-chemistry studies, and as per Romanian standards, the soil of the Agricultural Land in the Study Area was classified into 50 Soil Units. The distribution of those Soil Units is given in **Fig 3.2.5-A1**. Soil Map and the characteristics of the Soil Units are summarized in **Table 3.2.5-A1** and broken down for the two main perimeters: the Irrigation Study Area and the Soil Conservation Study Area.

Based on the study of 44 soil profiles from the ICPA in Bucharest and 24 soil profiles from the OSPA, along with the results of the chemical analysis of soil salinity for 20 soil samples gathered July 1, 1994 (**Fig 3.2.5-A2**), at major points throughout the Study Area (an analysis carried out by the Agro-chemistry Laboratory of ISPIF in Bucharest), the general soil characteristics in the Study Area are as defined below.

- The soils demonstrate a vast diversity and heterogeneity lying over Quaternary deposits, predominantly Mollisols (Chernozem and Gray Soils), Argilluvic Soils (Brown Soils) and Undeveloped Soils (Alluvial Soils).

- The parent material is generally made up of alluvial deposits and loess deposits.

- The texture of the soils in the surface horizon (A) is loam or clay loam with some sandy loam. In the deep horizon (B), the texture is mainly loam and clay loam.

- Given the texture and the mother rock, drainability is good to excessive.

- Soil depth from the surface to the mother rock is 85-120 cm for Chernozems, Brown and Gray Soils, and some 50 cm for Alluvial Soils. The depth of Eroded Soil is 10-25 cm.

- Gravel content (skeleton) is higher especially in the dejection cone of the Putna River, whose maximum limits are more than 75% gravel in the soil profile for a surface area of 706 ha, making this land unsuitable for farming.

- The pH of the soil is neutral to acid for Chernozem, Brown and Gray Soils, corresponding to a lower degree of base saturation. The Undeveloped Soil has a neutral to alkaline pH due to a higher degree of base saturation.

- Soil salinity: Previous research and studies, along with the chemical analyses presently being carried out, show that there is no salinity in the soils of the Study Area. The electric conductivity index is 0.4-1.2 mmhos/cm below the 1.7 mmhos/cm value (Romanian standards), and also below the 2 value (international standards), a value that marks the lower limit of soil salinity. In parallel, two other indicators are used for soil salinity in Romania. One, total salty content, or mineral residue, is expressed in mg for 100 g of soil and has a lower limit of 200 for soil salinity. The total salty content values for soils in the Study Area are 26-72 mg/100 g soil, which demonstrates the absence of salinity. The other indicator is electric conductivity in water extract 1 : 5, expressed in mmhos/cm; the minimum soil salinity value is 0.290 or more. For soils in the Study Area, this value varies between 0.036 and 0.214, signifying non-saline soils.

- The organic matter content (humus) and total nitrogen, as well as phosphorus and potassium, are low to moderate. These values vary according to the quantities of chemical fertilizer applied each year and the elements it contains, along with the quantity of manure spread and the crops farmed, given that leguminous crops supply the soil with nitrogen while sunflowers drain large quantities of potassium. The soil characteristics are given in **Table 3.2.5-A1** and the results of the chemical analyses for soil salinity are given in **Table 3.2.5-A2**.

Hydrophysical characteristics of soil in the Study Area: Based on the physical soil characteristics presented above, and on the determination made in the 1986 ICPA study, the hydrophysical soil characteristics break the Study Area down into four subdivisions:

- The first subdivision includes soils with a limited clay content (<30%) and LS(SL) - LL texture, normal total porosity (TP), low to average aeration porosity (PA), a low ultimate wilting point (CO), and average field capacity (CC) and available moisture holding capacity (CU). Permeability is average for the first 50 cm of the soil profile and high in the deep soil layers (50-150 cm). This subdivision groups all the Chernozems, a large part of the Typic Alluvial Soils, Mollic Alluvial Soils.

- The second subdivision includes soils with an average clay content (about 30%) and LL - CL(LC) texture, average to low total porosity (TP), low aeration porosity (PA), and average ultimate wilting point (CO), field capacity (CC) and available moisture holding capacity (CU). Permeability is also average, both in the 0-50 cm layer and in depth. This subdivision groups the Typic Gray Soils, Brown Soils, and Gray Alluvial Soils.

- The third subdivision includes soils with >35% clay content and vertisols, having CL - LC(CL) texture. The total porosity (TP) for these soils is average to low, aeration porosity (PA) low to very low in the deep soil profile. The ultimate wilting point (CO) is high and the available moisture holding capacity (CU) average. Permeability is average to low, but with values inferior to those of the soils in the above subdivisions. This subdivision groups the Vertic Chernozems and Typic Vertisols.

- The fourth subdivision includes soils with an increased gravel content (skeleton) and LS - LL texture, as well as very high permeability for the soil profile. For this type of land, irrigation will be necessary, taking maximum care to avoid water loss. This subdivision groups slightly to extremely gravely Typic Alluvial Soils, gravely substratum, extremely gravely Alluvial Soils, and other soils with a high gravel content, located mainly in the dejection cones of the Putna and Susita Rivers.

In conclusion, from a hydrophysical standpoint (see **Table 3.2.5-A3**), the soils in the Study Area have properties favorable to irrigation, yet given their particularly light texture and non-uniform relief, irrigation must be carried out with extreme care to avoid any erosion.

(2) Correspondence between Romanian Soil Classification and USDA Soil Taxonomy for Agricultural Land of Study Area

Soils in the Study Area were classified using the English translation of the Romanian terminology recognized and adopted by European Soil Classification. In accordance with USDA Soil Taxonomy, the soils in the Study Area were grouped into the following five Orders:

- Alfisols, which include Brown Soils with argillic B horizon and Bleached Brown Soils;
- Eutisols, which include Alluvial Soils, Regosols and Erodisols;
- Inceptisols, which include Gley Soils;
- Mollisols, which include Chernozem and Gray Soils;
- Vertisols, which group the Vertisoils.

The first part of **Table 3.2.5-A4** presents the Soil Units and their symbols in Romanian, the second part their translation into English in compliance with European terminology, and the third part the equivalence of these soil units in terms of type and subtype, with the USDA Soil Taxonomy.

(3) Soil Investigations

For soil investigations in the Study Area, the investigations already carried out by Romanian pedology and agro-chemistry organizations were used:

- At the request of ISPIF in Bucharest, ICPA in Bucharest carried out a pedology study of the Study Area in 1986, within the Ruginesti, Pufesti, and Panciu perimeter. Investigations of 44 soil profiles were studied, with 11 characteristic profiles presented in detail in this Report by Profile Card.
- During the period from 1974 to 1989, OSPA Bacau carried out pedology and agro-chemistry studies for the Ruginesti, Pufesti, Movilita, Tifesti, and Bolotesti territories included in the Study Area. Twenty-four characteristic profiles from these studies were used for the largest soil units, including 11 detailed profiles presented in Profile Card form. The detailed profiles are presented in **Data Book** - Profile Card. The soil investigation results for all 68 profiles are given in **Table 3.2.5-A5**.

Soil salinity plays a decisive role in irrigation. According to the previous studies mentioned above, and to the Pedology Map of Romania, there are no saline soils in the Study Area. To obtain more information, 20 soil samples were taken at characteristic points of the terrain and soil salinity analyses were carried out in ISPIF's laboratories in Bucharest. The results are given in **Table 3.2.5-A2**.

Investigations of the profiles were carried out at a depth of 85-150 cm. Soil salinity samples were taken at a depth of 8-10 cm, in the surface horizon. A synthesis of the results of the soil investigations is given in **Table 3.2.5-A5**.

3.2.6 Land Classification

(1) Land Classification

Land was classified in compliance with the standard presently used in Romania and classification is determined by a series of limiting factors that refer to the specificity of the soil, relief and drainage. These limiting factors are:

- p: the slope of the land in correlation with erosion;
- w: the danger of water stagnating on the surface of the land and in the top half of the soil profile, due to reduced soil permeability and to texture;
- Q: the groundwater level;
- q: the existence of stones (skeleton) in the soil profile;
- i: the risk of flooding.

Land Classification constraints are indicted in **Table 3.2.6-A1**. Land Classification is presented first by Soil Units in **Table 3.2.6-A2**., then in synthesis form by constraint and by class for the two major sectors of the Study Area: Irrigation Study Area and Soil Conservation Study Area separately.

The land classification for the Study Area shows that the main factors determining the land's use for agriculture are slope in correlation with erosion, skeleton content and water stagnation. According to its suitability for farming, land in Romania is classified under six classes that follow the international standard. Land corresponding to classes I-IV is suitable for farming and land in classes V-VI is not arable but suitable for other uses:

- Class I: Arable land without any limitation neither degradation risk.
- Class II: Arable land with limitation or minor risk of degradation.
- Class III: Arable land with limitation or moderate risk of degradation.
- Class IV: Arable land with limitation or severe risk of degradation.
- Class V: Non-arable land with limitation or strong risk of degradation
- Class VI: Non-arable land with no possible use for agricultural development

The land classification map of the Study Area is shown in **Fig 3.2.6-A1**, and area by soil unit is summarized in **Table 3.2.6-A3**. The following is a description of the land classes and subclasses in the Irrigation Study Area (27,190 ha) and in the Soil Conservation Study Area (16,890 ha).

Class I : Arable land without any limitation neither degradation risk

ISA = 10,478.6 ha (or 38.5%)
SCSA = 726.1 ha (or 4.3%)

This includes relatively flat land with a slope of 2% or less, good permeability and which is not affected by the groundwater table.

Most of the land in Class I is characterized by the presence of Typic Chernozem with Cambic B horizon; this is the soil with the best physical, hydrophysical and chemical qualities in the Study Area. The texture of these soils is loamy (L) and/or loamy-sandy (SL); the humus content, total N2, and phosphorus and potassium levels are moderate. Humus content is also very high in depth: at > 50 cm there is 0.8-1.2% organic matter. The pH is acid to neutral in depth. The Alluvial Soils included in Class I cover a limited area and are characterized by moderate textures

in the surface horizon and coarser textures deep in the soil profile. Generally speaking, permeability is high to very high. These soils have a modest N2, K_2O, P_2O_5 and humus content. The reaction of the soil (pH) is basic on the surface tending toward neutral in depth.

Class II : Arable land with limitation or minor risk of degradation

ISA = 13,424.8 ha (or 49.5%)
SCSA = 12,362.0 ha (or 73.2%)

Land in Class II covers most of both sectors. The limiting factors that place it under this category are:

- p: slope of 2.1-10% with slight to moderate erosion;
- w: water stagnation on the surface and top half of the soil profile due to soil permeability, due in turn to texture;
- Q: depth of the groundwater table;
- i: risk of flooding;
- q: skeleton content of soil.

Most of the land in Class II has limitations due to slope or the danger of water stagnating after rainfall. To a lesser extent there are soils affected by the high groundwater table or the danger of flooding.

Sub-class II p

ISA = 4,857.9 ha (or 17.9%)
SCSA = 8,666.8 ha (or 51.3%)

This is good quality land with no restrictions other than slope, which is between 2.1% and 10%. Most of the soil in this subclass is Typic Chernozem slightly eroded, Typic Gray Soils slightly eroded, or Brown Soils slightly to moderately eroded. This soil is found particularly in the contact zone between the piedmont and the last terrace of the flood plain of the Siret and includes the South Ruginesti and Paunesti territories, the zone between Carecuna and Zabraut along the Trotusani-Diocheti alignment, Northeast Straoane and East Panciu, the "bridges" between Susita and Putna as of the piedmont and up to Tifesti, and the Bolotesti - Jaristea - Odobesti alignment.

The texture of soils in this subclass is generally loamy (L) in the surface horizon and clay-loamy (CL) in horizon B. The humus content is moderate to low (M-L). The soil pH is moderately acid on the surface and slightly acid to neutral for the profile.

Sub-class II w

ISA = 4,578.5 ha (or 16.9%)
SCSA = 1,930.8 ha (or 11.4%)

This subclass is characterized by relatively flat land whose partially clayey texture in the profile results in limited permeability with a risk of water stagnation 5-15 days per year. It includes soils from the following categories: Typic Chernozem and Vertic Chernozem, Typic Gray Soils, Brown Soils with argillic B horizon and surface water gray, whose texture contains clay in horizon B, or soils lying over a parental material made up of deposits of loess or expansive clay.

Given the heterogeneity and diversity of these soils, some land of this subclass is found everywhere, especially on the large terrace over the flood plain of the Siret.

The permeability of the top 50 cm of soil is moderate, becoming limited in depth. Humus content is moderate to low; nitrogen is also low, while phosphorus and potassium content is moderate to good (M, H).

Sub-classes II Q and Qw

ISA =1,517.3 ha (or 5.6%)
SCSA = 309.7 ha (or 1.8%)

These soils are Typic Alluvial Soils and Gley Chernozem with argillic B horizon and a groundwater table at 3-5 m, and Gley Alluvial Soils with a groundwater table at 2-3 m. They are found in the flood plain of the Trotus and Siret Rivers on the alignment running through Valeni, Domnesti, Ciorani, and Calimanesti, as well as on a smaller surface in the Putna Valley. The texture of these soils is moderate to coarse (sandy) over alluvial deposits which provide good drainage. Permeability is excellent throughout the soil profile.

Sub-class II q

ISA =2,018.4 ha (or 7.4%)
SCSA = 447.9 ha (or 2.7%)

The limiting factor is the existence of gravel on the surface and in depth. The soils included in this subclass are Typic Chernozem with Cambic B horizon slightly to very gravely and Typic Alluvial Soils slightly to moderately gravely. The Chernozem is found on the ancient Putna Valley dejection cone between this valley and the Jaristea-Odobesti alignment. The Alluvial Soils are found toward the Susita Valley and in the flood plain of the Siret in the northern part of the Study Area. The soils are characterized by coarse textures with large amounts of gravel and high permeability. Generally speaking, these soils have only limited humus, N, P, K.

Sub-class II i

ISA = 452.7 ha (or 1.7%)
SCSA =1,006.8 ha (or 6.0%)

These soils run a limited risk of flooding. This subclass includes only Typic Alluvial Soils that are seldom flooded and lie along the Putna, Susita, Zabraut and Carecna Valleys. These soils have a sandy texture lying over alluvial deposits and only limited organic matter and N, P, K.

Class III Arable land with limitation or moderate risk of degradation

ISA =1,667.7 ha (or 6.0%)
SCSA =1,231.3 ha (or 7.3%)

Land in Class III requires erosion prevention and land improvement work determined by the type of limiting factors, which are:

- p: slope of 10.1-15% with moderate to heavy erosion;
- q: gravel content
- w: risk of water stagnation - medium stagnation time

Sub-class III p

ISA = 6.8 ha
SCSA =1,196.2 ha (or 7.1%)

This subclass includes the following soils: Brown Soils with argillic B horizon and gullied land, severely eroded Brown Soils and severely eroded soils (from the Undeveloped Soils

class). This land is already subjected to moderate erosion and could be damaged by agricultural use unless the recommendations for farming on slopes are followed. This land is found on the hills south of Panciu and Straoane alternating with the ravines in West Fitionesti, South Paunesti, and North Ruginesti. This land is presently used for vineyards.

The soils have formed over loess or loam deposits and have only limited amounts of organic matter, N, P, and K.

Sub-class III q

ISA =1,105.9 ha (or 4%)
SCSA = 0 ha

This soil has a high gravel content and includes Typic Chernozem with a gravely to extremely gravely Cambic B horizon and a gravely substratum. This land is located over another ancient dejection cone of the Putna River between Ivancesti and Jaristea. Levees alternate with small depressions, both farmed and unfarmed. The soil is characterized by a coarse texture over deposits of gravel, which causes excessive permeability; consequently irrigation would result in a vast loss of water due to infiltration. Organic matter content is low; N, P and K are low.

Sub-class III w

ISA = 555.0 ha (or 2%)
SCSA = 39.1 ha

The limiting factor is the risk of water stagnation on the surface and in the top half of the soil profile, due to the fine textures of the clay. The soils included in this subclass are Typic Vertisols over expansive clay with limited drainage and permeability and a good humus content. The land is located on an area between Unirea and Ivancesti.

Class IV Arable land with limitation or severe risk of degradation

ISA =451.1 ha (or 1.7%)
SCSA =101.9 ha (or 0.6%)

This land covers limited surfaces within the perimeter studied. The limiting factors are slopes of 15.1-20% with heavy to very heavy erosion, a higher gravel content and water stagnation on the surface. The characteristic soils for this class are Brown Soils with severely eroded argillic B horizon (sheet and gully erosion), Eutric Humic Gley Soils, Eutric Low Humic Gley Soils and Typic Alluvial Protosol, which are distributed over the flood plain of the Siret around Calimanesti and north of Vusoara (on the Trotus). The land is used for vineyards on the slopes or to grow grain (preferably corn) on the flood plain of the Siret, with a good yield in drought years.

Class V Non-arable land with limitation or strong risk of degradation

ISA = 291.9 ha (or 1.1%)
SCSA =2,278.7 ha (or 13.5%)

The limitations for this class are a slope of 20.1-25% with heavy to excessive erosion and a high groundwater table combined with water stagnation on the surface. It includes soil located on slopes with heavy erosion: Typic Regosols and Typic Regosols with Gullied Land. Class V land covers the entire Western part of the perimeter, next to the forest zones. This land is not used for farming at present; shrubs and bushes have been planted on steep slopes to prevent erosion.

Class VI Non-arable land with no possible use for agricultural development

ISA = 876.9 ha (or 3.2%)
SCSA = 191.0 ha (or 1.1%)

The limiting factors are excessive amounts of stones in the soil profile and the risk of flooding. The soils are Undeveloped Soils with very gravely to extremely gravely, Alluvial Soils over a gravely substratum, Alluvial Soils extremely gravely rubble land and Gley Alluvial Soils seldom flooded. The stone-laden land in this class is located southeast of Batinesti on the Putna's ancient dejection cone and on part of the land frequently flooded (more than once per year) lying north of the perimeter on the flood plain of the Trotus. The land along the Putna could be farmed, provided the stones are removed and manure is spread.

(2) Recommendations

- The present Soil Report is intended for the Feasibility Study phase of the Irrigation Project in Ruginesti, Pufesti, Panciu, Vrancea District. For any subsequent technical project, an in-depth pedology and agro-chemistry study should be performed based on the present profiles and carrying out complete chemical analyses, especially in the zones where Class III, IV, V and VI land is found.

- Should irrigation of land with a slope of over 2% be planned via the supply of additional water, erosion will result unless soil conservation measures are taken: sprinkler irrigation only and in reasonable amounts; plowing along contour lines.

- To prevent water from stagnating on the surface or in the top half of the soil profile for "constraint w" land due to reduced permeability (fine or very fine texture, clay, gley soils, Vertisols), other measures should be taken: scarification of land prior to irrigation, application of manure to increase soil fertility, application of lime to acid land, drainage system.

- In order to limit irrigation water loss on land with a light, coarse, sandy texture and a high gravel content, therefore with excessive permeability, the quantity of water used should be decreased for each session and the number of sessions should be increased. It is also necessary to fertilize with manure (25-30 ton/ha) and/or with green manure.

- To pinpoint the exact amount of chemical fertilizer to be applied in order to develop and improve yield per hectare, agrochemical studies will have to be carried out by OSPA Vrancea each year on the largest surfaces. In addition to nitrogen, phosphorous and potassium, it would be wise to determine the existence or absence of trace elements such as boron, magnesium, manganese, iodine, etc. Eventually such trace elements should be applied in addition to N, P, and K in order to improve farm production even more.

- Farm work should be performed correctly. In this sector, the present situation is instate of degradation. The first step is to level the land and carry out uniform plowing to the same depth for the same plot. Agro-technical practices should be followed closely for sowing, plowing and harvesting.

- Any irrigation of vineyards should use the drip technique, as they are planted on slopes and are thus subject to erosion.

- For the Soil Conservation Study Area, located upstream from the Irrigation Study Area, erosion prevention work must be performed and measures taken. Any farm work or activity should be carried out following the contour lines. Surface erosion must be prevented by creating strip meadows and/or strip cropping or contour farming. It may also prove necessary to institute grazing and land reforestation.

3.3 AGRICULTURE

The existing agricultural conditions in the Study Area have been made clear through the hearing survey carried out for 100 selected farmers/farming units and village heads, DJS-Vrancea and DA-Vrancea.

3.3.1 Land Use

(1) Land Use in Vrancea

The total area of Vrancea District including the Study Area is about 485 x 10^3 ha. Agricultural area and non-agricultural are 52.6 % and 47.4 % of the total area, respectively. Total agricultural area of Vrancea District is about 255 x 10^3 ha. Arable land (upland field), grass land (pasture), hay field (meadow), vineyards and orchards are 57 %, 18 %, 12 %, 11 % and 2 %, respectively (**Table 3.3.6-A1**).

(2) Land Use in the Study Area

Based on the land use maps of scale 1: 50,000 in 1986 and of scale 1: 25,000 in 1990 prepared by ISPIF-SA, and the Spot image photos of scale 1: 100,000 on Jul. 8, 1989, Apr. 5 1990 and Aug. 7 1992 with the supplemental field investigation, the present land use map of the Study Area is prepared as presented in **Fig 3.3.1-A1**. The areas and their percentages of the respective land use are as shown below:

Land Use	The Study Area		Irrigation Study Area		Soil Conservation Study Area	
	ha	%	ha	%	ha	%
Agricultural Land	44,080	85.1	27,190	94.1	16,890	73.7
Arable Land	23,350	45.1	20,840	72.1	2,510	11.0
Meadow	100	0.2	20	0.1	80	0.3
Pasture	3,340	6.4	500	1.7	2,840	12.4
Vineyard	17,170	33.2	5,830	20.2	11,340	49.5
Orchard	120	0.2	0	0.0	120	0.5
Non-Agricultural Land	7,720	14.9	1,710	5.9	6,010	26.3
Total	51,800	100.0	28,900	100.0	22,900	100.0

The land use patterns of the Study Area are represented by rainfed farming with the following specific features:

a) Single cropping with maize or wheat is prevailing in the upland fields. Usually, on the field where maize is the main crop, wheat is cultivated only in a single season, after the successive cropping of maize on the same field for 2 to 3 years. On the other hand, on the field where wheat is the main crop, maize is cultivated only once that is followed by wheat again, but mostly for a single year because of successive cropping being subject to loss in its yield.

b) Grapevine is one of the main crops next to maize in the Study Area.

c) Pasture provides grazing sources for cattle, horse and other small stocks.

3.3.2 Agricultural Production

(1) Cultivated Area

The main crops prevailing in the Study Area are maize, grapevine, wheat and perennial meadow plants, which occupied 43.6, 25.0, 9.8 and 6.9% of the total cultivated area in the Study Area in 1992 . The rest was shared by annual meadow plants (3.4%), barley (2.6%), vegetables (2.6%), sunflower (2.1%) and so on .The cultivated areas of maize, vegetables and vineyard in the last 8 years show an increasing trend , but wheat, barley, sunflower and potato show a decreasing trend (**Table 3.3.2-A1**).

(2) Yield

The average yields of maize, wheat and grapevine in 1992 (drought year) were 1,637, 2,549 and 3,643 kg/ha, respectively. The yield of maize was considerably low due to the drought in the year. The normal yield of maize is estimated at about 2,700 kg/ha. The yields of barley, sugar beet, sunflower, potato were 3,365, 15,272, 1,280, 12,757 kg/ha in 1992, respectively. The yields of bean seeds, grapevine, maize and potato are largely fluctuated by year, but those of wheat, sugar beet and sunflower are comparatively stable. Statistic summary of annual variation on yield between 1986 and 1993 are shown as follows:

Crop	Estimated Yield * (kg/ha)	Standard Deviation (kg/ha)	Coefficient of Variation (%)	Maximum Yield ** (kg/ha)	Minimum Yield ** (kg/ha)
Wheat	2,266	691	30	3,306	1,321
Barley	***2,416	-	-	***3,365	***1,884
Maize	2,661	994	37	4,407	1,323
Bean Seeds	***4,691	-	-	***10,000	***1,391
Sunflower	1,599	331	20	2,152	1,128
Sugar Beet	17,136	5,146	23	28,975	13,029
Potato	***12,772	-	-	***18,232	***7,328
Grape	6,530	1,832	32	8,921	3,074

Notes: * : average of 8 years data (1986-1993) in 19 villages/towns in the Study Area
**: average of the maximum/minimum yields in the 8 years of each villages/towns
***: data of 3 years 1985, 1990 and 1992 only

(3) Amount of Production

The amount of production of wheat, maize, barley, sugar beet, sunflower, potato and grapevine in 19 villages are 15,190, 43,383, 5,323, 3,421, 1,656, 6,187 and 55,474 ton in 1992, respectively, which occupy 33.3, 39.2, 44.0, 9.7, 19.8, 51.3 and 54.0% of those of Vrancea District.

3.3.3 Livestock

(1) General

The most common livestock in the Study Area is chicken, followed by sheep, cattle and pig. The average raised heads per farm household are 28 for chicken, 2.2 for sheep and around 1 for cattle and pig. Other livestock such as goat, house rabbit, horse and bee are also raised in a small scale.

The total production in 19 villages/towns including the Study Area in 1992 was 16,059 ton on meat, 155,835 h lit on cattle milk, 37,203 h lit on sheep and goat milk, 124,684 kg on wool, 47,990,000 pcs on egg, 23,804 kg on honey. Since 1990, the livestock production has rapidly increased except for honey **(Table 3.3.3-A1)**.

(2) Livestock Production

Poultry and pig are the most common livestock bred among the individual farmers, that is; ; 94.9% of the farmers breed poultry and 89.9 % breed pig, followed by sheep (54.4%), dairy cattle (38.0%), horse (25.3%) and goat (21.5%). The average raised heads of per farm household are 28.5 heads on poultry, 2.0 on pig, 9.4 on sheep, 0.4 on dairy cattle, 0.4 on horse and 1.2 on goat. Bee is also raised in a small scale (1.3%) **(Table 3.3.3-A2)**.

There are three livestock farming units in the samples of the hearing survey. Two of them are SCM and the rest is SCCP. One SCM raises 203 heads of dairy cattle and 50 heads of beef cattle, the another SCM raises 193 heads of dairy cattle and 3,650 heads of sheep. One SCCP raises 60 heads of beef cattle and 380 heads of pig.

Production and raising costs of livestock per head and farm gate price of each product are shown in **Table 3.3.3-A3, A4 and A5**. The raising costs of horses is the largest, followed by cattle, pigs, sheep, goats and poultry. The costs pigs and sheep are about 1/10 of those of horses and cattle. The productions of livestock per head are low, which are mainly consumed by farmers themselves.

3.3.4 Farming Practices

The data on farming in the Study Area were collected by the hearing survey for 100 farm households/farming units in the Area. These data have been arranged as much as possible by the type of farming because of the farming scales much differing by the type of farming.

(1) Type of Farming

At present, 6 different types of farming exist in the Study Area, namely; Individual farmers (I), Association of private farmers (families) without juridical personality (AAS), Association of private farmers with juridical personality (AA), Commercial company with double capital-state and private (SCM), Commercial company with whole private capital (SCCP) and Research and production institution (SCP). According to the data collected from the LO-Vrancea, individual farmers occupy 87% of the total farm households/farming units in the Area, followed by SCM with 12 % **(Tables 3.3.4-A1** and **A2)**.

(2) Farming Conditions

1) Individual Farm Household (I)

The average farming area of 79 individual farm households is 2.96 ha, of which 1.71 ha is upland, 1.13 ha vineyard, 0.10 ha pasture and 0.01 ha orchard. Besides, 28 heads of poultry, 9.4 heads of sheep, 2.1 heads of pig, 1.2 heads of goat, 0.4 heads of cattle and 0.4 heads of horse are raised. An agricultural labour force per farm household is 2.3 persons **(Table 3.3.4-A1)**.

2) Informal Association of Private Farmers (AAS)

The average farming area of 11 AAS which are associated by 109 private farmers per AAS on average(minimum 2 farmers, maximum 500 farmers) is 88.62 ha, sharing 0.8 ha per farm household. The land is all upland. Besides, 43 heads of poultry, 3.5 heads of sheep, 2.0 heads of pigs and 0.2 heads of horse are also bred. The agricultural labour force is 109 persons per AAS consisting of one person per household.

3) Formal Association of Private Farmers (AA)

The average farming area of 2 AA which are associated by 205 private farmers per AA on average (100 farmers and 310 farmers) is 225 ha, sharing 1.1 ha per farm household associated. The land is all upland. There is no livestock raising. The average labor force per AA is 205 persons consisting of 107 male and 98 female in their family labour.

4) Commercial Company with Mixed Capitals of State and Private (SCM)

The average farming area of 5 SCM is 726.6 ha per SCM, which is composed of 396.6 ha of upland and 326.2 ha of vineyard. Besides, 89.2 heads of cattle and 730 heads of sheep are bred. The labour force is 414 persons consisting of 317 male and 97 female of employed labourers.

5) Commercial Company with Whole Private Capital (SCCP)

The average farming area of 2 SCCP is 15.1 ha. The land is composed of 6.6 ha of upland, 7.5 ha of vineyard and 1.0 ha of meadow. Besides, 190 heads of pig and 30 heads of cattle are raised. The labour force possessed is 6.5 persons consisting of 5.0 male and 1.5 female.

6) Research and Production Institution (SCP)

There is one SCP of Grapevine Research Institute located in Odobesti. Its total area of 484 ha is used for vineyard. 157 persons consisting of 101 male and 56 female are employed as labour force.

(3) Farming Practices

1) Maize

Maize is grown in the Study Area from April to October. Prior to sowing, land is prepared by disk harrow. Sowing is done from the middle to end of April by machine by 81% of the farmers. The most of farmers use certified seeds purchased from seed companies or research institute. The main varieties used in 1993 were HELGA, HS-225, T-200, P-2747 so called by the farmers. 88% of the farmers apply organic manure or chemical fertilizer as either basal or top-dressing. Weeding is done twice by machine at the stages of around 20 cm of plant height of crop and of 80 cm by hands. Around 10% of the farmers perform disease control and 30% pest control. Harvesting is done in the 1st decade of October by hand. Usually, the farmers whose major crop is maize cultivate wheat only in a single season after the successive cropping of maize on the same field for 2 to 3 years within a rotation cycle. However, 14% of individual farmers are cultivating maize continuously for 5 years on the same field, because of difficulty of cultivation of wheat in a small scale (**Tables 3.3.4-A3** and **A4**).

2) Wheat

In general, preparation of land for wheat is taken in the last decade of September with machine. Sowing is commenced from the beginning to middle of October by machine by 78% of the farmers. Main varieties used are ARIESAN and TRANSILVANIA. All of the farmers are weeding at once during the growing period by machine (84%) or machine and hand (11%) or hand (5%). 96 % of the farmers has manuring. Disease and pest control are also done by around 10 % of the farmers. Harvesting is taken in the middle of July by machine (86%) or machine and hand (9%) or hand (5%). The farmers whose major crop is wheat cultivate maize only once that is followed by wheat again, but mostly for a single year because successive cropping is subject to loss in yield.

3) Other Crops

Other crops such as sunflower, sugar beet, potato, tomato and onion grown as summer crops are sown at the beginning of April to the middle to end of April, and are harvested at the end of July (tomato) to the middle of October (sugar beet). Industrial crops such as sunflower and sugar beet are cultivated in a large scale (**Table 3.3.4-A4**).

4) Cropping Pattern

The present cropping pattern in the Study Area, through the farm survey, is summarized in **Fig 3.3.4-A1.**

(4) Crop Production

The average yields by type of farming are in a range from 3,191 kg/ha (AA) to 3,855 kg/ha (SCM) in wheat, 1,087 kg/ha (SCP) to 5,113 kg/ha (I) in maize, 2,360 kg/ha (AAS) to 3,965 kg/ha (SCM) in barley, 1,500 kg/ha (AAS) to 27,800 kg/ha (SCM) in sugar beet, 1,363 kg/ha (SCM) to 2,400 kg/ha (AAS) in sunflower and 2,800 kg/ha (SCCP) to 11,107 kg/ha (SCP) in grapevine, respectively . The individual farmers are getting comparatively stabilized high yields in all crops by the diversified farming compared with other types of farming, and the farming of AA and AAS are not yet on the right track (**Table 3.3.4-A4**).

(5) Labour Requirement

The labour requirements much differ by crop and by type of farming. Among the crops, grapevine cultivation requires the largest labour force, i.e. 1,087 hr/ha which is equivalent to 11 times in the case of maize cultivation and 120 times in wheat. Among the types of farming, the individual farming requires always high labour force compared with other types of farming, which may be caused by more use of manual farm working. Maize requires high labour force during weeding and harvesting. The extremely low labour force is required for wheat cultivation in AAS, AA and SCM and for maize in AA and SCM due to the mechanized farming, where no positive labour input is required for the increase of crop yield (**Table 3.3.4-A5**).

(6) Production Cost of Crops

Among the crops, grapevine production requires the highest cost, i.e. 653,031 Lei/ha which equivalent to 7 times of that of maize, followed by vegetables (401,704 Lei/ha, the average of tomato, cabbage and onion), potato (276,366 Lei/ha), sugar beet (221,560 Lei/ha), barley (129,793 Lei/ha), wheat (122,744 Lei/ha), oats (121,584 Lei/ha), maize (92,766 Lei/ha) and sunflower (74,284 Lei/ha).The high costs required for the cultivation of grapevine and vegetables are mainly due to the cost of disease and pest control and the labour cost. In the case of wheat and maize cultivation, harvesting costs occupy 48% and 40 % of the total production cost, respectively. Sugar beet and sunflower assign 91% and 73 % of the production cost to harvesting and machine and tool costs. While, the potato allots 42 % to seeds (**Table 3.3.4-A6**).

(7) Constraints to Crop Production

The biggest constraint against the crop production in the Study Area is non-irrigation facility as well as poor marketing system, followed by lack of farming fund and insufficient fertilizer. However, that of association farmers (AA) is shortage of agricultural machinery and lack of farming fund. At present, the agricultural machinery possessed by AGROMECs which has close relation with the Study Area is below a half in number in 1986 except seeders, which may not be able to meet the farmers' demands in the Study Area (**Table 3.3.4-A7**).

3.3.5 Farm Household Economy

(1) Economic Environment

Most of individual farmers have too narrow farm holdings (3 ha perform household in average) to sustain their household. So they resort to off-farm income, entailing farm labor shortage or lack of viable, young labor force in their farming. To make the matter worse, marketing media or facility still remains undeveloped within their accessible sphere. These make them less responsive to crop or animal profitability. Out of their production value, on the basis of all farms in the Study Area, 84% was sold, but individual small-holders have much less share on their sale of farm product, implying they are self-subsistent farmers. Data from sampled farms show the averages as listed in **Table 3.3.5-A1**.

The declared annual living expenditure averages 1,633, hence household economy yearly produces a surplus of over 500×10^3 Lei. However, the estimated farm income covers around 70% of the annual living expense and the rest 30% depends on their off-farm income. These situations imply that agriculture currently serves secondary means to sustain life, but off-farm income is hardly relied on during the period of price-hike.

(2) Present Farm Income

The following gives source of farm income by major farming type:

(Unit: 10^3 Lei)

Farm Type	Total Area (Vineyard) (ha)	Annual Income	Farm Composition (%)					
			Self-consumed			Marketed		
			Crop	Grape	Animal	Crop	Grape	Animal
Individual	3.0(1.1)	1,797	12	23	5	20	11	29
AAS	85.6(0.9)	19,921	49	1	2	44	1	3
AA	727(326)	355,533	17	54	9	9	4	7

Notes : - Average Area : 2.96 ha
- Mean Farm Labor : 2.3 persons

The estimated total household annual income is as follows:

(Unit: 10^3 Lei)

Gross Farm Annual Income			Estimated Net Income	Off-farm Income	Total Household Annual Income
Crop	Animal	Sub-total			
2,195	1,095	3,290	1,797	987	2,784

As shown in the above table, the farm gross income earned by an individual farm consists of crop income accounting for two thirds of the total, and the rest, livestock, one representing a third. Income from wine grape accounts for a half of crop income, where self-consumed grape is used to produce home-fermented wine. It is estimated that 35-36% of the gross income can be counted as net farm income.

(3) Production Cost and Net Gain

Agricultural prices on input and output are listed in **Table 3.3.5-A2** to **A7**, though some seasonal fluctuations might exist, and market price in Focsani urban market in July 1994 is also attached for reference. Most individual farmers do not use chemicals and inorganic fertilizers for their crops except for vineyard and particular industrial crops for which improved seed and chemical fertilizers are supplied through their marketing or processing channels. Even seed other than hybrid varieties is self-supplied because of lack of fund of them. It follows that they do not have to incur farm expenditure on purchased inputs, but instead longer and harder labor is required to prepare manure, seed and weeding.

In the case of wheat and cash crops that require machinery operation, machinery hiring charge is inevitably payable. However, mechanization can save much labor and if machinery operations are timely procured, aged farmers can rely on machinery fleets from AGROMEC. The estimated production costs without irrigation are summarized in **Table 3.3.5-A8**.

From the above results, net gain from crops are roughly estimated taking into account the value of by-products is as shown in **Table 3.3.5-A9**. In case of grape or vineyard, it provides wage labor chance for small holders.

Although the profitability of wine grape is estimated at a marginal level, the actual gain therefrom by the farm households specialized in wine grape production regardless of their acreage under vineyard has been proved to be fairly high. According to the result of Farm Survey by the Study Team, the average rate of net profit comes to 46%, yielding averagely 490×10^3 Lei of net gain per hectare (**Table 3.3.5-A10**). Whereas a majority of common farm households also have their marginally sized vineyard, contributing to much lower mean productivity as shown elsewhere due to poor gain therefrom. In this context, 65% of tonnage of harvested raw grape clusters can be processed into crude wine, around 80% of which can be sold at an average unit price of 800 Lei/lit. It follows that one ton of raw material with a value of 170×10^3 Lei will bring a crude income of 416×10^3 Lei, thus leaving a value-added gain through home processing of additional 47% to the value of raw material or equivalent to 250×10^3 Lei, after subtracting estimated depreciation cost for processing kits and labor charge etc..

(4) Value of Farm Labor and Comparison with Machinery Rental Cost

Provided that AGROMEC machinery is hired to cover mechanizable parts of field labor, assuming that hire charge of seed-sowing comes to 10×10^3 Lei/ha, of plowing 30×10^3 Lei/ha, of spraying 4×10^3 Lei/ha, of grain combine harvester 15% equivalent of harvested grain, of root harvester 40×10^3 Lei/ha, the cost comparison can roughly be made on condition that the shadow labor wage is set at 5×10^3 Lei per day as shown in **Table 3.3.5-A11**.

Except for maize and horticultural crops, many of them are not identified justifiable to introduce rental machinery, in other words currently offered AGROMEC rental prices do not lie in a reasonable level. Apart from machinery, costs of chemical fertilizers and agro-chemicals seem rather expensive. Assuming one additional ton of grain from 100 kg component of compound fertilizer, or 455 kg/ha, about 94% of crude income from grain might be offset by payment for fertilizers.

3.3.6 Land Tenure

(1) History of Land Reform in this Century

In order to understand the recent changes in land law, we have to know the history of the land reforms in this century. Main land reforms are divided into four phases as follows:

a. Land Reform in 1921

Lands of about 6×10^6 ha, which were equivalent to 60% of the land owned by large land owners, were redistributed to 1.5×10^6 farmers. The reform contributed to capitalism of agriculture in Romania.

b. Land Reform in 1945

Lands of about 1.46×10^6 ha owned by noblemen and large land owners were allotted to 0.9×10^6 farmers. Redistribution of the land owned by noblemen and large land owners to the farmers almost finished in this reform.

c. Land Collectivization during the Socialist State
The small farmers with holdings of less than 10 ha were forced to join the state cooperatives from 1948 to 1962. The large holdings of 50 ha and above were acquired by the state and the vacant land was taken over by state farms or village authorities. By this way, 95% of the arable land of the state were collectivized by 1962.

d. Privatization of Land after Revolution in 1989
Land Law (Law No 18, effective on February 19, 1991) provides for the restoration of land operated by the state cooperatives to the former owners or their successors in title. Any owners of land who can prove a legal title before 1948 are entitled to recover the private ownership of land previously owned. Each family can recover the former property up to 10 ha as the maximum.

(2) Land Ownership

1) Process of Privatization

The process of investigating legal title to land, allotting the land, issuing the provisional certificates of ownership and converting the provisional title into the final title with fully registered land is now in progress throughout the country. In eleven towns and villages mainly related to the Study Area, percentage of farmers who have accepted the certificate and the title of property to the whole farmers are 85 to 100% and 0 to 48%, respectively (**Table 3.3.11-A1**).

2) Category of Land Ownership in the Cultivated Area

Before 1989, there were three categories of land ownership in the cultivated area. That is; a) the Cooperatives for Agricultural Production (CAPs) which owned the former private land, b) the Enterprises for State Agriculture (IASs) which was called as the state farm and owned state land, and c) privately owned land. CAPs occupied 66% of cultivated land, IASs 21% and the private land 13%, respectively.

At present, there are three categories of private land ownership in the cultivated area, namely; a) privately owned individual land which includes land of informal association of private farmers (AAS), b) formal association of private farmers (AA) and c) land of commercial company with double capitals of state and private (SCM) or with whole private capital (SCCP).

(3) Land Tenure in Vrancea

The total area of Vrancea District including the Study Area is about 485 x 10^3 ha in 1994. Public area, state property and private property in private area are 50.2%, 6.3% and 43.5% of the total area, respectively. Total agricultural area of Vrancea District is about 255 x 10^3 ha, 52 % of the total area. Public area, state property and private property of agricultural land in private area are 15.9%, 10.4% and 73.7% of the total agricultural area, respectively. Individual farms occupy 90.7% of the private land, commercial companies occupy 1.2% and associations of private farmers (legal) occupy 8.1% (**Table 3.3.6-A1**).

3.3.7 Marketing System

(1) Consumer Price and Marketing System

1) Consumer Price

Viewing only from the consumer price indices reported by the National Commission for Statistics, annual inflation rate was almost stable before the revolution. After the revolution,

average monthly rate of consumer price was violently and continuously risen in the post-revolutionary confused conditions. In October, 1990, inflation rate of food stuffs was the highest recorded at 8,025.5%, followed by 6,677.7% for non-food stuffs and 5,456.0% for services in May, 1994.

Remarkably, seasonal fluctuation of food prices including perishable fruits and vegetables is not reflected in the indices, though it actually happens in the free markets, especially in the countries not equipped with sufficient facility for storing and preserving perishables. The reasons and the factors shall be continuously studied on the absolute shortage of volume, unwillingness of delivery by farmers, under-developed marketing system and others.

In 1993, due to successive price rises caused by lift of the Government subsidies for food stuffs and services and to the introduction of the value added tax in July 1993, the inflation was 295.5%, according to the data by the National Commission for Statistics.
The average monthly rate in consumer price in the first five months of 1994 was reduced to 6% against 180.2% in the same period of last year. According to the Government forecast for the following months, a slowdown in the rise of prices for consumer goods is expected, while annual inflation rate will be reduced to 75% in 1994 as previously agreed with International Monetary Fund, and these recovery are acutely hoped to realize.

2) Retail Price

During 3 years starting from October 1990 to October 1993, the highest inflation rate was recorded at the price of packed maize 110 times as much as the base, followed by 93 times at the price of unpacked white wheat flour, 90 times at pork, 77 times at eggs, 76 times at salami, 75 times at fat cheese, 73 times at beef, etc.

Depending on the kind of food commodity, retail price in rural town is reported to be higher than in Bucharest. The reason why such phenomena happen shall be continuously studied from such point of view as unbalance of production volume in District, under-developed marketing or transportation system. In July 1994, most prices of food stuffs at free vegetable markets are still rising (by the inspection of the Study Team).

(2) Retail Trade

According to the data prepared by the National Commission for Statistics, the structure of number of retail trade units was accounted for about 18%, 20% and 62% for public, co-operative and private trade at the end of 1992, respectively. Private trade units were tremendously increased to reach 84,488, which expanding private retail sales not only of food stuffs but also of non-food stuffs.

(3) Wholesale Trade

The structure of wholesale trade was recorded to be 39%, 2%, and 59% for public, co-operative and private trade in 1993, respectively. Also privatization in the field of wholesale trade is surely promoted.

(4) External Trade

1) General Trade

Since the reopening of the Romanian trade by adjusting customs and tariff barriers and the adoption of the Accord of Romania's accession to the European Union and of the Free Trade Treaty with the EFTA countries (from May 1, 1993), the grant of the Most Favored Nation Status in the Trade Treaty concluded with the US (October 1993) and the conclusion of the Stand-by Agreement with the International Monetary Fund, the volumes of exports and imports were expanded, worth about 4.9 and 6.0 x 10^9 US$ in 1993, respectively, or about 22% and

12% higher than in 1992. External trade deficit was reduced to about 1.1 x 10^9 US$ from 1.4 x 10^9 US$ in 1992.

All these results have had a positive impact on the development of the Romanian economy and have led to greater confidence from foreign investors. However, the export of agricultural commodity was limited to be 450 x 10^6 US$ instead of 1,654 x 10^6 US$ import. The share of agricultural commodity in the total amount of export and import was about 9% and 25%, respectively.

2) Export-Import Countries

Main markets of Romanian exports were Germany, Italy, China, Turkey and Russian Federation, and those of imports were Germany, Russian Federation, Italy, Iran and USA in the order of external trade amount in 1993.

(5) Current Marketing System in the Study Area

The fact-finding survey by the JICA Study Team has revealed that a) still under structuring of marketing channels related to the agricultural produce originating from the farmers through collectors, processors, wholesalers and retail shops to the consumer, b) still rare participation of middlemen, but it may be rather profitable for private farmers to enjoy the reasonable prices in the process of restructuring new marketing channels in the near future, c) insufficient credit support for marketing, d) smaller marketable volume relative to the total production, and e) preference to bring back the final produce like sugar and sunflower oil instead of cash payment (**Fig 3.3.7-A1**).

(6) Transportation

In accompany with the deep drop of economic activity, transportation volume of goods in Romania was remarkably decreased from the peak of 2,874 x 10^3 ton in 1988 to 854 x 10^3 ton in 1992 including every branch of railway, motor, river, air transport and petroleum pipeline. Various means of produce transportation are available in the Study Area such as modern trucks, farm tractors with trailers or wagons, passenger cars with trailers, and horse or buffalo trailed carts (**Table 3.3.7-A1**).

3.3.8 Agro-industry

(1) Agro-industry and Privatization

1) Number of Firms Registered

By the information of the National Trade Register Office of the Chamber of Commerce and Industry of Romania, number of registered companies in the field of agro-industry has been reached to 238,180 firms in the whole Romania as of the end of June 1994, of which 0.5% or 1,140 firms in Vrancea District (see **Table 3.3.8-A1**).

2) Privatization

Privatization and the development of the private sector is now accelerated in Romania as one of the most powerful instruments of reform for approaching to such final goal as:

a) the elimination of the market monopoly;
b) the post privatization prosperity of economic agents;
c) the balancing of the national budget and its turning from an account instrument into a development instrument in keeping with the priorities of the country;

d) the maintenance or improvement of socio-economic stability at all levels: micro, sectoral, zone and macro;
e) the development of labor force market in the conditions of the highest social protection;
f) the encouragement and development of investments;
g) the attraction of foreign capital, the compensation of financial and technological gaps;
h) the re-capitalization, elimination of financial blockage and financial lack of discipline manifested through delayed credits and arrears;
i) the development of general economic and mainly managerial education and its adjustment to the rules of market economy; and
j) a better adjustment of the national economy to the conditions imposed by the profoundly changing world economic conjuncture.

Under such massive and rapid privatization program, according to the List No 7 published on July 25 to July 27, 1994, 104 big and medium size firms in total will be privatized, of which 18 firms including AGROMEC at TOPOLOVENT, BRILA, HIRSOVA and HORIA are operating in the field of agro-industry. Moreover, a list of 3,000 enterprises will be published on August, 1994 to go into private under a mass privatization scheme. Most of 3,000 companies are in trade, tourism, services and food industries.

(2) Food Industry

In accordance with the information released from the National Register Office of the Chamber of Commerce and Industry of Romania, 151,828 firms are registered in the field of food industry in the whole Romania until the end of June 1994, of which 703 locate in Vrancea District (**Table 3.3.8-A3**). Structure of ownership type is 1.1% and 98.9% for state and private plus mixed firms, respectively. Privatization of food industry is also rapidly accelerated.

(3) Agricultural Commodity Produced in Vrancea

At present, agricultural commodities produced in Vrancea District are almost similar to those of other districts and no particular price competitive or special commodities in Vrancea are found except for grape, cherry, sour cherry and nut. Weight of total agricultural production of Vrancea to the whole Romania is reported to be less than 2% according to the data by the National Commission for Statistics.

(4) Agro-industry in the Study Area

Leaving financial and marketing problems aside, many aggressive companies are started to structure like SC " MERRA " SA and SC Bernard SRL to develop agricultural and food production, even though many state companies are operating. They are expected to be privatized sooner or later. In general, most food processing companies suffer so much from high rate bank interest, shortage of raw materials, lower operation efficiency of the factories, etc.. They are shown in Data Book.

In due course, food processing facilities and their capacities are already equipped sufficiently for processing agricultural commodities produced in the Study Area and additional facilities may not be required. Improvement of existing processing facilities are, however, extremely essential, since most of the existing facilities are dilapidated. It may be urgently required to research and develop the most marketable commodities with competitive price, the most suitable pre-and-post harvest equipment and the restructuring of the marketing system especially for the small scaled private farmers in the Study Area.

3.3.9 Agricultural Supporting System

Agricultural supporting system has been established in and around the Study Area, accessible to farmers. However, the system is not yet consolidated and some of them do not function well, while others fail to operate in their full capacity due to feeble demand etc. Major units of the supporting system found in the Study Area is given in **Table 3.3.9-A1**.

Agricultural Bank can provide loans to the farmers with subsidized interest rates, by 4 agents in Vrancea District and each commune has its branch office or filial for easier access for the farmers. In 1994, the bank handled 28×10^9 Lei, of which 18×10^9 Lei, or 70% is allocated to agricultural loans (30% for state farms, 30% for AA and 10% to individual farmers). The major profile of loan/saving service is listed in **Table 3.3.9-A2**. APRO deals chemical fertilizers, agro-chemicals, spare-parts/attachments of machinery, fuels and paints, for direct sale to customers. AGROSEM's role is to produce certified seed under the contract with the farmer/state farm contractors, and to distribute it among the farmers groups. ROMCEREAL, as sole buying agent, storer and miller of grains and sunflower seed, purchases cereals and distributes flour among the bakeries, delivers bran to feed stuff producers, sunflower seed to oil factories. AGROMEC provides tractors, combines, sprayers for the farmers and their groups through a rental charge system, while maintain them properly. Agricultural Chamber (Camera Agricola), established one for each district, will be reinforced to expand its functional capacity from currently stationed a few staff to those covering all major disci-plinaries to render technical/information service for the farmers. The net-work of the chambers is illustrated in **Fig 3.3.9-A1** as a schematic flow.

Weekly Animal Market (Tirc Animale) is held every Saturday for auction sale of farmers' live animals and their products, where entrance fee of 100 Lei/participant and sales margin are collected according to the amount of sales. Currently, activities of AGROSEM is hampered by the failure of contracts with seed producers. AGROMEC can hardly drive rental service in its full capacity either by minutely divided parcels or client's reluctance of paying rental charge or failure of timely operation for crops.

3.3.10 Farmers' Organizations

Before the revolution, CAP (Agricultural Cooperative Farm) covered about two thirds of the total farmland in Vrancea, holding fleets of farm machinery. After the disintegration of CAPs,, a host of individual small holders have been established. However, many disadvantages have arisen from such small holding, for example, machinery use, credit access, productivity of crop and livestock and their management. MAF promotes to establish private farmers groups to solve these issues and now the farmers in the Study Area have begun to form associations, companies etc. in the following way:

SCM : the state and private individuals co-invested at the share 70:30 to 50:50;
AAS : the agricultural association set up by family, kindred without any juridical personality;
AA : the agricultural association set up by family, kindred with juridical character;
SCCP : the agricultural company with integrated private capital;
SCP : the research and producing station (State Farm); and
I : the individual farmer who doesn't participate in any such groups as stated above.

AAS can be easily established among kindred, without any legal/registry procedure, but requirement arises when participants establish AA. In case of SCM and SCCP, registration is necessary and taxes are imposed.

Membership of these companies shares invested land, fund and labor, taking advantage of dividend from their production. At least 10,000 Lei per membership and more than 10 members are required to establish SCCP. Current distribution patterns in Vrancea District and in the Study Area as of July 1994, expressed as numbers of farm are shown in **Table 3.3.10-A1**.

As to the scale of land holding and membership in a society, MAF data as of July 1994 and a farm survey by the Study Team is summarized in **Table 3.3.10-A2**.

3.3.11 Rural Community

(1) Method of the Farmer's Sociological Survey

Two kinds of the sociological surveys were performed to clarify social life of the farmers in the Study Area. These are a) the hearing survey to the farmers and b) the interview survey to the Mayors of the towns and villages mainly related to the Study Area.

The purpose of the hearing survey to the farmers is to identify the present condition of socio-economic condition of the farmers, the farmer's intention for farming and living, the farmers' consciousness on the guiding principles of their lives, and their view and expectation to the Project and the Government. Number of the farmers of 8 villages and 3 towns mainly related to the Study Area is about 70×10^3. Among these farmers, 100 samples were selected at random. The hearing survey was carried out during the period from July 4 to 10, 1994 by the selected interviewers.

The interview survey to the Mayors of the same towns and villages aims to identify the social conditions in the towns and villages. The items surveyed were demography, land use and land tenure, administrations, rural infrastructure and life environment.

(2) General View of Rural Conditions in the Study Area

The Study Area lies on the right side of the Siret River, has its width of 10 to 15 km and declines with a W-E direction. The elevation ranges from El 350 m at the west side to El 50 m at the Siret River. The residential quarters of the towns and villages are generally on the high land at the west side of the Study Area, except for Marasesti and Pufesti being located near the Siret River.

These towns and villages have paved main roads and unpaved secondary roads, electric supply facilities, post offices, several primary schools and high schools (in towns only), clinics (one for each village) and hospitals (one for each town) and several mix stores. Number of the farm households in 11 towns /villages is about 22×10^3 and the population is about 70×10^3. The sex ratio in the Area is 51% for female. The private farmers occupy 99.6 % of the whole farm households including the private farmers who are working in the commercial companies (6.4%) and the farmers who are working in the formal association 0.4% (**Table 3.3.11-A1**).
According to the hearing survey to the farmers , an average farm size of the private farmers is 3 ha including vineyard of 1 ha. With respect to land ownership of 100 farmers surveyed, the farmers who have accepted the certificate and the title of property are 76% and 18%, respectively.

(3) Structure of a Family

The structure of a family in the Study Area has the following three characteristics:

a) An average family size in 11 towns/villages mainly related to the Study Area is 3.1 persons in the census on January 7, 1992, and 2.8 persons in 100 farmers surveyed. The neuclearization of the family may be progressed in Romania.

b) Rural society in the Study Area is an aging society. The old-person households which designate the households made up exclusively of family members aged 65 and over are 17.2%.

c) The proportion of farm households with multiple income is high. The full-time farmers including pensionaries are 47%, but those excluding pensionaries are only 8.6%. The farmers earning the major share from non-agricultural occupation are 53%. The kinds of occupations are the jobs in rural community, such as bookkeeper, medical assistant, electrician, teacher, postmaster, foreman, cashier, caretaker, mechanic, officer, engineer and driver.

Workers in a family are 2.5 persons in average, ranging from a maximum of 7 persons to a minimum of 1 person. It is considered that these characteristics are helpful to promote organizing the associations .

(4) Housing and Drinking Water Supply

There are three types of housing in the Study Area; a single house, tenement house and apartment house. Percentages of each type in the 100 farmers' households is 87% in a single house, 9 % in tenement house and 4 % in apartment house. The floor space of a single house is 133 m^2 in average, ranging from a maximum of 400 m^2 to a minimum of 40 m^2, and the plottage of a single house is 1,143 m^2 in average, ranging from 11,000 m^2 to 120 m^2. The residential quarters of the towns/ villages are generally on the high land at the west side of the Study Area and the location of their field is very far from their houses.

With regard to drinking water supply, most of the towns and villages except for Pufesti are supplied with the pipe line network and the deep wells. Quantity of drinking water in Pufesti and Marasesti located at the elevation of lower than 85 m are enough throughout the year, but in other towns/villages located at high land, the water supplies are not enough. Especially, shortage of drinking water is very severe in Ruginesti, Paunesti, Movilita and Straoane, and this is one of the big social problems (**Table 3.3.11-A2**).

(5) Living Standard

The annual living expenditure of the farmers in the Study Area is about 1.2 x 10^6 Lei in average of 71 samples, and they are thinking that they belong to a " middle class " in the country. And the ideal (or target) of their annual income is 3.7 x 10^6 Lei which is equivalent to 2.9 times the present their income (**Table 3.3.11-A5**).

The spread rate of commodities, percentage of private households having the commodity to the whole private households, in the Study Area are; 66 % for black and white TV, 12% for color TV, 54% for electric washing machine, 63 % for electric refrigerator, 2 % for motorcycle, 1 % for truck, 14% for car and 2% for tractor, respectively.

They use usually the electricity for lighting, butane gas and woods for cooking and woods for heating rooms (**Table 3.3.11-A3**). Concerning the type of toilets in the Study Area, the flush type in the towns and the dipping-up type or a simple hole in the ground in the villages are common, respectively. The insufficient things and the reasons why the farmers in the Study Area want to get them are as shown in **Table 3.3.11-A4**. Among them, cars, trucks, tractors and other farming tools are most expected by them.

The most serious and protracted diseases prevailing to the Study Area are Rheumatism, Cardiopathy, Sciatica, Diabetes and Chronic hepatitis (**Table 3.3.11-A8**). Percentage of families get sicks during a year is 44 % of total surveyed families, and amount of annual expenditure for medical care in each family is 138,150 Lei in average, ranging from a maximum of 510,000 Lei to a minimum of 1,000 Lei. Farmers' views on the medical problems in the Study Area are as shown in **Table 3.3.11-A9**. Among them, high expenditure for medical care and poor equipment of hospitals are the most Seri problems for farmers.

Regarding the living situation of the farmers in the Study Area, it is generally described as follows: After the revolution in 1989, the cooperatives were disorganized and the farm lands

have been redistributed to the farmers. The farmers scarcely had any farming tools or farm machinery and they were not supplied with any farm materials during the last 4 years. Their agricultural income has decreased and their living standards have decreased accordingly.

(6) Farmers' Intention for Farming and Living

Ninety two (92) farmers replied to the questionnaires prepared by the Study Team are divided into 3 groups in accordance with their working places; a) in the individual own farm, b) in the farm of AA or AAS and c) the company's farm. Furthermore, the individual farmers including the farmers in the farm of AA of b) are divided into 4 groups depend on the farm size and family type as follows:

Group-A : Households with multiple income, farm size: 1 ha or more and not old-person households
Group-B : Households with multiple income, farm size: less than 1 ha and not old-person households
Group-C : Full-time farmers including pensionaries, farm size: 1 ha or more and not old-person households
Group-D : Full-time farmers including pensionaries, farm size: 1 ha or more and old-person households

These groups are compared in accordance with their intentions for farming, and for raising income and living standard. The results of the survey are summarized as follows (**Tables 3.3.11-A5** and **A6**).

The farmers working in AA, AAS and companies think that the farming is wonderful occupation and intend to keep up farming positively at their present places of work. They want to increase their income by yield increase of present cultivating crops with irrigation. Their living standard is higher than that of the private farmers and their ideal income is also higher.

With regard to the private farmers, the full-time farmers except for the old-person households think that farming is wonderful occupation and intend to keep up farming positively as same as the farmers working in AA, AAS and companies and most of them want to work in the own private farm. On the other hand, a half of the farmers with multiple income think that the farming is not wonderful occupation and intend to participate in the associations. Most of the private farmers also want to increase their income by yield increase of present cultivating crops with irrigation.

(7) Expectation to the Government and the Project

The main items greatly expected by the farmers in the Study Area are a) construction of the irrigation facilities, b) improvement of agricultural credit with low interest, c) assistance for getting farm machinery and d) repair and maintenance of rural infrastructures. All the farmers surveyed are expecting the implementation of the Project (**Table 3.3.11-A7**).

(8) Position of Women

Between 1918-1945, the improvement of the system of laws started in Romania, and the constitution law of Romania was one of the most modern constitution laws in the world at that time. In this situation, the women rights became equal to the ones of men. However, they did not have access to the political positions in the government. The women from the rural areas, most of the time, were busy with the farm and only a few of them were attending the educational system for more than 4 years.

Between 1946-1989, under the new communist laws, women were equal in all rights to men (equal wages for the same works, the right to vote, the right of having any jobs). Since 1968, Ceausescu has forbidden women to make abortion and this thing has led to the death of many

women who tried to make abortion in some other places than hospitals. The life of women became very hard, because they had to work not only at their jobs, but also when they were at home. Due to lack of food obliged, most of women to work for hours to buy food even of bad quality or insufficient. At present, the Romanian laws do not make any discrimination between sexes as same as before.

3.4 EXISTING IRRIGATION AND DRAINAGE

3.4.1 Existing Irrigation

The construction of the Project of Ruginesti - Pufesti - Panciu has started, but not yet function at present, in the Study Area since 1988. Only one irrigation system exists and functions in the Study Area, that is; the Putna Irrigation System. The irrigation water for this system is taken from both banks of the Putna River at its upstream section by constructing temporary cofferdams, and it is led to the respective irrigation areas through the main canals by gravity. These canals are used not only as irrigation canals but also as drainage canals.

The total irrigation area covered by both Irrigation Canals (named the Right Canal and Left Canal) is 2,000 ha, which is spread at both banks of the Putna River delta surrounded by the Susita River on the north, the railway from Focsani-Burca on the south and the Siret River on the west. The Right Canal system covers the area both inside and outside the Study Area. The operation and maintenance of the System is made by Hydro-system Marasesti, SCELIF-SA-Vrancea.

The general layout of the Putna Irrigation System is shown in **Fig 3.4.1-A1**, and the main features of the Irrigation Canals of the System are as shown below:

- Design discharge: 1.0 m^3/s for the Right Canal System
  0.8 m^3/s for the Left Canal System

- Canal dimensions:

Bottom width	= 1.20 m
Canal height	= 1.20 m
Side slope	= 1 : 1
Lining	= mainly earth lining (concrete block or wet masonry in some sections)
Longitudinal gradient	= 1 : 1,000

According to the interview to the Officer in charge of the System and the site investigation by the Study Team, the following points have been made clear:

a) Unstable intake of the irrigation water due to the fluctuation of discharge of the Putna River and no permanent head works exist;
b) Troublesome maintenance works like excavation of inlet at the intake (once a week);
c) Malfunction of the check structures in the System; and
d) Lack of canal section at some sections of the Canals.

3.4.2 Existing Drainage

(1) River Flood and Countermeasures

The rivers such as the Trotus, Carecna, Zabraut, Susita and Putna rivers passing through the Study Area are raised within the Sub-Carpathian hills, flow from west to east direction, and drain into the Siret River.

Records of the river discharge have been only observed in Putna River which is the biggest one in the above-mentioned rivers and its catchment area at the junction of the Siret River is 2,768 km^2. The major flood discharge of Putna River at the Colacu gauging station (catchment area: 1,100 km^2) are given in the table below:

Rank	Discharge (m^3/s)	Specific Discharge ($m^3/s/km^2$)	Recorded Month / Year
1	1,040	0.95	Jun 1977
2	964	0.88	Aug 1979
3	860	0.78	May 1970
4	709	0.64	Jun 1990
5	610	0.55	Jul 1971

Source: INMH (1952-93)

The probable maximum discharge of the Putna River at the Calacu gauging station is preliminary calculated as shown below:

Return Period (years)	Probable Discharge (m^3/s)	Specific Discharge ($m^3/s/km^2$)
2	290	0.26
5	520	0.47
10	690	0.63
20	880	0.80
50	1,150	1.05
100	1,370	1.25
200	1,610	1.47

Note: Calculated by the Iwai Method

Usually inundation occurs in rainy season (May to August) when the strong thunderstorm comes. According to the Soil Map prepared by ICPA in 1986, the following 5 areas are suffered from inundation at least once one or two years. Its total area is 1,410 ha. Locations of these areas is shown in **Fig 3.4.2-A1** and characteristics of these areas are given in **Table 3.4.2-A1**.

(Unit: ha)

River	Left Bank	Right Bank	Total
Domosita	-	-	160
Carecna	50	120	170
Zabraut	-	150	150
Susita	290	160	450
Putna	360	120	480
Total	-	-	1,410

Note: the Domosita river is a tributary of the Trotus river

The river works in the Study Area are underdeveloped. The rivers in the Study Area have no dike except for temporary works in the left bank of the Putna River. A few river structures such as revetments, drops, groins, spur dikes and gabion works can be seen on the Putna and other rivers.

(2) Drainage in the Study Area

As stated in the above section, the inundation area caused by the flood in tributaries locates mostly outside of the ISA. Some area of inundation spreads western edge of the ISA, they are mostly the cultivation field on the high water channel of tributaries. Most of the area in ISA can drain the excess water to the tributaries by natural gentle slope. the following areas are identified the poor drainage area in the ISA;

- the ending point of the Putna River Left bank irrigation canal in Bizighesti village, which could be drained after the completion of the culvert under the Siret - Baragan Canal.
- the swampy area in Domnesti village, which needs pumps because the water level in the Calimanesti Dam is higher than the swampy area.

The probable storm rainfall of 12, 42 and 72 consecutive hours at Adjud, Fitonesti, Panciu and Odobesti are estimated as follows;

(Unit : mm)

Duration	Return Period (year)	Adjud	Fitonesti	Panciu	Odobesti
24 hr.	2	43.3	36.8	48.0	48.2
	5	56.2	58.4	71.4	64.4
	10	63.9	77.6	86.7	74.7
	20	70.9	99.9	101.4	84.5
	50	79.5	134.9	120.4	96.9
48 hr.	2	50.0	50.7	63.2	61.8
	5	69.9	80.4	87.3	83.4
	10	81.6	107.2	103.5	98.1
	20	92.8	138.7	119.2	112.4
	50	107.3	188.5	139.9	131.3
72 hr.	2	60.3	59.5	68.7	70
	5	79.6	103.9	94.2	90.9
	10	91.5	143.8	111.4	103.4
	20	102.3	190.2	128.2	114.6
	50	115.7	263.4	150.3	128.3

Note : estimated by the IWAI Method based on the data from INMH

3.5 SOIL CONSERVATION

The soil conservation study is made mainly focusing the soil erosion problems that may bring about damages or negative effects on the irrigation development in the Project Area.

3.5.1 Present Conditions

(1) General

A variety of topographic features in Romania has been created by water erosion because of its natural conditions. The wind erosion is only affecting small areas in its southern part. According to the distribution of the geo-morphologic hazards on main relief units in Romania, it is found that surface (sheet and rill) erosion and gully erosion are occurring especially on hills and tableland areas. The rainfall intensity is higher in mountainous and hilly areas of the south and southeast part.

The critical season for erosion occurrence generally stretches between May and August when heavy rain falls during crop-growing period. Manual activity has an important role in inducing and intensifying the erosion processes particularly through the land use, crop structure on the arable land, crop farming, management of pasture and forest.

According to the research conducted by Academician M. Motoc, 42 % of the agricultural area of Romania are located on slopes of more than 5 %. And most of the pasture, vineyard and orchard are developed in these sloped areas, which has erosion potential.

Agricultural Land	Area of Whole Country (10^3 ha) (A)	Area with over 5% Slope (10^3 ha) (B)	B/A (%)	Mean Slope (%)
Arable land	9,880	2,570	26.0	17.0
Pasture land	4,480	3,360	75.0	21.8
Vineyard	310	170	55.0	16.0
Orchard	360	270	75.0	18.0
Total	15,030	6,370	42.4	18.0

The soil erosion rate of the agricultural area in Romania is shown as follows;

Degree Of Erosion	Erosion Intensity (ton/ha/year)	Ratio (%)
Non Appreciable	0- 1	57.4
Slight	2 - 8	3.0
Moderate	9 - 16	19.0
Strong	17 - 30	18.0
Very Strong	31 - 45	2.6

From the above, it is said that the Study Area is included in the areas which have high possibility of occurrence of soil erosion.

(2) Soil Conservation Study Area (SCSA)

SCSA is located in the elevation between El 200 m and El 400 m. Most of SCSA are used for farm land such as vineyard and pasture. Generally, the top of hills is gently sloped or flat, and the erosion is shallow and slight. Many ravines and gullies are observed in steep slops along such rivers as Trotus, Carecna, Zabraut, Susita and Putna. Specially, deep gully is developed in the places where land slop exceeds 10%. These areas are divided into 5 zones and 17 blocks by geographical conditions (**Fig 3.5.1-A1** to **A5**). Characteristics of each zone are given in **Table 3.5.1-A1**.

Zone	Number of Blocks	Related Rivers
A	5	R.Trotus - V. Carecna
B	3	V.Carecna - P.Zabraut
C	4	R.Zabraut - P.Susita
D	3	P.Susita - R.Putna
E	2	R.Putna - R.Milcov
Total	17	

(3) Irrigation Study Area (ISA)

ISA is mostly located under El 170 m. There are not so many eroded places in this area and observed erosion is shallow and slight due to the following reasons:

a) Slope of land is gentle (less than 5%);
b) Vineyard, having comparatively high resistance against erosion, are prevailing in the sloped area; and
c) Soil conservative farming, such as contour strips, grass strips and inter cropping is prevailing in the sloped area.

The slope of ISA is, however, very long and the soil of ISA has big possibility of severe erosion. Therefore, the farm land is still exposed to sheet erosion, especially after an irrigation farming.

On the other hand, wind erosion is scarce due to freezing of top-soil in winter and high resistibility against wind erosion because of the farm land being strengthened by soil conservative farming. Any windbreaks are scarcely observed in the Study Area.

3.5.2 Countermeasures and Existing Facilities

(1) Constraints against Soil Conservation

Considering the results of the initial and comprehensive field survey in Phase I, the constraints against soil conservation in the Study Area are summarized below:

a) High pluvial aggressiveness;
b) Low resistance of soils against water erosion;
c) Diversity of gully erosion;
d) Widely dotted erosion areas;
e) Low density of drainage networks in top-hill areas;
f) Over-grazing in pasture;
g) Felling of trees in reforested; and
h) Lack of operation & maintenance expense

(2) Countermeasures

Generally, water erosion is classified into three pattern; sheet, rill and gully erosion. Water erosion causes the damages in the downstream area as well as fertility reduction of soil due to the discharge of top-soil. Basis of countermeasures for water erosion is summarized below:

- To promote percolation of rainfall to underground and to take measures to minimize surface runoff;
- To take measures minimizing velocity of the surface runoff flow;
- To conduct concentrated water safety through drainage facilities; and
- To modify soil structure for improving durability (single grained - aggregated structure)

The countermeasures to cope with the above basic concept may include reforestation, terracing, contour strips, inter-cropping, drainage canal, diversion structures, gully control works, waterway protection etc..

(3) Institutional Organizations Related

The erosion control works in the Study Area have been designed and executed by the Regional Office for Land Reclamation, Designing and Agricultural Constructions (OIFPCA)-Vrancea, under the supervision of the Department of Land Reclamation and Agricultural Constructions (DIFCA). OIFPCA was reorganized to the Enterprise for execution and operation of land reclamation (IEELIF) in 1983 and then IEELIF was split into SCELIF-SA and SC ZBOINA-SA in 1991.

(4) Existing Facilities

The following countermeasures and facilities are common in the Study Area in addition to masonry and concrete check dams. Standard designs of drainage canals and check dam are shown in **Figs 3.5.2-A1**.

- Soil conservative farming (contour strips, grass strips, inter-cropping)
- Reforestation
- Terracing
- Catch drain
- Collecting canal (inclined drainage canal)
- Drops, chute works

Almost all these facilities were constructed in the 1970's and have become overage. Therefore, rehabilitation of these works should also be emphasized. At present, many erosion control facilities such as check dam and chute works are constructed at the downstream side of gully, but not so many like catch drain and diversion works at the upstream side of gully. To prevent the occurrence of gully and its growth, the countermeasures at the upstream side should be emphasized and more investment should be paid to the gully prevention works.

3.5.3 Slope Conditions

Gradient of slope is one of the causes of erosion. Based on the topographic map with scale of 1/25,000, slope conditions of the Study Area is divided into the following four categories. (Refer to **Fig. 3.5.3-A1**)

(Unit : ha)

Zone	under 3%	3-5 %	5-10%	over 10 %	Total
A	6,550	1,893	934	1,611	10,988
B	5,518	1,479	240	566	7,803
C	7,871	1,535	795	1,713	11,914
D	7,000	424	196	295	7,915
E	9,528	988	2,197	467	13,180
Total	36,467	6,319	4,362	4,652	51,800

3.5.4 Estimation of Soil Losses

Main purpose of soil conservation is to control the soil losses by water erosion and to sustain high agricultural productivity. To formulate the erosion control plan, it is important to presume soil losses in the Study Area.

If soil losses exceed the allowable soil loss, some erosion control works are required. The allowable soil loss is dominated by depth of top-soil. According to the Romanian design manual for soil erosion works, the allowable value is 6 ton/ha/year. And, according to the manual for soil conservation in US. Department of Agriculture, the allowable soil losses are ranged between 4.5 and 11.2 ton/ha/year.

The probable annual soil losses by sheet erosion can be estimated with the USLE (Universal Soil Loss Equation) method as follows.

$$E = K \times S \times C \times C_s \times L^m \times I^n$$

where; E: Soil losses (ton/ha/year)
K: Coefficient of rainfall (**Table 3.5.4-A7**)
without irrigation: K1= (Region-2+Region-8+region-9)/3
= (0.100+0.167+0.207)/3 = 0.158
with irrigation: K2= K1 x 120% = 0.190
S: Coefficient of soil erodibility (**Table 3.5.4-A8**)
C: Coefficient of crop management (**Table 3.5.4-A9**)
C_s Coefficient of erosion control practice (**Table 3.5.4-A10**)
L^m: Coefficient of slope length where the exponent (m) has a value of 0.3
I^n: Coefficient of gradient where the exponent (n) has a value of 1.5

Soil losses of the representative crop lands in the Study Area estimated with the said USLE method are shown in **Table 3.5.4-A1** to **A-6**.

3.5.5 Assessment of Erosion Control Area

Taking the relation to the irrigation project (Ruginesti-Pufesti-Panciu) into consideration, the erosion control area in the Study Area can be divided into the following five categories. Classification map is presented in **Fig 3.5.5-A1**. Results of assessment are shown in **Table 3.5.5-A1**.

Category	Type of Soil Erosion	Area (ha)	Priority
I	Areas affected by very strong and excessive sheet erosion, associated with gully erosion but outside the irrigation area.	4,907	C
II	Areas affected by moderate and strong sheet erosion but outside the irrigation area.	4,329	C
III	Areas which need soil erosion control in order to protect the irrigation area.	4,788	B
IV	Moderate and strong sheet erosion areas which need soil erosion control and exist within the irrigation area.	1,931	A
V	Slight sheet erosion areas which need erosion control and exist within the irrigation area.	7,655	A
Total		23,610	

Note: A: areas which need urgent action against soil erosion
B: areas which need medium-term action against soil erosion
C: areas which need long-term action against soil erosion

3.5.6 Erosion and Productivity

One of the most important damages caused by sheet erosion is the reduction of crop yields. According to the MAF Report " Instructions for Studies and necessary Calculations for Soil Erosion Control, 1973", the agricultural yield in Dobrogea decreased averagely by 15% on moderately eroded soils and by 50% on strongly eroded soil. Romanian researches has shown a stratification of yield, depending upon the thickness of eroded soil. According to **Fig 3.5.6-A1** (quotations from "Soil Erosion Prevention and Remediation in Romania" by Dr. N. Popescu) illustrating the relation between reduction of yield and thickness of eroded soil, an amount of 60 kg grains is lost by 1 cm depth of eroded soil on condition that an average yield is 4,000 kg/ha for noneroded soils. In a short time, these losses are not so large but these losses will become very severe in a long term.

For example, for a erosion of 20 m^3/ha/year in first year, yield loss become 12 kg/ha, representing an annual rate of 0.6 kg/m^3. Furthermore, the figures in the following table are obtained with the formula for the relation between yield loss and erosion used in Romania below.

$$Y = (n+1)/2 * n * a * X$$

where: Y: yield loss after n years
n : year
a : erosion rate (m^3/ha/year)
X: unit yield loss (kg/m^3)

thickness of eroded soil:		
	0-30 cm:	X=0.6 kg/m^3
	30-70 cm:	X=0.5 kg/m^3
	>70 cm:	X=0.2 kg/m^3

Erosion Conditions	Erosion Rate (m^3/ha)	Thickness of Eroded Soil (cm)	Unit Yield Loss (kg/m^3)	Yield Loss (kg/ha)		
				after 5-yrs	after 10-yrs	after 20-yrs
Strong	20	0-30	0.6	180.0 (4.5%)	660.0 (16.5%)	2,520.0 (63.0%)
Moderate	10	30-70	0.5	75.0 (1.9%)	275.0 (6.9%)	1,050.0 (26.3%)
Slight	5	30-70	0.5	37.5 (0.9%)	137.5 (3.4%)	525.0 (13.1%)

Reference Data 1: Relation between depth of surface soil, pruning weight, and yield of grape vine (Pennsylvania, USA)

Depth of surface soil (cm)	12.7-15.2	15.3-17.8	17.9-20.3	20.4-22.9	23.0-25.4	25.4-27.9
Pruning weight (kg/vine)	0.45	0.82	0.82	1.00	1.04	1.18
Yield (kg/vine)	3.58	5.12	5.16	5.66	5.66	6.39
Yield (tons/ha)	5.85	8.38	8.45	9.27	9.27	10.45

Sources: Soil Conservation by J. H. Stallings, 1959

Reference Data 2: Effect of depth of topsoil on yield of corn

(Unit: ton/ha)

Depth of topsoil (inches)	Indiana	Iowa	Missouri	Ohio
0	1.19		1.00	
2	2.01	3.51	1.57	
4	2.57	4.33	2.38	2.13
6	3.01	5.21	2.89	2.87
8	3.39	6.09	3.39	3.20
10	3.64	6.40	3.76	
12	4.02	7.84	4.02	

Sources: Soil Conservation by J. H. Stallings, 1959

3.6 ENVIRONMENTAL CONDITIONS

3.6.1 Environmental Policies

(1) National Programs for Environmental Protection

Important ongoing programs for protection of the environment in Romania aim at the following:

- Monitoring of the quality of environment (PHARE project), with priority areas defined below as environmental disaster zones.
- Conservation and protection of bio-diversity through the Environmental Program for the Danube River Basin, and the Black Sea Environmental Program under the Global Environmental Facility fund administered by the World Bank.

The Siret River Basin is concerned by these environmental and monitoring programs. The Environmental Program for the Danube River Basin includes a large part of Romania and aims at strategic action plan, regional environmental survey, inventory of biological resources and strengthening of monitoring. The study for the Siret River Basin Environment Action Plan has been launched as part of this program. The Action Plan will identify the action priorities based on a review of main pollution sources with special focus on water quality issues.

(2) Nature Conservation Areas

The last official list of Romanian protected areas comprising a total of 586 in number is ready for publication (1993 edition). Location of nature conservation areas in the Siret-Baragan Canal area is shown in **Fig 3.6.1-A1**. According to this national list, the Vrancea District owns 20 protected areas totaling 2,600 ha (**Table 3.6.1-A1**). The list is made from the following normative documents, with the first and second categories only being recognized as legal protection basis:

- Journals and Decisions of the Council of Ministers;
- Government Decisions;
- Decisions of the Regional and Districtual Authorities; and
- Orders of the Environment, Water and Forest Minister.

According to this national list, 9 protected areas have been established by Decisions of the Regional and District Authorities of Vrancea, and 11 by the Government Decisions. Characterization of protected areas in Vrancea District is given below according to IUCN protection categories and provisions of the Law 9/1973.

(Unit: number of protected areas)

	Scientific Reserves	National Parks	Natural Monuments	Natural Reserves	Landscape Reserves	Total
Botanical	-	-	-	2	-	2
Forestry	-	-	-	6	-	6
Geological	-	-	2	-	-	2
Landscape	-	-	-	-	-	-
Paleontol.	-	-	-	-	-	-
Speological	-	-	-	-	-	-
Zoological	-	-	-	-	-	-
Mixed	-	-	-	10	-	10
Total	-	-	2	18	-	20

According to the list provided by the Environmental Branch Agency of Vrancea, there are 23 protected areas for a total superficies of about 17,600 ha as established by the Council of Vrancea District by Decision No. 12 (Sept. 18, 1992). These areas which are not included in the national list have not yet been approved by the Academy of Romania. The procedure for setting up protected areas in Romania begins with scientific approval by the Academy, before submission to the MoE, and approval by the Parliament.

The "Flood Plain Siret" protected area (1,764 ha) is composed of 19 small pieces of forest and almost all of them are located along the Study Area on Siret river banks (**Table 3.6.1-A2**). These areas belong to the jurisdiction of ROMSILVA, Focsani branch.

(3) Environmental Disaster Zones

Environmental disaster zones have been defined for developing remedial measures in areas strongly degraded by industrial development. There are 2 such areas included in the Siret river basin, exactly upstream of the Study Area: Borzesti-Onesti in the Trotus Valley, and Bacau in the Siret valley.

3.6.2 Institutional Organization

(1) Main Environmental Agencies

The Ministry of Water, Forest and Environmental Protection (MoE) and its affiliated agencies "Research institutes, Romanian Water Authority, Romanian Forest Authority" at national or regional levels are described with their functions in **Data Book**.

(2) Distribution of Jurisdictions for EIA Procedure

As regards to the environmental approval procedure and the EIA (Environmental Impact Assessment) procedure, the Directorate for Strategy and Legislation of Environmental Protection and Environmental Assessment (MoE) has responsibility for the following tasks:

- Working out Environmental Permits for some activities;
- Reviewing the Environmental Permits made in the Branch Agencies;
- Reviewing and approving plans from the Branch Agencies concerning Permit procedures;
- Approving of Environmental Impact Assessments for some activities;
- Regulating for the content and quality of EIA; and
- Licensing public and private institutions and firms for carrying out Impact Assessments.

Environmental permits, which are permission or authorization certificates, are issued either by MoE (for major projects or for permits) or by the Branch Agencies of MoE (for small projects or for authorizations).

(3) Distribution of Jurisdictions for Water Management

Water management is distributed among several agencies. MoE has overall responsibility for environmental protection through setting of the environmental standards and for pollution control through setting of the emission and effluent standards as regards to industrial, municipal or agricultural activities. Potable water quality standards are set by the Ministry of Health. River Basin Agencies are responsible for granting of permits for abstraction of water and discharge of wastewater. Branch Agencies of MoE are responsible for the implementation of the environmental planning and they issue environmental permits in certain cases.

Monitoring activities with regard to water are shared by several institutions: intake of raw water (River Basin Agencies), water quality (River Basin Agencies and ICIM), irrigation water (Ministry of Agriculture), drinking water (Ministry of Health and Municipalities), bathing waters (Ministry of Health), discharges of wastewater (Branch Agencies of MoE and River Basin Agencies), hydrological balance (INMH) and flooding control (MoE).

3.6.3 Legislation

(1) Environmental Protection Laws

Law No 9, 1973 is the general law for protection of environment in Romania. A new environmental protection law will soon be applied (expected to start within 1994). Consultation of the draft new law is not possible, but this law is expected to set out the new requirements for the following items:

- Authorization procedure for activities having an impact on environment;
- Use of agro-chemical;
- Protection of natural resources, with in particular the protection of water and aquatic ecosystems;
- Conservation of bio-diversity; and
- Status of protected natural areas and protection of natural habitats and wildlife.

Main laws related to water management are: Water Law No 8/1974, Law No 5/1989 concerning rational use and protection of water quality and Law No 1001/1991 concerning charges and penalties for use of water and discharge of wastewater.

Forest management activities and conservation of wildlife habitats are mainly regulated by the following laws: Forestry Law No 3/1962, Law No 12/1974 concerning fishing and fish-raising in mountainous waters, Law No 265/1976 concerning hunting and prey, Law No 2/1987 concerning conservation, protection and development of forests and Law No 42/1992 concerning the protection of forests.

(2) Environmental Permitting System and EIA Procedure

1) Legal Background

The environmental permitting system or approval system is composed of 3 kinds of administrative documents: Permit, Authorization and EIA study. The Ministry's Order 437 is regarded as the legal basis for authorization procedure, while Order 170 is considered to be the legal reference for environmental permit. Difference between Permit and Authorization is, however, not explicitly mentioned in these texts (translated versions). This distinction seems to be fundamental within the decision procedure of MoE. Legal documents that lay down the environmental approval system are the following:

- Minister's Order 170 (1990) sets out the issuing procedure and competence for issuing environmental approval (MoE or Regional Branch Agencies of MoE).
- Government Decision 113/1990 provides the contents and standards for the technical documentation for obtaining the environmental approval. These standards are stipulations about the documentation necessary for an environmental approval, with regard to emissions into air, water and soil. The list of activities requiring an EIA is also given in this Decision.
- Minister's Order 437 dated July 17, 1991 also provides rules for the contents and standards about the documentation to be submitted for obtaining the environmental approval, and the list of activities which must have an environmental approval.
- Order 619 / 1992 provides the general methodology for carrying out the EIA study.

2) Environmental Permit

Environmental approval is the essential piece of the environmental administration for controlling the conformity of activities with regulations. Starting the construction works of a project is subject to the obtaining the Environmental Permit. Starting the operational phase of the project is subject to obtaining the Environmental Authorization. EIA may be required for obtaining the Environmental Permit if the activity of concern belongs to the list of activities needing EIA. Environmental Permit may be issued either by the Branch Agency or by MoE according to the importance of the project. The permitting agency may impose conditions in the permit with additional or stricter limits than in the environmental standards. Alterations and expansions of ongoing activities may be considered as the new activities and, therefore, may require an environmental permit as a precondition for an authorization.

3) Environmental Authorization

Environmental Authorization is the official confirmation that the factory or installation is working in accordance with the established standards for emission or other limits and/or in accordance with conditions set in the environmental permit. New as well as existing activities require an authorization. Environmental Authorization gives the conditions for respecting environment in the case of an existing activity. Environmental Authorization is carried out by the Regional Branch Agency of MoE on the basis of a technical documentation. In case of important works with expected impacts on the environment being significant, EIA is required.

4) Environmental Impact Assessment (EIA)

EIA is required for certain kinds of activities before issuing the approval by MoE or one of its regional branches. In general, the objective of an EIA study is more specifically related to obtaining the Environmental Permit in cases of a new established activities. EIA is part of the technical documentation to be presented for requiring the Environmental Approval. Small plants may only require a limited impact analysis, while large projects will require a more comprehensive study. EIA is drawn up by the authorities or by a registered and officially licensed private firm. The investor or owner finances the EIA study.

5) Case of the Project

The actual construction works of the irrigation system within the Project Area started in 1987, before implementation of the present environmental permitting system. Accordingly, these works are being performed without any permit neither EIA. The normal procedures for implementing a project are to get Authorization upon Permit being obtained after submission of EIA. In the case of the Project, Permit is not needed, but starting its operation, after completion of the Project construction works is subject to obtaining Authorization from the Vrancea Branch Agency of MoE. Requirement for Authorization is fulfilled by submitting a technical document about the Project including an analysis of impacts on environment.

This Project is a special case: First, investment was once approved, and the construction works of the Project facilities are under way. Second, there is no any official guidelines for conducting EIA on this type of project. Accordingly, the view of the MoE is that a full study of EIA will not be required and that EIA should aim at proposing measures for reducing negative impacts that can be reasonably obtained at the operational stage of the Project. This study will be supervised by MoE, the authority designated for approving the propositions of the study.

It was once approved by MoE that ISPIF would prepare EIA for irrigation projects. ISPIF has prepared general guidelines for carrying out EIA, but these guidelines have not been presented to LRD and are not official. However, within the context of lack of environmental experience, there is not any strict rules for following nor any guidelines in the elaboration of EIA. The standpoint of the MoE is that results of EIA study are not evaluated according to the guidelines but to the capacity of carrying out propositions for mitigating the important negative impacts.

(3) Standards for Water Quality

Quality standards for superficial waters are defined by STAS 4706-88 according to 3 river quality classes, which follow water use purposes (**Table 3.6.3-A1**). However, quality standards for groundwater have not been established. River water quality classes are the following:

- First class quality (I): Water eligible for drinking water supply, livestock farms and salmonid fish farming;
- Second class quality (II): Water eligible for the purpose of fish breeding except for salmonid and recreation;
- Third class quality (III): Irrigation, industry and other uses; and
- Degraded quality (D): Quality poorer than category III.

For irrigation purpose, water quality should correspond to standards set by STAS 9450-88. Irrigation water quality criteria are defined for salinity, alkalinity and toxicity. For salinity, 4 quality classes from C1 to C4 have been defined according to criteria like chloride concentrations, sulphate concentrations and others (C.S.R. indicator). For alkalinity, 3 quality classes have been defined from S1 to S3. Result is S.A.R. indicator. Toxicity criteria for irrigation purpose are defined according to concentration levels of heavy metals and are the same as values given in STAS 4706-88 (**Table 3.6.3-A2** and **-A3**).

Compliance with environmental standards is needed for legal operation and is a prerequisite for obtaining an environmental authorization. However, it is generally recognized that most Romanian economic entities are actually illegal as regards to the environmental protection standards.

(4) Protection of Wildlife Species

The national list of protected wildlife species established between 1930 and 1940 includes 23 species of plants and 24 animal species mainly birds. These species are the so-called "Monuments of Nature". A new list should be elaborated soon taking into account the Red List which is now under preparation for the protection of threatened or endemic species. The Red List includes about 1,300 plant species in total, and a similar list exists also for the fauna.

The list provided by the Regional Branch Agency of MoE of Vrancea includes 160 animal species with mammalian (27), birds (98), fishes (12) reptiles/batrachians (10) and plants (only partial list has been provided for plants). The list includes species regulated under different laws and is not an official list of protected species. Included species are "Monuments of Nature", vulnerable species (290 countrywide) and species threatened of extinction (155 countrywide). This list has been established according to the Environmental Law No 9, 1973, hunting and fishing laws (Law No 26/ 1976; Law No 12/ 1974) and other legal documents: Order No 27/ 1993, Law No 81/ 1993 and Government Decision No 127/ 1994, all regarding enforcement rules for the protection of natural environment or wildlife.

3.6.4 International Conventions for Conservation of Nature

Several international conventions for the conservation of nature have been signed or ratified by Romania. The Convention on the Conservation of Wildlife Migratory Species (Bonn, 1979) has not been signed but adhesion is actually considered. These conventions are listed below according to degrees of adhesion (signature, ratification). As part of the Danube River basin, the Study Area is concerned by these conventions through the following aspects:

- Conservation of wildlife species;
- Limiting negative effects at the downstream sections of the Project;
- Measures for the protection of water resources, with in particular the prevention of pollution of groundwater resources; and
- Measures for improving the aquatic ecological conditions.

(1) Ratified Conventions

- The Ramsar Convention: This convention was ratified with Law No 15 in 1991. The Danube Delta Biosphere Reserve is registered on the Ramsar list, and has been established as a World Nature Heritage within the scope of the Man and Biosphere Program;
- Convention on the Conservation of Wildlife and Natural Environment (ratified in 1993); and
- Convention for Protection of the Black Sea (ratified in 1992).

(2) Conventions with Ratification Procedure underway

- Convention on biological diversity (Rio, 1992);
- Convention of Washington (CITES, 1975); and
- Danube River Protection Convention (signed in June 1994), by transformation of the Bucharest Declaration (1985).

3.6.5 Geographical Areas for the Environmental Investigation

(1) Siret-Baragan Canal Area

The Siret-Baragan canal area is defined in this study as including:

- The Main Canal area, beginning from the Study Area upstream toward the southern part of the irrigation scheme, within the Ialomita river basin; and
- The Romanian part of the Siret River basin which is lying upstream of the Study Area.

This area is limited by sub-Carpathian mountains on west and by the Ialomita-Siret plain on east. In the south-eastern part of Focsani, the Siret/Danube confluence lies just upstream of the Danube Delta and the Black Sea, which are strategic pieces of the environmental policies in Romania as mentioned in 3.6.1 and 3.6.4.

There are 10 administrative districts which correspond to this area. Those located along the Siret River are: Buzau, Vrancea, Bacau and Neamt. Population living in these districts are respectively 516,300 hab, 392,700 hab, 736,100 hab and 577,600 hab. Main upstream cities are Bacau, Suceava, Piatra Neamt and Onesti. Plains and valleys of the Siret-Baragan canal area have several human/industrial establishments including the following:
- Water reservoirs for energetic supply and secondarily for irrigation;
- Exploitation of petrol/gas resources (Trotus river basin);
- Industrial plants (mainly chemical, petrochemical, wood processing and metallurgical plants);
- Livestock industry.

The geographical location of natural areas, protected areas and human settlements or industrial activities in the Siret-Baragan canal area are shown on **Fig 3.6.1-A1**.

(2) Onesti-Bacau-Adjud Area

The Onesti-Bacau-Adjud triangular area is located just upstream of the Calimanesti intake. The important part of the industrial development of the Siret River basin belongs to this area. Accordingly, this area is a geographical reference for understanding the effects of water pollution sources on the environmental conditions of the Study Area. This area is also corresponding to the Borzesti-Onesti and Bacau environmental disaster zones. In Bacau area, EIA of industrial plants was launched in 1992 and installation of a monitoring equipment with a mobile laboratory for collection and analysis of samples (UNDP project) was started. An environmental action plan is now under study for the pilot zone of Onesti-Borzesti-Bacau with the objective of prevention of industrial pollution.

(3) Pufesti-Ruginesti-Panciu Area

The Pufesti-Ruginesti-Panciu Area is the Study Area, which lies at the foot of sub-Carpathian mountains and in the northwest corner of the wide Siret Ialomita plain. The tributaries of the Siret River: Milcov, Putna, Susita, Zabraut, Carecna and Trotus (from south to north, successively) flow through the Study Area from northwest to southeast and drain into the Siret River at the eastern boarder of the Study Area. Accordingly, the Study Area constitutes a patchwork of islands separated by deep riverbeds in the hilly zone. **Fig 3.6.5-A1** is a map of the Study Area with indications of environmental indicators: human settlements and elements of the natural environment. This area presents the following several important characteristics from the geographical point of view:

- The Study Area is regarded as a place with climatic aggressivity, which is a major factor of wind and pluvial erosion. The strong intensity of short rain is mentioned as the most specific feature of climatic aggressivity in this area;
- The Study Area belongs to the zone of sub-Carpathian hills strongly affected by pluvial erosion. In average, 2.6 ton/ha of soil are carried to the rivers, with the highest values found

in the hilly zone in the outside curve of the Carpathian mountains being 25 ton/ha yearly, which is 5 times the admissible value; and

- The Study Area belongs to the Carpathian curve, commonly called the Carpathian Elbow, which means specific tectonic and seismic features. From neotectonic aspects (Quaternary period), the sub-Carpathian curb is the only area in Romania to show tangential movements with intense or moderate deformations. Several earthquake epicenters have been located in the area of Focsani, Putna and Milcov.

The Study Area is full part of the seismic area nationally classified as zone A (coefficient of seismicity of 0.32), corresponding to a seismic intensity of 8 on Richter scale. Focsani belongs to an area of intensity of 9 on Richter scale. An earthquake of intensity over 7 could probably occur in years 2004 / 2005, and earthquake between 5 and 7 could probably occur in 1996/1997. For taking into account the seismic risk, the civil works are designed taking into account technical criteria according to 4 classes of construction, from reduced importance to vital importance. For example, the Main Canal is a construction of "normal importance" and has been designed accordingly.

3.6.6 Natural Environment

(1) Geomorphological Context

The Study Area lies at the junction of the sub-Carpathian mountains with the plain of the Siret River. Topographic orientation is a general decreasing altitude from northwest toward southeast, followed by the Siret River and its tributaries. Along the Siret River in the north of Susita River, the alluvial plain is composed of 3 successive old terraces (2-5m / 15-20m / 40-45m high relative to Siret) situated between 60 and 120m. Sediments of the oldest terrace (45m) are gravel and sand (3-6m) and loess (20-25m). Contact between western side hills and eastern alluvial terraces is made by 3 topographic levels, which correspond to loess accumulations (120m / 250m / 320m).

At the south of the Susita River, the topography is dominated by the low alluvial plain under level 120m. This plain is composed of varied loess sediments (2 to 15m deep). Contact with sub-Carpathian hills is direct. Hills are formations of the Quaternary period and are composed of big accumulation of heterogen and non-cemented gravel (400 to 500m deep), with intercalation of sand and clay. These sediments correspond to fluvial-lacustrine deposits of the upper pleistocene period (Cindesti stratum).

(2) Climatic Conditions

Thermic, pluviometric and eolian conditions are presented in 3.2 of Chapter 3. Climatic indicators briefly presented here are representative of mean, minimum and maximum multi-annual values for the period 1896-1975. The data are collected at the meteorological stations of Focsani, Odobesti, Marasesti, Panciu and Tecuci. Mean temperature is 20.5 °C for summer, and -1.9 °C for winter. In the case of precipitation, the mean quantity is 203.6 mm for summer and 650 mm annually. The maximum is 214.9 mm for summer and 767.4 mm annually. The annual minimum is 398.3 mm.

(3) Natural Drainage Conditions

The flow of the Siret River is regulated by several storage reservoirs on its major tributaries (**Fig 3.6.1-A1**). Geographical characteristics of the Siret tributaries situated in the Study Area are given in the following table:

Name of River	Length (km)	Catchment Area(km^2)	Village / Towns
Milcov	68	498	Odobesti, Focsani
Putna	153	2,767	Bolotesti, Tifesti
Susita	68	410	Panciu
Zabraut	41	119	Movilita
Carecna	26	79	Pufesti
Trotus	158	4,440	Adjud
Siret	* 602	* 42,830	(Study Area)

Note : * in Romania only

In this table, the river length is considered from the source to the confluence with the Siret except for the Milcov (confluence with the Putna). Hydrologic data are summarized in 3.2.3. These rivers are characterized with the following:

- Irregularity of runoff: the Putna River has a mean annual discharge of 11.6 m^3/s, a minimum discharge of 0.5 m^3/s (frequency 20%) and a maximum discharge of 1,200 m^3/s (frequency 1%). Flooding of the Putna River in 1970 showed a maximum discharge of 860 m^3/s.
- Recharge of groundwater: Each tributary of the Siret River in this area has the function of recharging the phreatic aquifer all along the river corridors. About 50% of water discharge of the Putna River flows underground. The Carecna River flows only underground in summer.

(4) Groundwater

Only shallow phreatic aquifers are considered in this part. Groundwater fulfills the "Cindesti" stratum in the Study Area, and also lies in alluvial plains and terraces along the river corridors of the Trotus, Susita, Putna and Milcov, and along the Siret River.

Along the Siret River, water table is only few meters below ground between 0 and 5 m. Along Siret tributaries in the Study Area, water table is between 5 and 10 m deep in most cases. In alluvial terraces between the Siret River and western hills, water table lies at about 20m or more. Water table is deeper in hilly area because of surface morphology (**Fig 3.6.6-A1**). Seasonal variation of water table is very low: About 0.5 to 1m in high topographic levels (terraces) and 1 to 2 m in low topographic levels (the Siret river side).

Water recharge starts each year in spring season when ground thaws. Groundwater discharge ranges between 5 and 15 lit/s/m in the Siret tributaries of the Study Area, and is more than 20 lit/s/m in the plain of the Siret River. Water recharge is mainly assured by infiltration from the Siret tributaries, and infiltration from water runoff at the "Cindesti" stratum, upstream. Shallow groundwater flows according to morphological and geomorphological structure from northwest to southeast, and discharges into the Siret River in the downstream part, south of Focsani.

Permeability is about 50 m/day on average. However, permeability in loess has been evaluated between 0.1 and 4.0 m/day horizontally, and 5 to 10 m/day vertically, while it reaches 30 to 200 m/day in alluvial sediments of the Cindesti stratum. This corresponds to a discharge equivalent to 0.5 to 50 lit/s (in wells). Zones where groundwater is particularly vulnerable to surface pollutants are presented in **Fig 3.6.6-A1** according to the permeability of surface sediments, as indicated by the geographical distribution of loess and alluvial sediments and according to the pedological study (part 3.2.5). Most vulnerable zones are those without loess layer on surface. Vulnerability is increased by the facts that these zones are those where water table is not deep.

(5) Water Quality

1) General Situation

In the Siret-Baragan area, water quality of the rivers and aquifers has been the major environmental issue in the decade 1980-90. Since 1990, industrial activity has been declining in Romania and in the Siret River basin. Accordingly, the present conjecture is that industrial wastewater quantities have decreased and water quality has been improved (**Table 3.6.6-A1**).

Water borne problems, which actually remain with less intensity due to the decrease in industrial activity, are cited as follows:

- Bacterial load due to lack of sanitary system in rural areas (lack of emptying of septic tanks; lack of sewerage systems);
- Overloading of water treatment facilities due to entrance of industrial used water;
- Leakage of sewerage system in urban areas;
- Industrial leakage and spillage on site; and
- Poor management of agricultural practices.

2) Water Quality Data

Responsibility for water quality monitoring was transferred to environmental branch agencies in December 1990, before given back to Apele Romane in December 1992. Data have been partially produced between 1990 and 1992.

In connection with the Study Area, sampling for river water quality has been performed in the following 3 stations: Galbeni on the Siret River upstream of the confluence with the Trotus, Cosmesti on the Siret River downstream of the confluence with the Trotus and Adjud on the Trotus River at proximity of confluence with the Siret River. For groundwater quality, several stations are selected among those existing along the Siret, Trotus and Putna corridors. A new station located in Adjud/Siret, called Adjud-Vechi, was opened in 1994. Geographical location of all these monitoring stations is shown in **Fig 3.6.6-A2**. Heavy metals are monitored by ICIM at Cosmesti and Adjud stations, including a large range of indicators in 1984 but limited to iron and lead from 1989 (**Table 3.6.6-A2**).

Frequency of sampling is monthly for monitoring of surface water by Apele Romane and is more variable for groundwater. For monitoring of heavy metals by ICIM, sampling was 2 times a year (spring and summer) in 1984 and has been 1 per month since 1989.

Water quality data available for this study are the following:

- Surface water quality in 1988, 1989, 1992, 1993 according to Apele Romane, for the following indicators: pH, BOD_5, COD (permanganate method), NH^{4+}, Fe^{2+}, Phenol and extract residue;
- Surface water quality in 1984 according to the national water quality monitoring network (SNSCA) and provided by ICIM. Parameters are iron, manganese, zinc, cooper, chrome, cadmium, lead, mercury, arsenic and aluminum;
- Surface water quality indicators in 1989-93 from same sources as precedently, but limited to iron and lead indicators; and
- Groundwater quality indicators in 1988, 1989, 1992, 1993 according to Apele Romane: NO_3, NO_2, pH, Cl, Fe, NH_4.

Data from Apele Romane can be consulted for 1994 in **Tables 3.6.6-A2** and **A3** (the details are shown in **Data Book**). Apart from these official data, water quality tests have been performed by the JICA Study Team along the Siret River and its tributaries between Adjud

upstream and the Buzau River downstream. Results have been summarized in **Fig 3.2.3-A5**.

3) Quality Classes of Siret and Trotus Rivers

Surface water quality of the Siret and Trotus Rivers is of primary concern, because it affects the quality of irrigation water. Quality test results of the retained monitoring stations are summarized in the table below in terms of river quality classes for each type of pollutant. This table shows variations from degraded to high quality conditions. More detailed data are given in **Data Book**.

According to the Aquaproject study (1986), the Siret River at the confluence with the Trotus River was, in more than 80% of cases, classified as C2 for salinity, S1 for alkalinity and in category I for toxicity. In 20% of cases, corresponding to low river discharges, the river was classified into second or third quality categories, which globally means good quality for irrigation purpose.

		pH (a)	BOD_5 (b)	CODMn (c)	NH^{4+} (d)	Fe^{2+} (e)	Phenol (f)
1988	Galbeni	I	D	D	III	II	III
	Cosmesti	I	II	III	III	III	III
	Adjud	I	III	III	I	II	D
1989	Galbeni	I	D	D	III	II	II
	Cosmesti	I	III	III	III	III	III
	Adjud	I	D	D	II	I	D
1992	Galbeni	I	II	III	III	I	II
	Cosmesti	I	II	I	II	I	I
	Adjud	I	II	D	II	I	II
1993	Galbeni	I	III	III	II	II	II
	Cosmesti	I	II	II	I	II	III
	Adjud	I	I	I	I	II	III

4) Water Quality of the Siret River

Monthly average concentration values in 1988-89 and 1991-93 are given for Galbeni and/or Cosmesti stations in **Tables 3.6.6-A2** and **Data Book**, according to the above mentioned indicators. Table below is a summary of monthly average indicators with higher concentrations than authorized for irrigation purpose. In this table and the following, G (Galbeni), C (Cosmesti) and A (Adjud) mean the above mentioned monitoring stations; numbers from 1 to 12 mean months; from (a) to (b) are the quality indicators as indicated in the precedent table; (xxx) means the lack of data; (-) means that there is not any concentration level liable to degraded quality at least within the set of indicators which have been taken into account. The following table give the monthly distribution through each year with indication of the type of indicator of concern. Concentration values are also provided for Cosmesti in 1994 and show degraded levels for BOD_5 from April, with highest levels in June (BOD_5 17.3 mg/lit and COD Mn 30.87 mg/lit).

		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1988	G	b-c-d	b-c-d	b-c-d	b	b-c	b	b	b-c	b	b-c-d	b-c	b-c-d
	C	c-f	c-d-f	c-d-e-f	e-f	e	-	-	-	-	-	c-f	d-f
1989	G	b-c	b-c-d	b-c-d	b-c-d	b-c	b-c	b-c	b-c	b-c	b-c	-	b-c
	C	d	c-d	-	-	-	-	f	-	-	b	c	c
1992	G	c	b-c	-	-	-	-	-	c	c	-	-	-
	C	-	b	-	-	-	-	-	-	-	-	-	-
1993	G	-	b-c	f	a	-	-	b-c	b-c	b-c	-	-	-
	C	-	-	-	-	-	-	-	-	-	-	-	-

The data of heavy metals concentrations have been collected for the period 1989-1993, and for 1984 as summarized also in **Table 3.6.6-A2**. Data given in the table for the period 1989-1993 are the result of monthly sampling and annual average. Data for 1984 are the result of 2 samples in spring and summer in 1984. In comparison with environmental criteria set up for heavy metals in rivers or in irrigation water, the Siret River was severely degraded for iron and zinc and partly degraded for manganese and cadmium in 1984. There is no data for the period 1989-1993 except for iron which is within acceptable limits.

5) Water Quality of the Trotus River

Adjud Trotus station provides water quality data for the Trotus River between Onesti upstream and Calimanesti downstream. The Trotus River is characterized by its underground flow upstream the station, which makes difficult the correlation between upstream industrial wastewater discharges and downstream surface water quality. Annual monthly mean values of water quality data are given in **Fig 3.6.6-A3** and **Data Book**. Figures are also included in annex for phenol, animal and vegetal fat, chemical consumption of oxygen and lead (Pb) as measured in 1992 at Adjud - Trotus station (**Fig 3.6.6-A4**). Comparison with environmental standards (class II and class III river qualities) are shown in these figures. These data show that the concentrations in 1992 might be largely higher than those authorized periodically or permanently (in the case of animal and vegetal fat). Table below is a summary of monthly average indicators with higher concentrations than authorized for irrigation purpose. Table gives the monthly distribution through each year with indication of the type of indicator of concern.

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1988	b-c-f	b-c-f	f	-	-	-	-	c-f	b-c-f	b-c-f	b-c-f	b-c-f
1989	b-c-f	b-c	c-f	b-c-f	b-c-f	-	c-f	c	f	c-e-f	b-c-f	c-f
1992	f	c	xxx	c	c-f	xxx	f	c	-	-	-	b
1993	-	f	-	-	-	-	-	-	-	-	c-f	f

Note: Data for Adjud - Trotus monitoring station; for explanation of numbers and letters, see explanation above.

Data provided by ICIM for heavy metals (**Tables 3.6.6-A2**) showed a degraded or extremely degraded water quality for iron, zinc, lead, cadmium and mercury in 1984. Data for 1989-1993 were only those for iron and lead, and they indicate degraded quality of maximum values. Data provided by the Environmental Branch Agency of Vrancea pertaining to lead, phenol, COD and animal and vegetal fat concentrations in the Trotus River in 1992 are shown on **Fig 3.6.6-A4** in comparison with legal standard levels.

6) Groundwater Quality

Groundwater quality data have been collected for the Siret, Trotus and Putna corridors for the period 1988-89 and 1991-93. These data are given for $N0_3$, $N0_2$, pH, Cl, Fe and NH_4 (**Table 3.6.6-A3**). According to these data, nitrates and nitrites concentrations are generally low or very low. pH indicator is normal between 7 and 8 in most cases. Concentrations for chloride, iron and ammonia are frequently high or extremely high. The highest values recorded are 902 mg/lit for chloride in 1993 (Putna, well F3), 0.64 mg/lit for iron in 1993 (Siret, well F4, and Putna, well F4) and 4.08 mg/lit for ammonia in 1993 (Siret, well F4). Admissible values in Romania (drinking water quality standards) are 250 mg/lit for chloride, 0.1 for iron and 0 for ammonia, with values by exception extended to 400 mg/lit for chloride, 0.3 mg/lit for iron (with manganese), and 0.5 mg/lit for ammonia. European standards are the same except for chloride limited to 200 mg/lit.

According to these data, groundwater pollution has been extending and intensified from 1988 to 1993 in the case of the Siret and Putna phreatic waters. Samples collected from the wells in the Siret corridor were severely contaminated with iron and ammonia. Samples collected from the Putna corridor show a severe contamination with chloride, iron and ammonia. However, groundwater in the Trotus corridor presented a good quality in all cases.

Since observation wells of the Putna corridor are just lying upstream of the confluence with the Siret River, the results might be correlated with those of the Siret groundwater. In that case, iron and ammonia contaminants would be of the same as of industrial or agricultural origins, upstream of the Study Area. The fact that chloride concentrations are so high for the Putna/Siret groundwater should certainly be imputed to an industrial origin within the Focsani-Marasesti zone.

(6) Soil Erosion

Total area of cultivated land affected by sheet erosion in Romania is about 5,300,000 ha. Land losses due to gully erosion and landslides are estimated to reach about 5,000 ha each year. While the average admissible value (technical standard) of erosion rate is 5 to 6 ton/ha, the effective average loss is about 16 ton/ha/year. Compared with other areas of Europe on the similar temperate and climate conditions, the erosion rate in Romania is the highest one.

In Vrancea District, the erosion rate including the effects of sheet erosion, gully erosion and landslides is about 34 ton/ha/year. For sheet erosion only, the rate becomes 17 ton/ha/year in average, representing the highest value in Romania for this type of erosion. Gully erosion represents 12 ton/ha/year and landslides 5 ton/ha/year. These values are calculated based on the indicators such as climatic aggressivity and slope distance among others. Climatic aggressivity is rated 0.14 for the hilly zone of sub-Carpaths, within a national scale comprised between 0.08 and 0.16. Main factors of gully erosion are absence of cohesivity of geological materials (Cindesti strata) and soils (lack of humus matter and vegetation on ground), slopes, climatic aggressivity (kinetic energy of storms) and historical land use factors. The maximum rainfalls for 24 hours calculated based on 25 year's data since 1977 for the respective probability of occurrence are as follows:

(Unit: mm / day)

	1%	5%	10%	20%
Focsani	121	84	70	56
Odobesti	94	75	67	57
Panciu	125	93	80	67

The Study Area is affected by sheet erosion on gentle slopes and gully erosion on hills or along the Siret tributaries. Slopes within the order of 7% or more are particularly sensitive to sheet erosion phenomena. However, according to ISPIF, and given the climatic and geo-morphological conditions of the Study Area, sheet erosion might affect slopes of not more than 2 - 3%. Accordingly, more than half of the agricultural land in the Study Area could be liable to sheet erosion or gully erosion.

(7) Natural Ecosystems

The Study Area is intensively used for human settlements and agriculture. Human settlements include villages and towns, roads, railways, high tension lines and the most irrigation works like Calimanesti dam, pumping station and Main Canal. Hydrologic and natural conditions of the Siret River are now determined by the Calimanesti dam and upstream dams. Within this patchwork of land use, natural ecosystems are reduced to small areas. The following areas may be considered as the remaining natural areas (**Fig 3.6.5-A1**):

- Terrestrial forest, which mainly lies on sub-Carpathian hills and is managed by ROMSILVA.
- Riverside forest, which only lies on the previous flood plain of the Siret River, with small units managed by ROMSILVA for protection purpose. Only small pieces subsist now and are not managed with strict rules of protection.
- Degraded lands, which include small pieces of wet pasture lands on alluvial terraces and dry pasture land in places of alluvial accumulation with high permeability. Dry pasture land is found on the alluvial cone of the Putna River. It is also found that the erosion of

upper hills has led to dispersion of the heterogen gravel which were previously lying under loess strata. Localization of wet pasture land seems to be variable in time according to a climatic cycle of dry / wet decade periods.

- Riverbeds of the Siret tributaries, which are generally more than 500 m width, particularly for the Putna and Carecna Rivers. In the hilly part of the area, they provide scenic landscapes, sometimes majestuous. Major gully erosion phenomena are lying along these rivers.

In Vrancea District, forest represents about 40% (185,000ha) of the total area, mainly located on hills (54%) and mountains (40%).

(8) Vegetal Species

In the Study Area, natural vegetal species have generally been replaced by cultivated species except for in non-arable land or around riverbeds particularly the Putna River and plain or upper hill pasture land. Vegetal species are distributed within the Study Area as follows :

- Willows and poplar species which form groves on the Siret River banks where natural vegetation has been preserved;
- Beech trees, oak trees and locust trees species in forest hills of sub-Carpaths. Main species are Fagus silvatica, F. moesiaca, Quercus petraea, Q. dalechampii, Q. polycarpa and Robinia pseudacacia. Hills corresponding with loess accumulation along the Panciu-Movilita axis are forested with durmast woods and mixed species such as hornbeam, lime-tree, ash-tree, maple-tree and acacia species. There are also beech-tree woods on the upper hills, south of Putna River, mixed with hornbeam woods;
- Mezophyle vegetation species of wet pasture land in alluvial plain; and
- Xerophyle vegetation species of dry pasture land.

(9) Animal Species

1) Main Fish Species

Main fish species of the Siret area are Chondrostom nasus, Leuciscus cephalus, Gobio kessleri and Sabanejewia aurata. Species apparented to carps (bream zone) and barb fishes (barb zone) are registered for the Siret River and its tributaries within the Study Area. Number of species is greater for the Siret River followed by the Milcov and Putna Rivers. In the Trotus River at the level of Adjud, main species were inventoried in 1955-56 as including Chondrostoma nassus, Gobio kessleri, Sabanejewia aurata, Barbus peloponnesius peteny and Bobio uranoscopus. It seems that these species have completely disappeared from the Trotus River.

2) Main Bird Species

The Siret River is, like the Prut river, a natural corridor for migration of Finno-Scandinavian bird species from north to south. However, major wetland habitats for periodic installation of migratory birds are not located in and around the Study Area. Between Focsani and Bacau, migratory birds do not find appropriate environment except for food. It seems that Marasesti has been an important place for migratory birds before hydrologic regulation of the Siret River. Actually, the successive water reservoirs from Bacau to Adjud, more particularly in their upstream part, are going to become new habitats favorable for local and migratory birds. Even now, Calimanesti reservoir seems to present an habitat favorable for birds. Isolated species like Little Egret (Egretta Garzetta) and Shelduck (Tadorna Tadorna) which were classified as "Monuments of Nature" was observed during a field trip in July, 1994.

According to the Antipa study (1988), main bird species inventoried along the Main Canal and the Siret River are those indicated in the list of protected species in Vrancea District. Classification of species is provided according to forest and wetland systems, and migratory / local species. Protected species known as "Monuments of Nature" and possibly found in and

around the Study Area as isolated or even exceptional cases are: Imperial eagle (Aquila Heliaca), Spotted eagle (Aquila Clanga), Avocet (Recurvirostra avosetta), Great white egret (Egretta Alba), Little egret (Egretta garzetta) and Shelduck (Tadorna tadorna).

3) Main Mammal Species

Main mammal species of the Vrancea District are included in the list of protected species. Most valuable species are exclusively found in the Carpathian mountains, outside the limits of the Study Area, such as Chamois (Rupicapra rupicapra), Lynx (Lynx lynx) and Brown bear (Ursus arctos). Wildlife species within the Study Area may be characterized as follows:

- Locally protected small size species living in the cultivated plain or in the forested area are Brown hare (Lepus europaeus), Rabbit (Oryctolagus cuniculus), Weasel (Mustela nivalis), Polecat (Mustela putorius), Stoat (Mustela erminea) and Fox (Vulpes vulpes). Species which are specially affected by human activities in the plain are Mink (Mustela lutreola) which is already in drastic decrease of number, Red Squirrel (Sciurus vulgaris) which is now at the starting stage of spreading since its protection in 1976 and Otter (Lutra lutra) which is now probably extinct in the Siret River but can be found along the Siret tributaries, particularly in the Putna upstream area.

- Locally protected small or big size species living generally in forested area but moving sometimes to the plain: Roebuck (Capreolus capreolus), Deer (Cervus dama), Raccoon dog (Nyctereutes procyonoides), Mink (Mustela lutreola), Wild boar (Sus Scrofa) and Red squirrel (Sciurus vulgaris).

- Small species of insectivores or rodents not included in the Vrancea protection list but commonly found in the Study Area are the following: Hedgehog (Erinaceus europaeus), Mole (Talpa europaea), Common shrew (Sorex araneus), Water shrew (Neomys fodiens), Wood mouse (Apodemus sylvaticus), Yellow necked mouse (Apodemus flavicollis), House mouse (Mus musculus spicilegus), Common vole (Microtus arvalis), Ground vole (Arvicola terrestris), Brown rat (Rattus norvegicus), Harvest mouse (Micromys minutus), European suslik (Citellus citellus) and Dormouse (Muscardinus avellanarius).

3.6.7 Social Environment

(1) Socio-Economic Characteristics

Total population within the Study Area is about 65,000 inhabitants, mainly distributed among 11 towns and villages. Towns are Marasesti (12,370 habitants), Panciu (10,016 habitants), Odobesti (8,572 habitants) and Focsani (101,335 inhabitants). In these towns, active population employed in agricultural sector is 7%, 15%, 27% and 4%, respectively. Villages mainly included in the Study Area are Ruginesti, Paunesti, Pufesti, Movilita, Straoane, Fitionesti, Tifesti and Bolotesti. Their total population is about 36,850 inhabitants with 69% of the active population employed in agriculture in 1992. Trends in population levels show a relative stability. Sanitation and health conditions data are given in **Tables 3.3.11-A2** and **-A3**. Privatization of agricultural land and forest (previous owners of forest receive 1ha of forest per household) has been carried out with the Land Reform Law (18/91) enacted in 1991. Socio-economic data are given in detail in 3.3 of Chapter 3.

(2) Environmentally Damageable Establishments

A screening of impact assessment due to industrial and municipal wastewater emission sources was made within the scope of the Danube environmental project. Results for those emission sources that are mostly located upstream the Study Area are given in **Table 3.6.7-A1**.

1) Industrial Plants

Location and categories of industrial water pollution sources for the areas lying within Onesti / Bacau / Focsani perimeter are summarized in **Table 3.6.7-A2**. Total wastewater quantities discharged from these industrial plants upstream or within the Study Area in 1991 are indicated in **Table 3.6.7-A2**. Global quantities in 1991 were 77.2×10^6 m^3 in the Trotus valley, 46.7×10^6 m^3 in the Bacau area and 9.7×10^6 m^3 in Adjud.

In general, industrial wastewater is partially or totally treated on site (SC Rafo, SC Carom), or collected and treated with municipal wastewater (SC Ambro, SC Vrancart). Main problems for these industrial pollution sources are the following:

- Poor condition of operation of wastewater treatment plants (SC Carom, SC Rafo, pig farm);
- Leakage of contaminants from sewers (SC Rafo);
- Storage of sludge in artificial lagoons being full or nearly full (SC Ambro, SC Vrancart, Onesti platform); and
- Overload from industrial effluents entering the municipal wastewater treatment plant.

Within the Study Area, major point pollution sources are industrial and zootechnical plants (**Table 3.6.7-A3**). The industrial chemical plant of Marasesti is considered to be the most important industrial pollution source of Vrancea District. Zootechnical centers in the Study Area are generally small units with presently reduced activity. Stockage sites for pesticides do not actually present important problems because of the small quantities involved (quantity equivalent to 4 months of use, in the actual context of scarcity). Only the stockage site of Cimpineanca has been important since it was supplying the whole Vrancea District before the actual scarcity of pesticide products.

2) Municipal Pollution Sources

Other important point pollution sources for river water quality are municipal wastewater treatment plants and solid waste disposal sites. It is estimated that about 32% of population in the whole Siret River basin is provided with a sewerage system. General conditions of wastewater collection and treatment and its pollution load equivalent are described in **Table 3.6.7-A4**. Wastewater treatment plants are generally considered as malfunctioning for the following reasons:

- Overload;
- Poor quality of construction;
- Problems of maintenance; and
- Specific problems (like heavy oil content in the Bacau influent).

Within the Study Area, villages and towns are generally not provided with sewerage system (**Table 3.3.11-A3**). In Marasesti, Panciu and Odobesti, municipal wastewater is collected and treated for part of the living population. Solid waste which are largely composed of organic matter are disposed of outside the villages, in natural ravines for example.

(3) Use of Natural Resources

1) Water Use in Siret River Basin

Water resources in the Siret basin area are generally rivers for industry, rivers and deep or shallow aquifers for municipal supplies and for domestic consumption of villages. In most cases, groundwater source is phreatic water in the Siret River area at a depth comprised between 10 and 50 m.

Actual water use and evolution during recent years in the Siret River basin is explained in the table below according to data of Apele Romane. Total consumption was about 693×10^6 m^3 in

1993 with more than half of this value being consumed by industry and only a small part (about 10%) for irrigation. Evolution between 1988 and 1993 shows a big decrease of water consumption for industry and agriculture. Industrial water consumption decreased by half of its 1988 value and agricultural consumption is now about 18% of its 1988 level.

(Unit: 10^3 m^3/year)

Usage	1988 (vol.)	(%)	1989 (%)	1990 (%)	1991 (%)	1992 (%)	1993 (vol.)	(%)
Industry	799,464	100	94.9	99.8	74.8	55.1	411,712	51.5
Agriculture	457,998	100	109.3	112.8	17.4	22.5	82,047	17.9
Municipal	164,183	100	100.6	100.3	100.7	119.2	199,037	121.2
Total	1,421,645	100	100.2	104.0	59.3	52	692,796	48.7

Main water users in the upstream part of the Siret River basin are industrial plants and cities. Municipal water abstraction is around 300/350 lit/pers/day, but this includes important losses within the distribution system. The abstracted part of total annual volume of surface water has been estimated to be about 3% for the whole Siret River basin. Actual and future trends of water use upstream and downstream of the Study Area are indicated in the following table. Water use quantities indicated in this table, according to the Aquaproject data, differ widely with those presented in the precedent table. However, they show that water use in the upstream area in 2000 may increase drastically for domestic use, moderately for irrigation and slightly for industry. Groundwater supply will remain at its 1993 level. From the same source, multiannual average water storage of the Siret River is $5x10^9$ m^3/year upstream and $7x10^9$ m^3/year downstream.

(Unit: 10^6 m^3/year)

	Siret upstream		Siret downstream	
	1993	2000	1993	2000
Use for irrigation	140	220	190	350 ***
Industrial supply	900 (s) / 110 (g)	1060 (s) / 110 (g)	-	-
Industrial consumption	510 (s) / 75 (g)	540 (s) / 75 (g)	-	-
Domestic supply	70 (s) / 115 (g) *	220 (s) / 115 (g)	- / 55 (g) **	- / 55 (g)
Domestic consumption	48 (s) / 75 (g) *	98 (s) / 75 (g)	- / 55 (g)	- / 55 (g)

Note: (s) Surface water; (g) Groundwater;

* Focsani municipality withdraws 30 million m^3 of water each year from deep groundwater, and consumes 50% of this amount. All other cities of Siret river basin withdraw groundwater from phreatic aquifers.

** Water intake from groundwater sources in Braila and Galati cities is restituted to Danube river after use.

*** Volume of water needed for irrigation in the alternative of realization of Siret - Baragan canal at km 51 (first step of the project)

2) Water Use in the Study Area

Water use in Vrancea is distributed as follows: industry 26%, agriculture 69% and households 5%. Water resources are mainly surface water (about 79% of the total). However, groundwater represents 100% of water resources in towns of Panciu, Marasesti, Odobesti and Focsani. The case of Focsani is special since its water sources are deep groundwater (80 m deep). In villages of the Study Area, drinking water sources are shallow groundwater (supply by collective or individual wells). Water is collected by hand pump or by bucket and chain method. Sectoral distribution of water uses in 1993 is detailed for towns of the Study Area below:

	Industrial Use (%)	Agricultural Use (%)	Domestic Use (%)	Total Quantity Used (m^3/day)
Marasesti	77	2	21	12,727
Panciu	53	3	44	5,469
Odobesti	40	3	57	7,534
Focsani	49	0.5	50.5	64,930

Source: Apele Romane, Focsani Branch

3) Wood Products

Wood reserves in Vrancea are estimated to reach $40x10^6$ m^3 for a forest area of 184,200 ha. According to the Land Reform Law, about 10% of forest land is going to be privately owned in Vrancea at the end of 1994. Remaining 90% is managed by ROMSILVA. About 350,000 m^3 of wood are cut each year for processing in the 10 existing major wood processing units. Wood production and processing occupies 1,100 persons. Wood products are mainly consumed as construction materials and partially as fuelwood. In Vrancea, about 120,000 households depend on fuelwood supply. In the Study Area, energetical needs are generally satisfied with gas bottles or fuelwood. Forest products are not directly an important resource for people living in the Study Area. Production forest data are compiled for towns and villages of the Study Area (**Table 3.6.7-A5**).

4) Other Resources

Fishery resources and cynegetic resources are not significant in the economy or society of the Study Area. Resources development potential could be lying in tourism activity in relationship with wine production and memorial monuments mainly located in the plain. This potential might be important in future since valleys of the Siret tributaries have a landscape value and give access to natural areas of the Carpathian mountains.

(5) Use of Agro-chemicals

1) Use of Fertilizers

Use of chemical fertilizers in Romania was 118 kg/ha in 1989 and use of natural fertilizer was 4,225 kg/ha in the same year (increased use since 1970). Since then, application of fertilizers has been drastically reduced because of high cost. The estimated quantity of chemical fertilizers effectively used in 1992 was 47 kg/ha/year in Romania (probably less in the Study Area), as a total of nitrogenous products (29 kg/ha), phosphorous products (15 kg/ha) and potassium products (3 kg/ha). At the same time, the used quantity of natural fertilizers was 1.8 ton/ha. However, natural fertilizers are mostly not used within the Study Area.

Quantities of chemical fertilizers as recommended by the Cosmesti/Tecuci experimental station of the Institute for Irrigation and Drainage, for the most common cultivation of the Study Area, are indicated below. Taking into account the planned crops within the irrigation project as evaluated by ISPIF, the total quantity of chemical fertilizers recommended is about 190 kg/ha/year which is largely over the quantity actually used.

(Unit: kg/ha/year)

	Nitrogenous products	Phosphorous products	Potassium products
Wheat and barley	145	65	-
Maize	130	65	-
Luceme	145	65	-
Vineyards	100	100	120

2) Use of Pesticides

Pesticides are used in negligible quantities because of high prices of these products in Romania after 1985. They are, however, applied in vineyards in small quantities. Most common diseases in vineyards of the Study Area and types of treatments commonly used are indicated in **Table 3.6.7-A6**, with quantities recommended (in liters or kg/ha/year). Quantities effectively used are lower than those recommended. Most of these diseases may occur in spring and summer time. Plasmopara viticola may occur after rains and is treated by $CuSO_4$ which is the most common treatment (mixed with carbonate of calcium in solution).

3) Trends in Use of Agro-chemicals

Land privatization is regarded to be a factor of more efficient use of agro-chemical inputs. However, retail price of nitrogenous fertilizers have increased (300% between 1990 and 1992), leading to a reduction of use from 140 kg/ha to 30 kg/ha.

Future use of fertilizers and pesticides will, however, increase to higher levels according to the following: Advantage of the irrigation system; and economic improvement and ability to buy chemical products.