CHAPTER 3

THE STUDY AREA

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3.1 GENERAL FEATURES

3.1.1 Location

The Study Area lies on the right bank of the Siret River in the northeastern part of Vrancea District, with altitude approximately between 46^0-10' to 45^0-45' North and longitude 27^0-05' to 27^0-15'. It locates about 200 km northeast from Bucharest, the capital of Romania. The capital city of the Vrancea District is Focsani, which locates at the south-eastern border of the Study Area.

3.1.2 Administration

The Study Area covered by 19 villages/towns out of 63 villages/towns in Vrancea District. Within these 19 villages/towns, 11 villages/towns are involved in the Study Area wholly, 3 villages are partially included and 5 villages have separated land in the Study Area. Names of the first category are Ruginesti, Paunesti, Pufesti, Movilita, Straoane, Fitionesti, Panciu, Tifesti, Bolotesti, Marasesti and Odobesti from the north. The second category consisted with Jaristea, Brosteni and Campineanca. The third category includes Soveja, Vidra, Racoasa, Focsani and Grafoafa.

3.1.3 Population

According to the Population and Housing Census as of January 7, 1992, the total population in the Study Area (11 villages) was estimated at 67,805. The agriculture is the main work in the Study Area, occupying 49% of total workable population of 16,395. The annual growths of population between January 1948 and 1977, and 1977 and 1992 in Vrancea District were 0.85% and 0.42%, respectively .

3.1.4 Social Infrastructure

(1) Roads

The National Motor Highway No. 2, which connects Bucharest and Ukraine at Siret, penetrates the Study Area on its eastern border. Through the highway, it is possible to access with about 200 km or within 4 hours from Bucharest, the capital of Romania. The National Motor Highway No 24 diverts to the eastern direction from the National Motor Highway No. 2 in the Study Area and connects to Tecuci and Iasi over the Siret River. In addition to the above, there is a national road No. 2D crossing the Study Area from east to west.

There are 5 district roads connecting major villages in the Study Area with the total length of 107 km. Most of them are paved with asphalt, cut-stones or gravel, and some of them are not passable by cars during rainy season. The public bus services connect the main towns and villages in the Study Area through these national and district roads.

Furthermore, the village roads pass through the Study Area from east to west. They are basically working as farm roads and are very difficult to drive after heavy rains. The road density of Romania and Vrancea District are 30.5 and 14.3 km / 100 km^2, respectively.

(2) Railway

State owned Romanian National Railway (CFR) has one main line No 500 and 2 branch lines in the Study Area. Main line No 500 connects Bucharest and Vicsani at the north, which runs along the National Motor Highway in the Study Area. There are 27 and 30 train services a day to the north and south for the passengers/cargoes and cargoes only, respectively. Branch line No 507, which connects Marasesti and Panciu with distance of 18 km, is operated 4 mixed train services upward and downward. Another branch line connecting Focsani, Odobesti and Vidra Burca is not used at present.

(3) Electricity

The electricity supply is served by the State owned Romanian Electric Company. In the Study Area double high tension lines with 110/20 kv are passing through and interconnect the major hydro- and thermal-power stations in the northeast Romania. One sub-station locates in Focsani. The Calimanesti dam is the reservoir for the Siret Baragan Canal (the Main Canal) and also has hydro-power station.

The electrification in the Study Area has almost completed with 425 km of electric supply network and most of the houses are receiving electricity. The average monthly electricity consumption per house is 130 kwh. Extension of electric lines for the proposed pumping stations is expected to have no trouble in the Study Area.

(4) Water Supply

Each village has separate water supply system except Pufesti. But they are not fully functioning at present because of lack of water sources, deterioration of facilities or operation funds. Their water sources are lake/springs and deep/shallow wells. The groundwater quality is normally good enough for drinking, but water in lakes is poor. Some of the village is extracting groundwater near the National Motor Highway No. 2 and conveying it by pipe lines with high energy. The water shortage in Paunesti and Movilita is most serious in the Study Area, and

urgent countermeasures against water shortage are strongly requested by the farmers in these villages.

(5) Health Care

Each village has minimum one clinic, but only three towns, Panciu, Marasesti and Odobesti have hospital with totaling 475 beds in the Study Area. A hospital bed population in the Study Area is 7 beds/1000 capita. Special local diseases are not specific in the Study Area, but higher share of aged people may cause one of the problems for the medical care of the aged people in the near future. The ratios of the people whose age is above 60 years old in the Study Area, Vrancea District and whole Romania were 19.5%, 18.0% and 16.4% in 1992, respectively,

(6) Education

Each village has more than 3 primary schools and totally 57 primary schools with 10,000 pupils under 653 teachers, are operated in 11 villages of the Study Area. A high school has been operated in Panciu. Higher education can be obtained only outside of the Study Area, such as Focsani.

3.2 NATURAL FEATURES

3.2.1 Topography

The Carpathian Mountains formulate the arc running from north to west in the center of Romania. The Study Area locates on the outer arc at the turning point from north (East Carpathian) to west (South Carpathian). East slope of the Carpathian Mountains continue to Moldovian Sub-carpathian, Moldovian Highland and Moldovian Plain. The Study Area lies on the right bank of the Siret River which runs along the foot of the Moldovian Highland.

The topographic orientation is, in general, decreasing altitude from north-west toward south-east, following with the Siret River and its tributaries. The Siret River and other tributaries always change their flow channel then shallow and wide flood course is general in the Study Area. The Study Area is divided into two study areas, one is Irrigation Study Area (ISA) and the other is Soil Conservation Study Area (SCSA). Both study areas spread on the Siret terrace, old and recent. ISA locates on the recent terrace with elevation between 80 to 180 m and gradient less than 3 %. ISA is divided into 5 blocks by the tributaries of the Siret River. They are the Trotus, Carecna, Zabraut, Susita, Putna and Milcov from the north (**Fig 3.2.1**). SCSA mainly locates on the eastern slope of Sub-carpathian Mountains with elevation more than 200 m. Plateau of these hills with rather gentle slope are vineyard, and the steep slopes between the tributaries or depressions are partially eroded seriously.

3.2.2 Meteorology

(1) General

The climate of Romania is influenced by the south-western sea basin (the Mediterranean and the Adriatic) and the eastern basin (the Black Sea). That of the western part of Romania can be classified as a moderate continental climate, and of the eastern part including the Study Area can be classified as continental one with some extremes. The annual mean temperature of Romania ranges between 8 and 12°C. The cumulative temperature more than 10°C is 2,500 to 3,700°C. The first frost day in autumn varies between the middle of September in the mountain area and the beginning of November, and the last frost day in spring varies from the beginning of March and beginning of June.

Annual precipitation ranges between 400 and 1,000 mm and the summer rainfall is dominant. The highest annual precipitation of 1,075 mm was observed at Varfu Omu and the lowest of 383 mm at Constanta. The maximum daily rainfall of 340 mm was observed before 1900. The rainy days that has more than 0.1 mm varies 70 to 140 days. Annual potential evapotranspiration is less than 750 mm and actual one is less than 650 mm. In the Romanian plain, the number of day of snowfall is 15 to 25 days, and that with snow cover is 30 to 60 days. These numbers of days are recently reducing.

(2) Meteorological Networks

The National Institute of Meteorology and Hydrology (INMH) has responsibility for collecting all the national meteorological observation data. Meteorological stations in and around the Study Area are shown in **Fig 3.2.2**.

(3) Precipitation

The annual rainfall in the Study Area ranges between 400 and 500 mm. The average annual rainfall at Focsani Station is 538 mm and the rainfall during irrigation period, April to September, occupies more than 60% of the annual rainfall (**Fig 3.2.3**). The probable rainfalls estimated based on the rainfall records at Focsani Station are as shown below:

Return Period (year)	Annual Rainfall (mm)	Rainfall during Apr. to Sept.(mm)
2	530	319
5	433	250
10	387	217
20	350	192

On the other hand, the probable continuous rainfalls for 1, 2 and 3 days estimated based on the rainfall records at Panciu Station located at the western edge of the Study Area are as shown below:

Return Period (year)	1-day rainfall (mm)	2-days rainfall (mm)	3-days rainfall (mm)
5	71	87	94
10	87	103	111
20	101	119	128
50	120	140	150
100	135	156	167

(4) Temperature

The average of mean monthly temperature in Focsani is 10.4°C. Mean, absolute maximum and minimum monthly temperature between 1977 and 1992 in Focsani is shown in **Fig 3.2.3**. In winter between December and February, the monthly mean temperature becomes below 0°C. Absolute maximum and minimum temperature are 38.5°C and -28°C, respectively. Annual cumulative temperature above 10°C is about 3,300°C.

(5) Frost and Snowfall

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

(6) Relative Humidity

The relative humidity at Adjud Station, which locates at the northern border of the Study Area, shows 78% and 72% for the annual average and the monthly average between April and September, respectively. Comparing with other areas adjacent to the Study Area, the northern part of Siret-Ialomita Agriculture Development Project Area shows higher humidity (**Fig 3.2.3**).

(7) Evaporation

Only a few meteorological stations in Romania are observing the pan evaporation. The evapotranspiration (Etp) is estimated based on the Thornthwaite Formula for irrigation planning. Annual mean evapotranspiration at Adjud Station is estimated at 674 mm. The evapotranspiration during April to September is 605 mm corresponding to 90% of the annual. The balance between the evapotranspiration and precipitation at Adjud Station is as follows:

Period	Precipitation (mm)	Evapotranspiration (mm)	Balance (mm)
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 2,057 hr. And sunshine duration during April to September is 1,452 hr. corresponding to 70% of total annual duration. The longest sunshine duration appears in July at 7.65 hr/day, and the shortest duration in December at 1.87 hr/day.

(9) Wind

According to the wind observation data at Adjud Station, the N or NW wind is dominant through the year. Calm days in each month slightly varies between 28.2 and 44.7%, and the average wind speed in winter from north/northwest is generally stronger ranging from 5.5 to 7.2 m/s.

(10) Installation of Automatic Rainfall Recorder

A set of automatic rainfall recorder brought from Japan by the Study Team was installed in the workshop of SCELIF-Vrancea in Marasesti after the discussions and field investigations by the Study Team members and Romanian counterparts. This location is suitable for collecting precipitation data in ISA for finalizing the operation system of the Project facilities.

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 total catchment area becomes approximately 45,110 km^2), excluding river basin of the Danube. The length of the Siret River is also the second longest in the territory at 3,966 km (also after including length in Ukraine, the total length becomes approximately 4,064 km). The major rivers in Romania can be said the continental rivers with rather gentle slope and formulate many meandering during the floods.

The Study Area lies on the right bank of the Siret River about 100 km upstream of the confluence with the Danube in Galati. Generally the rivers in the Study Area have wide and flat low-water channel and wide high-water channel. Because of thick river sediments, most of tributaries disappear its water at the entrance of flat plain and penetrates under the river bed, and

appear near the Siret. The summary of monthly mean discharge for the Siret, Putna, Buzau and Ialomita rivers is shown in **Table 3.2.1**.

(2) The Siret River at Calimanesti

The water source of the Project is the Calimanesti Dam, which locate at 108 km upstream the confluence of the Siret River with the Danube with catchment area of 25,355 km^2. The hydrological observation has been continued at Cosmesti Gauging Station, about 15 km downstream from the dam with catchment area 27,946 km^2. Between the Calimanesti Dam and Cosmesti Station, there is no major tributaries and only one pumping station for Nicoresti-Tecuci-Movileni Irrigation Project with the maximum intake of 11 m^3/s exists.

Mean annual discharge at Cosmesti Station is 175.4 m^3/s and yearly and monthly variations are shown in **Table 3.2.2** and **Fig 3.2.3**. According to these data, the lowest monthly mean discharge of 11 m^3/s was observed in January 1964. On the other hand, the lowest monthly mean discharge during April to September of 30.0 m^3/s was observed in September 1963. However, the lowest average mean discharge during April to September was 61.5 m^3/s in 1990. The probable lowest monthly mean discharges for 2, 5 and 10 probable years estimated based on the discharge records at Cosmesti Station are 46, 31 and 25 m^3/s, respectively.

(3) The Putna River

The Putna River is the largest tributary of the Siret River in the Study Area. The discharge of this river is considered as one of the supplemental irrigation water resources in the plan of the Siret-Ialomita Agricultural Development Project. According to the hydrological observation data at Colacu Station with catchment area of 1,100 km^2, the mean yearly discharge is 11.7 m^3/s, the lowest monthly discharge through the year is 0.9 m^3/s (in January 1964), and one during the period between April and September is 1.1 m^3/s (in September 1963). At the downstream area, Botrlau station, 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 in February 1988, and 1,040 m^3/s at Colacu in August 1977.

(4) Water Quality

According to the results of water quality tests conducted by the Study Team, the water quality in the Study Area is slightly alkaline (pH 7.0 to 8.5 and EC 330 to 1,800 µS). Furthermore, the water quality in the Calimanesti Dam shows that pH is 7.7-8.0 and Electric Conductivity (EC) is 700 µS. Therefore, if it is judged from the observed data above, there will be no trouble in using the Siret River water as the irrigation water for the Project.

(5) Automatic Water Level Recorder

A set of automatic water level recorder brought from Japan by the Study Team was installed at Colacu in the Putna River, where the operation and maintenance is easy and no automatic recorder is installed at present after several discussions and field investigation by the Study Team members and Romanian counterparts. It will become possible to analyze the correlation between precipitation and river runoff by using the river discharge data of this recorder and the precipitation data at Tulnici Station located 24 km upstream of Colacu.

3.2.4 Geology

(1) General

The Study Area is a succession of the Quaternary accumulations with the oldest formation, called "Cindesti" Strata of Pleistocen Inferior, to the most recent fluvial terrace formations of the Siret plain from west to east direction. SCSA lies on the accumulation of loess above the Cindesti strata to the old terrace. The accumulation of loess on the Cindesti strata is deeper on the hills between Panciu and Movilita. On the other hand, ISA lies on the recent terraces of the Siret River with thin loess.

(2) Seismicity

After sever earthquake with Richter scale 7.8 on November 10, 1940, the study and observation of Romanian seismicity started systematically. The earthquake in 1977 recorded 7.2 of Richter scale. The epicenter of both earthquakes was in Vrancea. The seismic observation center was installed in Vrincioaia, upstream area of the Putna River. Therefore, it can be said that the Study Area is located in the center of earthquake in Moldavice seismic area.

3.2.5 Soil

(1) General Soil Characteristics

Based on Soil Reports elaborated by OSPA Bacau (1974-1989) and ICPA Bucharest (1986) and in accordance with Romanian standard, the soil of the Study Area has been classified into 50 soil units. The soil investigation is limited to the agricultural land within the Study Area. The distribution of respective units is shown on **Fig 3.2.4**, and the characteristics of respective soil units are summarized in **Table 3.2.2**.

Based on 44 soil profiles prepared by ICPA, 24 soil profiles prepared by OSPA and a supplemental chemical analysis of 20 soil samples in the Study Area to make clear the soil salinity conducted in the Agrochemical Laboratory of ISPIF-SA, Bucharest, the general features of soil in the Study Area are summarized as follows:

a) The greatest diversity and heterogeneity of soils with a predominance of Mollisols (Chernozems and Grey Soils), Argilluvic Soils (Brown Soils) and Undeveloped Soils (Alluvial Soils) are observed;
b) The mother material of soil generally is alluvial deposits and loess deposits;
c) Soil texture in a surface horizon (A) is composed of loam, clay loam and a small proportion of sandy loam. In a deep horizon (B), the texture is of loam to clay loam;
d) Drainability is good to excessive;
e) The soil depth from the surface to C horizon (mother material) is between 85-120 cm for the Chernozems, Browns and Grey Soils, and about 50 cm for the Alluvial Soils. The depth of eroded soil is 10-25 cm.;
f) The soils with a high gravel contents are located near the Putna valley in the area of 706 ha with the limits between 6-75%;
g) Soil pH is from neutral to acid for the Chernozems, Brown and Grey soils, corresponding to a low degree of base saturation. The undeveloped soils has a neutral to alkaline pH due to high degree of base saturation;
h) Electric Conductivity (ECe) is of 0.4 to 1.2 mmhos/cm, which is smaller than 1.7 mmhos/cm (limit of Romanian standard) and also smaller than 2.0 mmhos/cm (limit of international standard), and it is judged that no saline soils exist in the Study Area;
i) Total salinity content expressed in mg/100 g soil is generally very low, from 26 to 72 mg, smaller than 100 mg (limit of Romanian standard), signified also to be no saline soils; and
j) Contents of organic matter, nitrogen, phosphorous and potassium are low to moderate.

(2) Hydrophysical Characteristics of Soil

Based on the soil report prepared by ICPA Bucharest (1986), the hydrophysical characteristics of soil in the Study Area are broken down into the following four sub-divisions:

a) The first sub-division 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 includes all the Chernozems, a large part of the Typic Alluvial Soils and the Mollic Alluvial Soils.

b) The second sub-division 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 the deeper

layers. This sub-division includes the Typic Grey Soils, the Brown Soils and the Gleyed Alluvial Soils.

c) The third sub-division includes soils with more than 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) is average. Permeability is average to low, but with values inferior to those of the soil in the above sub-divisions. This sub-division includes the Vertic Chernozems and the Typic Vertisols.

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

From the above hydrophysical characteristics of soils, it is concluded that the soils in the Study Area have properties favorable for irrigation, but due to their particularly light texture and non-uniform relief, irrigation might be carried out with extreme care to avoid soil erosion.

3.2.6 Land Classification

Land classification of the agricultural land in the Study Area has been carried out according to the Romanian standards in use for land classification (**Table 3.2.4**). Land classification map is shown in **Fig 3.2.5**. Most significant factors for agricultural use in the Study Area are slope in relationship with erosion phenomena and skeleton contents in soil. The characteristics for each type of land classifications are summarized as follows:

Class I : Arable land without any limitations neither degradation risk
Class II : Arable land with limitations of minor risk of degradation
Class III : Arable land with limitations of moderate risk of degradation
Class IV : Arable land with limitations of severe risk of degradation
Class V : Non-arable land with limitations of strong risk of degradation
Class VI : Non-arable land without possible use for agricultural development

The land class of the Study Area is summarized as follows:

Land Classification		The Study Area		Irrigation Study Area		Soil Conservation Study Area	
		ha	%	ha	%	ha	%
Agricultural Land		44,080	100.0	27,190	100.0	16,890	100.0
Land Class	I	11,204	25.4	10,478	38.5	726	4.3
	II	25,787	58.5	13,425	49.5	12,362	73.2
	III	2,899	6.6	1,668	6.0	1,231	7.3
	IV	553	1.3	451	1.7	102	0.6
	V	2,571	5.8	292	1.1	2,279	13.5
	VI	1,066	2.4	876	3.2	190	1.1
Non-Agricultural Land		7,720	(14.9)	1,710	(5.9)	6,010	(26.2)
Total		51,800	(100.0)	28,900	(100.0)	22,900	(100.0)

Classes I to IV are used for agriculture and viticulture, while Classes V and VI are suitable for pasture and erosion control plantations. The Irrigation Study Area is mainly composed of I and II types of land classes which do not involve restriction of any kinds against agricultural use.

3.3 AGRICULTURE

3.3.1 Land Use

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 July 8, 1989, April 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**. The areas and their percentages of the Study Area 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

The present agricultural conditions and its future trend in the Study Area have been made clear based on the statistic data available at DJS-Vrancea and DA-Vrancea and the interview to the farmers. In this case, the general information for the agricultural production in the Study Area is mainly based on the existing data for 19 towns and villages related with the Study Area, and the data regarding the farming conditions and cropping techniques are collected mainly from the interview to 100 farmers or farm units selected from 11 towns and villages in the Study Area in consideration of numbers of farmers in the respective towns and villages. The farming systems were considered in the selection of the farmers due to that the farming systems might have strong influence on the farming conditions of the farmers.

(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 3.3.1**).

(2) Yield

The average yields of maize, wheat, barley, grapevine, sunflower, sugar beet and potato in 1992 (drought year) were 1.6, 2.6, 3.4, 3.6, 1.3, 15.3 and 12.8 ton/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 2.7 ton/ha. The average yields in the last 8 years show that the yields of crops largely fluctuate by year and that yield of barley is in the trend of increase but that of wheat is in the trend of decrease (**Table 3.3.1**).

(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 (**Table 3.3.1**).

3.3.3 Livestock

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%) .

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.

In connection with the production trend of livestock since 1986, the raising of pig and poultry is in the trend of increase but that of sheep, rabbit and bee is under the decreasing trend. The livestock productions except for egg and bee are under the increasing trend with the lowest values in 1990. The egg production has been increasing continuously since 1986 but that of bee decreasing (**Table 3.3.2**).

3.3.4 Farming Practices

At present, 6 different types of farming exist in the Study Area, namely; a) Individual farmers (I), b) Informal association of private farmers (AAS), c) Formal association of private farmers (AA), d) Commercial company with mixed capitals of state and private (SCM), e) Commercial company with whole private capital (SCCP) and f) Research and production institution with state capital (SCP). The farming conditions of respective types of farming are shown in **Table 3.3.4**. Furthermore, the present cropping pattern is summarized in **Fig 3.3.2**.

(1) Maize Production

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.

(2) Wheat Production

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) Production of Other Crops

Other crops such as sunflower, sugar beet, potato, tomato and onion are grown as summer crops. Sugar beet is sown late in March, sunflower, potato and onion early in April and tomato late in April. Tomato is harvested in the middle of July to early in September (for about 50 days from 90 days since sowing), onion early in August (about 120 days since sowing), sunflower late in August to early in September (150 days), potato early in September (150 days) and sugar beet early in October to the middle of October (190 days).

(4) Crop Production

Wheat is cultivated commonly except for SCCP farms and the average cropped areas are between 0.39 ha in AAS and 111.4 ha in SCM. The average yields are from 3.2 ton/ha in AA to 3.9 ton/ha in SCM.

Maize is also cultivated commonly except for SCCP farms and the average cropped areas are between 0.33 ha in AAS and 30 ha in SCM. The average yields are from 1.1 ton/ha in SCP to 5.1 ton/ha in I farm.

Barley is cultivated only in AAS and SCM farms. The average cropped areas and yields are 0.05 ha and 2.4 ton/ha in AAS, and 34.6 ha and 4.0 ton/ha in SCM, respectively.

Sugar beet is also cultivated in AAS and SCM farms only. The average cropped areas and yields are 0.02 ha and 1.5 ton/ha in AAS, and 2.0 ha and 27.8 ton/ha in SCM, respectively. The yields differ significantly depend on farming type.

Sunflower is cultivated in AAS, AA and SCM farms. The average cropped areas and yields are 0.03 ha and 2.4 ton/ha in AAS, 0.13 ha and 1.6 ton/ha in AA, and 40.8 ha and 1.4 ton/ha in SCM, respectively.

Grapevine is cultivated in all farms. The average cropped areas are in a range of 0.01 ha in AAS to 326.2 ha in SCM farms and the average yields are 2.8 ton/ha in SCCP to 11.1 ton/ha in SCP farms.

The following specific features for crop production in respective types of farms have been found out through the Study:

a) The individual farmers (I) are introducing the diversified farming and getting comparatively stable higher yields in all planted crops compared with other types of farming such as associations and companies.
b) AAS and AA, the associations of the small-scale farmers, are inferior to the individual farmers in introducing the diversified farming and getting high yields. The activities of the associations are not yet on the right track .
c) SCM is practicing the commercialized farming in a large scale and comparatively stable higher yields with the introduction of diversified farming.
d) SCCP is cultivating livestock as the main farming and SCP is the farm for research and production of grapevine.

(5) Constraints to Crop Production

The biggest constraint against the crop production for all the farmers 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 for seeders, which may not meet the farmers' demands in the Study Area. Furthermore, the biggest constraint for SCM and SCCP is insufficient marketing system.

3.3.5 Farm Household Economy

(1) Economic Environment

Most of individual farmers have too narrow farm holdings (3 ha per farm household in average) to sustain their household. Therefore, 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.

(2) Present Farm Income

The farm gross income earned by an individual farm consists of crop income and livestock income which account for two thirds of the total and one thirds, respectively. Income from wine grape accounts for a half of crop income, where self-consumed grape is used for producing home-fermented wine. According to the farm household survey results, the annual household income is estimated at $2,784 \times 10^3$ Lei, while the total annual expenditure amounts to $2,123 \times 10^3$ Lei, leading to a surplus of 661×10^3 Lei. It is estimated that about 35% of the gross income can be counted as net farm income.

(3) Production Cost and Net Gain

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.

Although the profitability of grapevine is estimated at a marginal level, the actual gain therefrom by the farm households specialized in grapevine production, regardless of their acreage under vineyard has been proved to be fairly high. According to the result of the farm survey by the Study Team, the average rate of net profit comes to 46%, yielding averagely 490×10^3 Lei /ha of net gain per hectare. 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 the 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 100×10^3 Lei will bring a gross income of 416×10^3 Lei, thus leaving a value-added gain through home-processing of 47% adding to the value of raw material, after subtracting estimated depreciation cost for processing kits and labor charge.

(Unit: 10^3 Lei/ha)

Item	Wheat	Maize	Barley	Sunflower	Sugar Beet	Potato	Grape	Vegetables
Primary	499	338	411	560	943	3,888	1,110	4,866
By-product	18	31	19	0	19	0	0	0
Total Income	517	369	430	560	962	3,888	1,110	4,866
Cost	279	145	209	169	280	1,745	443	1,923
Gain	220	224	221	391	682	2,143	667	2,943
Profit (%)	43	61	51	70	71	55	60	60

3.3.6 Land Tenure

(1) History of Land Ownership

Redistribution of the land owned by noblemen and large land owners to the farmers almost finished in the land reform in 1945. However, with the establishment of the socialist state, the small-scale farmers with holdings of less than 10 ha were forced to join the state cooperatives from 1948 to 1962. After the revolution in 1989, Land Law (Low 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.

The process of investigating legal title to land, allotting the land, issuing 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 the farmers who have accepted the provisional certificate and the final title of property to the whole farmers are 85 to 100% and 0 to 48%, respectively.

At present, there are three categories of private land ownership for the cultivated area, namely ;

a) privately owned individual land (I) including land of informal association of private farmers (AAS);
b) formal association of private farmers (AA); and
c) land of commercial companies with mixed capitals of state and private (SCM) or with whole private capital (SCCP).

(2) Land Tenure in Vrancea

The total agricultural area of Vrancea District is about 255×10^3 ha, 52% of the total area, as of 1994. 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 land, respectively. Individual farms occupy

90.7% of the private area, commercial companies occupy 1.2% and formal associations of private farmers occupy 8.1%.

3.3.7 Marketing

(1) Environmental Factors Affecting the Agricultural Marketing

The following macro-economy and agricultural factors deeply affect the improvement of agricultural marketing in Romania:

- Cut of State subsidies and violent inflation in accordance with market economy;
- Impatience to secure economic performance and profit following the privatization program; and
- Increase of unemployment.

Furthermore, the above mentioned phenomena of macro-economics cause the following problems to Romanian agriculture:

- Destruction of farming structure and cooperatives with the execution of land law;
- Appearance of new land owners dwelling in the cities (43%);
- Confusion of small- and medium-scale farmers caused by operation of land law neglecting farming and marketing systems;
- Decrease of farmers' will for improving their farming and organizing the farmers' associations due to the increase of aged farmers;
- Unwillingness of the farmers to deliver farm products to the Government organizations as a way of farmer's self-defense against the violent inflation;
- Lack of marketing strategy and technology transfer; and
- Shortage of credit with soft interest.

(2) Consumer Price and Marketing System

Viewing from the consumer price indices reported by the National Commission for Statistics, the average monthly rate of consumer price has been violently and continuously risen in the post-revolutionary confused situation. At the same time, transportation volume of goods in Romania has been remarkably decreased and the marketing has been slow down in relation to the deep drop of the economic activity. However, coming into 1994, 5 years after revolution, inflation rate of consumer price has been slow down in the rise of prices and the Government forecasts the annual inflation rate to be reduced to 75% in 1994, which was the figure previously agreed with International Monetary Fund.

Under such situation, a) higher inflation rate of food stuffs than non-food stuffs and services, b) not so clear occurrence of seasonal fluctuation of food prices, c) cheaper prices of some food stuffs in Bucharest than in rural towns and d) wide different prices of goods among rural towns are found out as the remarkable characteristics. Such phenomena are caused by the unconsolidated marketing channel, lack of marketing information system, shortage of transportation means and farmers' unwillingness to deliver their products to the Government as their self-defense against the violent inflation.

(3) Seasonal Fluctuation of Food Stuff Price

Under the premature marketing system and the violent inflation, seasonal fluctuation of the prices of perishable fruits and vegetables is found out except for such food stuffs as bread, meat and edible oil which are controlled and subsidized by the Government. In accordance with the stabilization of macro-economy and the progress of market economy, seasonal fluctuation of food stuffs prices not only of perishable foods but also of other food stuffs is easily forecasted to become wider, which causes high profit competition among growers and traders with the improvement of delivery and marketing system available to do even in off-harvest season.

(4) Marketing System in the Project Area

In the Project area, the following five remarkable matters on agricultural marketing system are recognized:

a) Producers deliver their net marketable cereals excluding stockpiles for self-supply to the state enterprise ROMCEREAL and cash crops to vendors, open-sky markets or peasant markets directly. However, those volumes are quite small;
b) The major marketing channel depends on the informal producer-consumer line through relatives and acquaintances by words of mouth. Marketing systems are not yet established originating from the producers to the consumers through collectors or middlemen, agro-processors, wholesalers and retailers;
c) A very few middlemen or collectors exist;
d) Insufficient credit support for marketing. Transportation of crops depends popularly on horse or cow-drawn carts even though there are trucks and farm trailers operated by the state enterprises;
e) Less delivery volume to the market as compared with production; and
f) Preference to bring back the final products like sugar and sunflower oil itself instead of payment in cash.

3.3.8 Agro-industry

(1) Privatization and Agro-industry

Agro-industry in Romania consists statistically of food, drinks and tobacco industries. The National Register Office of the Chamber of Commerce and Industry of Romania reports that 238,180 enterprises had been registered in the field of agro-industry in the whole of Romania until the end of June 1994. Within this structure of ownership, 98.9% of them are private or mix-funded enterprises, and the remaining 1.1% are state ones. Thus, privatization and the development of the small- and medium-size private enterprises should now be accelerated in Romania as one of the most powerful instruments for the economic reform.

(2) Agro-industry

Privatization is the most important activity for reconstruction of Romanian economy and the agriculture has the top urgency for privatization together with housing and manufacturing industries. According to the Transition Report by the European Bank for Reconstruction and Development, the private sector accounts for 35% of GDP in Romania which is evaluated as one of intermediate countries among the Eastern Europe and the former Soviet Union.

Many enterprises related to agriculture have been privatized in Romania. As of November 1994, those private enterprises had been established as 77 companies for farm machinery manufacturing and farming services, 13 for seed production and supply, 18 for fertilizer production supply, 9 at the field of chemicals, 50 for animal breeders, 82 for feed production and supply, 28 for florists, 75 for fruits and vegetables production, 209 for meat processor, 55 at the field of dairy processing and marketing, 13 for green house growers of fruits and vegetables, 2 for the sericulture, 341 for agro-processors, 237 at the field of beverage and drinks, 17 for edible oil refineries, 30 for sugar refineries, 35 for exporters of agricultural produce, and even 132 for agricultural traders. Most food processing companies suffer so much of the following problems:

- Shortage of supply of raw materials;
- Less than 50% operation efficiency of the factories;
- Time-worn facilities;
- Lack of know-how for operation and management, technology renovation and marketing strategy; and
- Shortage of credit with soft interest.

(3) Agro-industry in the Project Area

At present, the agricultural commodities produced in Vrancea District are mostly similar to those in other districts, but the production amounts of such four fruits as grape, cherry, sour cherry and nut are higher than those of other districts. Accordingly, agro-industry in Vrancea District is concentrated on processing of cereals mainly consisting of wheat, barley, maize and rye, industrial crops of sunflower, sugar beet and grape, dairy and animal husbandry of pig, cow cattle and sheep including power animals and fruits and vegetables.

Forty eight (48) private companies are now recognized in the field of agro-industry and number of the food processing facilities and their capacities are sufficient for processing agricultural commodities to be produced in the Project Area in due course. Existing facilities and equipment are, however, remarkably time-worn.

3.3.9 Agricultural Supporting System

Agricultural supporting system has been established in and around the Study Area accessible to the farmers in it. However, the system is not yet consolidated and some of them do not function well, while others fail to operate in their capacities due to feeble demand, etc. Major units of the supporting system found in the Study Area is given in **Table 3.3.3**.

Agricultural Bank can provide loans to the farmers with subsidized interest rates, by 4 agents in Vrancea District and each village has its branch office 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). 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 contract with farmer/state farm contractors, and to distribute it among the farmers groups. ROMCEREAL, as sole buyer, storer and miller of grains and sunflower seed, purchases cereals and distributes flour among bakeries, delivers bran to feed stuff producers, sunflower seed to oil factories.

AGROMEC provides tractors, combines and sprayers to the farmers and their groups through a rental charge system, while maintain them properly. Centre Agricole (Agricultural Center), established one for each district, will be reorganized into Camera Agricola (Agricultural Chamber) to expand its functional capacity from currently stationed a few staff to those covering all major disciplinary to render technical/information service for the farmers. The network of the center is illustrated in **Fig 3.3.3** as a schematic flow. Animal market sale 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 are 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' Organization

Before revolution, CAPs (Agricultural Cooperative Farms) 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 such as machinery use, credit access, productivity of crop and livestock and their management have arisen from such small holding. 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 ways. In this connection, agricultural chambers established in each village play a core role in fostering the farmers to organize themselves so that they can reach higher farm productivity.

SCM : Commercial company with mixed capitals of state and private at the share 70:30 to 50:50;
SCCP : Commercial company with whole private capital
AAS : Informal association of private farmers (normally set up by family or kindred);
AA : Formal association of private farmers (normally set up by family, kindred or near-by farmers);
SCP : Research and production institution with state capital (State Farm); and
I : Individual farmers.

AAS can be easily established among kindred without any legal/registry procedures, but some requirements arise when participants establish AA. In the 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 divided from their production. At least 10,000 Lei per membership and more than 10 members are required for establishing SCCP.

3.3.11 Rural Community

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.

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

The Study Area lies on the right bank 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.

Number of the farm households in 11 towns/villages is about $22x10^3$ and the population is about $70x10^3$. 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 associations (0.4%) (**Table 3.3.4**). According to the hearing survey to the farmers, an average farm size of the private farmers is 3 ha including vineyard of 1 ha.

(2) Structure of a Family

It is considered that the following specific characteristics of the farmers in the Study Area are helpful to promote organizing the associations of the farmers:

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 nuclearization 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%; and
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 %.

(3) 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. 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 a 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.

(4) Living Standard

The annual living expenditure of the farmers in the Study Area is about 1.2×10^6 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 3.7×10^6 Lei which is equivalent to 2.9 times the present their income.

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 have 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.

(5) Farmers' Intention for Farming and Living

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 the introduction of 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 presently cultivated crops with introduction of irrigation.

(6) 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 .

(7) Position of Women

Between 1918 when the nation of Romania was formed and 1945, the laws and regulations including the most advanced constitution during that time were established. The right of women

has been equal to that of men since then. Even during the socialistic nation, the salary, vote right and work right was equal to men and women.

3.4 EXISTING IRRIGATION AND DRAINAGE

3.4.1 Existing Irrigation

Only one irrigation system called the Putna Irrigation System exists in the Study Area. 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 by gravity to the respective irrigation areas through the main canals. These canals are used not only as irrigation canals but also as drainage canals against the flood discharge from the surrounding hills .

The total irrigation area covered by both Putna Irrigation Canals (named as 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**.

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 during the irrigation period);
c) malfunction of the check structures, road-crossing structures, etc. in the System; and
d) lack of canal section at some sections of the Canals.

In addition to the above Putna Irrigation System, some irrigation facilities designed for the Project such as a part of distribution and booster pump stations, distribution canals and distribution pipes have already almost been completed or are under construction in the field.

3.4.2 Existing Drainage

(1) River Flood and Countermeasures

According to the meteorological and hydrological data, the biggest flood occurred in 1986 for the last 30 years which brought comparatively heavy damages. The flood damage survey by ICPA reported that most of the main rivers passing through the Study Area overflowed during

that flood time. The flood areas which have damages almost every year are mostly the cultivated areas at the high land for emergency flow inside the riverway.

The river improvement works or flood control works are mostly not progressed in the Study Area except for some sections. A concrete-lined drainage canal has been completed at the section between the road-crossing point of the Zabrautu River and the Siret-Baragan Canal.

(2) Drainage in the Study Area

As the farm lands in the Study Area have gentle slope toward the rivers or natural streams which flow through the Study Area from west to east , the gravity drainage is generally possible. Therefore, no drainage canal has been constructed except for the catch drain passing through the west edge of the Study Area which was constructed in 1970's in order to protect the upstream area from its soil erosion.

However, the following poor drained areas have been confirmed through the field survey by the Study Team:

a) The farm land of the Bizighesti village due to the Putna Canal having no canal-crossing works under the Siret-Baragan Canal.
b) The natural wet land of the Domnesti village along the Siret River. Its drainage condition has become worse due to the completion of the Calimanesti Dam.

3.5 SOIL CONSERVATION

3.5.1 Present Conditions

(1) General

Because of its natural conditions, Romania is greatly affected by water erosion. Water erosion affects almost the entire country while wind erosion only affects small areas of its southern part. The Study Area is located at the foot of the Sub-Carpathians in the northeastern part of the Vrancea district, which is the area most affected by water erosion in the country. The Study Area (51,800 ha) is divided into two sub-areas: the Soil Conservation Study Area (SCSA), which mainly extends in hills and tablelands at the western side of the Study Area and covers 22,900 ha, and the Irrigation Study Area (ISA), which is mainly developed in gently sloped land and covers 28,900 ha.

(2) Erosion in SCSA

SCSA's elevation ranges between 170 and 400 m. Most of SCSA is used for farm land such as vineyards and pastures. Generally, the top of the hills are gently sloped or flat, and the erosion is shallow and slight. Many ravines and gullies are observed in steep slopes along rivers such as Trotus, Carecna, Zabraut, Susita and Putna. Specially, deep gullies are developed in places where land slope exceeds 10 %.

(3) Erosion in ISA

ISA's elevation is mostly lower than 170 m. There are not so many eroded places in this area and observed erosion is shallow and slight due to the following reasons:

- Slope of land is gentle (less than 5 %);
- Vineyards which have comparatively high resistance against erosion, prevail in the sloped area; and
- Soil conservative farming, such as contour strips, grass strips, inter-cropping etc., prevail in the sloped area.

The slope of ISA is, however, very long and the soil of ISA has big possibility for 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 the freezing of top-soil in winter and to the high resistibility against wind erosion because of the farm land being strengthened by soil conservative farming. Windbreaks are scarcely observed in the Study Area.

3.5.2 Existing Facilities

The following countermeasures and facilities are commonly seen in the Study Area in addition to masonry and concrete check dams:

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

Most of the erosion control facilities were constructed in the 1970's and are obsolete. Therefore, rehabilitation of these works should be emphasized. To prevent the formation of

gullies and their growth, the countermeasures carried out at the upstream side should also be emphasized and more investment should be made in 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 25,000, slope conditions of the Study Area is divided into the following four categories.

(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 estimate soil losses in the Study Area. The annual soil losses by sheet erosion can be estimated with the USLE (Universal Soil Loss Equation) method. Annual soil losses of the representative crop lands in the Study Area is shown below:

(Unit: ton/ha/year)

Crops	Slope (%)	Actual (without irrigation)	Future (with irrigation)
Maize	5	4.6- 8.5	5.5-10.3
	10	12.9-24.1	15.5-29.0
Vineyard	5	4.0- 7.5	4.8- 9.0
	10	11.3-21.1	13.6-25.4

3.5.5 Assessment of Erosion Control Area

Taking the relation to the irrigation project (Ruginesti-Pufesti-Panciu) into consideration, the erosion control areas in the Study Area can be divided into the following 5 categories. Classification map is presented in **Fig 3.5.1**. Results of assessment are shown in **Table 3.5.1**.

Class	Type of Soil Erosion	Area (ha)	Priority for Action
I	Areas affected by very strong and excessive sheet erosion, associated with gully erosion but outside the irrigation project area.	4,907	C
II	Areas affected by moderate and strong sheet erosion but outside the irrigation project area.	4,329	C
III	Areas which need soil erosion control, in order to protect the irrigation project 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.	1,706	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 "Instruction 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.

On the other hand, according **to Fig 3.5.2** 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.

Furthermore, the yield losses can be estimated with the formula for the relation between yield loss and erosion used in Romania as shown below:

Erosion Condition	Erosion Rate (m^3/ha/yr)	Thickness of Eroded	Unit Yield Loss (kg/m^3)	Yield Loss (kg/ha/year)		
				after 5-yrs	after 10-yrs	after 20-yrs
Strong	20	0-30	0.6	180	660	2,520
Moderate	10	30-70	0.5	75	275	1,050
Slight	5	30-70	0.5	38	138	525

3.6 ENVIRONMENTAL CONDITIONS

3.6.1 General

As regards to the policy network for the protection of environment, the main characteristics of the Study Area and its surrounding areas are as follows:

- As part of the Siret River basin, the Study Area and its surrounding areas are concerned by the Environmental Program for the Danube River Basin and also the Environmental Program for Protection of the Black Sea. The study for the Siret River Basin Environment Action Plan has been launched as part of these programs. The Action Plan will identify the action priorities based on a review of main pollution sources with special focus on water quality issues.

- The Study Area and its surrounding areas lie just downstream the so-called "Environmental Disaster Zones", which have been defined for developing a remedial measures against environmental degradation due to industrial development. These areas are included in the Onesti-Bacau-Adjud triangle. An environmental action plan is now under study for the Onesti-Borzesti-Bacau pilot zone with the objective of prevention of industrial pollution.

- The Study Area and its surrounding areas lie outside the existing nature conservation areas. The "Flood Plain Siret" protected area (about 1,744 ha), which is composed of 19 small pieces of forest, is mostly located along the Study Area on the Siret River banks. Certain wildlife species living around or in the Study Area have a status of protection (like hunting laws), but there are not strictly protected species except for isolated birds such as Little egret and Shelduck observed around the Calimanesti reservoir.

Several international conventions for the conservation of nature were signed or ratified by Romania. As part of the Danube River basin, the Study Area and its surrounding areas are concerned to these conventions.

3.6.2 Natural Environment

Hills in the western side are the emergence of the thick "Cindesti stratum" composed of heterogeneous and non-cemented gravel (400 to 500 m deep) with intercalation of sand and clay. This geological stratum is the main reservoir of phreatic aquifer within the Study Area. Small groundwater units are lying in alluvial plains and terraces along the river corridors of Trotus, Susita, Putna and Milcov in addition to along the Siret River. Water recharge is mainly assured by infiltration from the Siret tributaries and the water runoff at the upstream Cindesti stratum. Shallow groundwater discharges into the Siret River at the downstream section, south of Focsani.

The Study Area is mostly intensively used for human settlements and agriculture. Remaining natural areas are limited to terrestrial forest on hills, riverside forest on the Siret River banks, degraded lands (erosion, natural pasture land) and riverbeds of the Siret tributaries. Natural vegetal species have generally been replaced by cultivated species. Vegetal species mainly belong to the group of willow and poplar groves along the Siret, and to the group of durmast woods and mixed species like hornbeam, lime-tree, ash-tree, maple-tree and acacia on hills. The Siret River is a natural corridor for migration of bird species from north to south. However, the major wetland habitats for periodic installation of migratory birds are not located in and around the Study Area.

3.6.3 Social Environment

Within the Study Area, industrial and zoo-technical plants are small units with limited impact on environmental quality. The exception is the industrial chemical plant of Marasesti, which is considered to be the most important industrial pollution source in Vrancea District. These important industrial and municipal pollution sources are located far in the upstream area of the Study Area.

Evolution of water use in the Siret River basin has shown a big decrease of water consumption for industry and agriculture between 1988 and 1993. Industrial water consumption in 1993 decreased by half its 1988 value, and agricultural consumption is now about 18% of its 1988 level. Water resources in the Siret basin area are generally river water for industries, rivers and deep or shallow aquifers for municipal and domestic supplies. In most cases, groundwater source is shallow phreatic water in the Siret River area at a depth of between 10 and 50 m. Groundwater represents almost 100% of water resources in towns (Panciu, Marasesti, Odobesti and Focsani) and villages. Forestry, fishery and cynegetic resources are not important in the Study Area.

3.6.4 Water Quality

In the Siret-Baragan area, water quality of the rivers and aquifers was the major environmental issue in the decade 1980-90. These water-borne problems actually remain with less intensity due to the decrease of industrial activity.

According to the water quality data at the upstream section of the Study Area (the Trotus and Siret Rivers before their confluence), surface water is periodically degraded. Monthly concentration values were sometimes above the irrigation water quality standards in the Siret River for biochemical oxygen demand, chemical oxygen demand and ammonium. Phenol concentrations were also sometimes very high, even considering mean monthly concentrations.

According to the groundwater quality data around the Study Area, nitrates and nitrites concentrations are generally low. pH indicator is normal, between 7 and 8 in most cases. Concentrations for chloride, iron and ammonia are high. The highest values recorded are 902 mg/lit for chloride in 1993 (Putna), 0.64 for iron in 1993 (Siret and Putna) and 4.08 for ammonia in 1993 (Siret). 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 for chloride, 0.3 for iron (with manganese) and 0.5 for ammonia. European standards are the same except for chloride limited to 200 mg/lit.

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 contaminated with iron and ammonia. Samples collected from the Putna corridor showed a contamination with chloride, iron and ammonia. However, groundwater in the Trotus corridor presented a good quality in all cases.

3.6.5 Soil Erosion

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.

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, sheet erosion might affect slopes of not more than 2-3%. Accordingly, more than half of ISA could be liable to sheet erosion or gully erosion.

3.6.6 Environmental Permitting System

The environmental permitting system or approval system is composed of 3 kinds of administrative documents: Permit, Authorization and Environmental Impact Assessment (EIA) study.

The construction works of the irrigation system within the Project Area started in 1987, before the 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, the investment was once approved and the construction works of the Project facilities are under way. Second, there is no official guidelines for conducting EIA on this type of project. Accordingly, the view of 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 the 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 MoE is that the results of EIA study are not evaluated according to guidelines but to the capacity of carrying out the propositions for mitigating the important negative impacts.

3.7 PRESENT PROBLEMS IN AGRICULTURE

On the basis of the results of the field survey and the analysis of the data and information collected, the existing problems in the Study Area in performing the agriculture are summarized as follows:

1) The total precipitation during the expected irrigation period from April to September in the Study Area ranges between 200 and 500 mm, and is largely changeable by year. Therefore, the crop yields are largely fluctuated by year accordingly and the yields in the drought years are a very few. The rotation farming in consideration of the maintenance of soil fertility and injury due to continuous cropping is not fixed at present. In order to secure the stable farm income by maintaining the stable high yields of crops, the introduction of the irrigation systems and some new crops in case of necessity and the establishment of a planned rotation farming will be strongly required. With regard to the irrigation, the Irrigation Study Area is mainly composed of the land of Classes I and II in the land classification and the soil of the Area has no restrictions of any kinds for introducing irrigation system.

2) The farm income of the households in the Study Area estimated based on the results of interview with the farmers in the Area covers only around 70% of the annual living expenses of them and the remaining 30% depends on their off-farm income. Most of the private farmers in the Area are expecting to increase the agricultural production by introducing the irrigation farming and then to improve their living standards. Therefore, the immediate installation of the irrigation facilities in correlation with the improvement of the marketing channel for the agricultural products is strongly requested.

3) It has become clear that the marketing channel related to the agricultural products originating from the farmers through collectors, processors, wholesalers and the retail shops to the consumers is still under structuring. The improvement of the marketing channel is urgently required. In this case, establishment of the financial assistance system to them is very important.

4) The capacities of the food processing facilities which exist around the Study Area are sufficient for processing the food to be produced with the Project implementation. However, they are already old enough and the improvement of them is badly necessary.

5) The following facts have been cleared through the field survey: "The nuclearization and aging of the families have progressed in the Study Area. The proportion of farm households with multiple income has become high. The full-time farmers including pensionaries are 47%, but those excluding pensionaries are only 8.6%. The farmers earning their major share from the non-agricultural occupation are 53%." It is considered that these specific characteristics of the farmers in the Study Area are helpful to promote organizing the associations of the farmers. Therefore, organizing the associations of the farmers which is recommended by the Government of Romania will be progressed in the near future in consideration of the mutual use of agricultural machines, effective marketing of the agricultural products, effective use of the irrigation facilities, etc..

6) The individual farmers are introducing the diversified farming and getting comparatively stable higher yields in all planted crops compared with other types of farming such as associations and companies. Furthermore, the individual full-time farmers have strong intention to continue their agricultural independently without joining some associations nor forming new associations. It will be important to take into consideration the intention of these individual full-time farmers which occupy about 10% of the total farmers in formulating the Project. In order to stabilize the farm income of the individual farmers and to improve the living standard of them, such measures as selection of the most appropriate crops, improvement of marketing channel for the agricultural products and procurement of agricultural machines with low-interest credit services will be necessary.

7) The existing agricultural supporting systems such as Agricultural bank, Agricultural input supply company (APRO), Seed Conditioning and Trading company (AGROSEM), Cereal trading company (ROMCEREAL), Agricultural mechanization service company (AGROMEC), Agricultural center and Livestock market are not yet consolidated, and some of them are not functioning well and others fail to utilize their capacities due to feeble demand. Therefore, it will be necessary to improve these agricultural supporting systems by securing the financial sources, establishing the low-interest credit service system,

establishing the procurement and/or replacement of agricultural machines/facilities and effective utilization of them, securing the man-power, etc..

It is judged to be very effective to implement an integrated agricultural development project focusing the irrigation development as the main theme in order to solve the problems in agricultural activities mentioned above. Furthermore, implementation of the project will contribute to the improvement of the living standard of the farmers in and around the Study Area and also to the activation of the area.

On the other hand, there exist in and around the Study Area the following problems related with the agriculture which will not be able to be solved only by the implementation of the Project. It is desirable that these problems be solved by the Government of Romania or the Administration of Vrancea District.

1) The process of investigating legal title to land, allotting the land, issuing provisional certificate 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 included in the Study Area, the percentages of the farmers who have accepted the provisional certificate to the whole farmers are already 85 to 100%. However, the percentages of them who have the final title with fully registered land are only 0 to 48%. The delay of the process of land ownership is disturbing the intention of the farmers especially small and medium-scale individual farmers to continue farming and to participate in the associations. Furthermore, it makes it very hard for them to receive any financial assistance from the financial organizations. The promotion of the process of the land ownership is strongly recommended.

2) The towns and villages in the Study Area have own water supply systems except for Pufesti. However, they are not fully functioning at present because of lack of water resources, deterioration of the systems or lack of operation funds. The countermeasures against the domestic water shortage should be taken as soon as possible in consideration of the living conditions of the people in the Study Area.

3) The establishment of an agricultural financial supporting system such as low-interest credit services to the farmers related to the improvement of marketing channel, agro-industries, agricultural extension services etc. should be materialized as soon as possible.

4) The improvement and flood control of the tributaries of the Siret river which pass through the Study Area and the soil conservation at the hillsides located at the west side of the irrigation development area are to be implemented as soon as possible for the success of the Project.

CHAPTER 4

THE PROJECT

CHAPTER 4 : THE PROJECT

4.1 OBJECTIVES OF THE PROJECT

This Project is recognized as a model agricultural development project for other future development projects in Romania under its new social and economic systems. The Irrigation Study Area has high potentials for agricultural production owing to the favorable natural conditions such as climate, topography and soil. However, the yield of crops has been largely fluctuated by the meteorological conditions especially rainfall because of no irrigation systems existing. The farmers in the area have strong expectation for the introduction of the irrigation system in order to achieve the stable agricultural production. On the other hand, the anxiety of the farmers to the new social and economic systems might be one of the causes of stagnation of the agricultural production in the area.

In order to promote the activation of the agricultural sector which is one of the Romanian emergency tasks in agricultural sector in parallel with the maintenance of the self-sufficiency of main food in the region which is the other emergency task, with the elimination and/or improvement of the above-mentioned constraints to agriculture in the Project Area, the Project aims:

- to create the sustainable and profitable agriculture as a model agricultural development;
- to show to the farmers the direction of farming by stabilizing the farming conditions and increasing the agricultural productivity; and
- to promote the stable life of the people in the area by activating the regional economy through the improvement of living standard of the farmers.

In order to attain the objectives of the Project, the following plans are proposed:

- Sustainable farm production through a year by introducing the irrigation system;
- Improvement of land productivity by the effective use of land and water resources;
- Production of high value-added crops, establishment of new marketing system and improvement of agro-industries suitable for the free-marketing system;
- Organization for the operation of the irrigation facilities and farming to be introduced newly; and
- Consideration of intention of the individual farmers in planning the above.

4.2 BASIS OF PROJECT FORMULATION

4.2.1 Basic Concepts in Project Formulation

As a result of the study, the following basic concepts are presented as the basis in the formulation of the Project.

(1) Water Resources

The probable monthly mean drought discharges of the Siret River at the downstream section of the Calimanesti Dam are estimated to be 31 m^3/s for 5 year probability (80%) and 25 m^3/s for 10 year probability (90%) using the discharge records at the Cosmesti Gauging Station from 1950 to 1993. The water resources development plan for the Siret-Ialomita Agricultural Development Project by MoE seems to be reasonable in general judging from the total storage efficiency of the existing dams on the Siret River at its upstream section of the Calimanesti Dam. Therefore, the irrigation plan in the Project is prepared on condition that the irrigation water necessary for the Project is provided without any shortage from this completed Calimanesti Dam. The water of the rivers flowing through the Study Area is not be used in due consideration of the above, efficiency of operation of the Project irrigation facilities and the water resources for the future developments in the area.

(2) Planning of Project Facilities

The planning of the Project facilities is made on the basis of the construction works to be completed as of December 1994 in consideration of the remaining new Project works and repairing works of the completed facilities.

(3) Design Conditions of the Project Works

The design conditions for the Project Works adopted by MAF are also generally applied in the formulation of the Project in consideration of the past ample experiences on the irrigation farming for a long time in Romania and the economy of the Project. The modifications and/or changes of the existing design of the Project Works are made in consideration of maximum utilization of the facilities already completed at the site, if any.

(4) Irrigation in Vineyard

The irrigation system is introduced to a part of the objective vineyards, excluding ones where the troublesome soil erosion may occur due to the comparatively steep slope of land and the height of land from the Main Canal is higher than the economical water-lift limit tentatively adopted, in consideration of the results of research and investigation made by the Government organizations concerned, the existing data and information available and the probable big damages for the grapevine in the severely drought year.

(5) Change of Vineyard to Arable Land

The present vineyards scattered in the irrigation development area with small blocks are to be changed to the ordinary arable land in consideration of efficiency of land use and profitability of farming, which corresponds with the actual trend of the land use at the site.

(6) Existing Putna Canal System

The areas within the Irrigation Study Area which is benefited by the existing Putna Canal System at present are converted to the beneficial area of the proposed new irrigation system. However, the Putna Canal System is kept as it is in consideration of the existence of the beneficial area of the System outside of the Project Area and the emergency supplemental use of the water of the System for the Project beneficial area.

(7) Future Farming System

The proposed agricultural development plan is prepared on condition that most of the individual small-scale farmers in the Project Area organize some associations, which meets the policy of the Government of Romania, even though some of them still continue their farming individually.

(8) Soil Conservation Works

The countermeasures for soil conservation in the Project are planned only in the case that the probable soil erosion may directly damage the Irrigation Area to be developed through the Project implementation in consideration of the main objective of the Project and environmental preservation of the Irrigation Area. Other soil conservation works which are necessary for the stability of the area but do not have direct connection with the stability of the Irrigation Area are considered as future projects to be executed with other financial sources.

(9) Cropping Pattern

The proposed crops and cropping patterns are prepared in general based on the crops and cropping pattern presently adopted by the farmers in the Project Area and those proposed in the existing plan prepared by MAF, in consideration of farmers' intention for farming, farmers' self-sufficiency of foods, food demand in the area, technical level of the farmers in farming practices, sustainability of farming, environmental preservation through farming, present conditions of marketing and financial supporting systems, expansion of livestock in the near future, etc.. Furthermore, mechanization of farming shall be further expanded in consideration of the present farming practices, climatic conditions in the area, the size of the farm fields, etc.

(10) Marketing System

The efficient functioning of a marketing system is very important for the success of an agricultural development project in addition to the establishment of the irrigation system. However, the establishment and/or improvement of the marketing system are excluded from the Project because of the improvement of the marketing system being the theme of the private sector in general.

(11) Agro-industries

The operational capacities of the agro-industries presently located around the Project Area are sufficient for dealing with the products to be produced with the Project implementation. Therefore, the improvement of these factories only is required in connection with the implementation of the Project. With the same reason as the above, this matter shall be settled in the private sector.

(12) Agricultural Credit

The financial support is one of the most important factors for the improvement of the farming conditions of the small- and medium-scale farmers. And the improvement of the agricultural credit system is one of the main themes in the Project formulation. This matter is considered as one of the recommendations for the Project implementation.

4.2.2 Presently Proposed Irrigation Plan

(1) Irrigation Plan

The existing irrigation plan is prepared on the basis of sprinkler irrigation by pumping-up the waters of the Calimanesti Dam and the Siret-Baragan Canal. The Project has also been prepared on the same basis.

(2) Water Requirements

The water requirements are estimated with the method established by ICITID. The evapotranspiration (ETo) is estimated with Thornthwaite method. Based on the above estimation, the net irrigation water requirements for the booster pumps (SPP) with 80% provability are set as 0.5 lit/s/ha and 0.58 lit/s/ha for sprinkler and furrow irrigation, respectively.

(3) Irrigation Efficiency

The irrigation efficiency (Ep) is set as 78.7% using the following formula:

$$Ep = Ea \times Eb \times Ec$$

where; Ea : Field application efficiency ((90%)
Eb : Distribution efficiency (95%)
Ec : Conveyance efficiency (92%)

(4) Irrigation Time

The following irrigation system is also adopted in the Project, which has been practiced for many years in Romania:

A. Operation (an example):

a. Sprinkling in an unit	:	10 hr. (7:00 -17:00)
b. Break for transferring lateral lines etc.	:	2 hr. (17:00 -19:00)
c. Sprinkling in the next unit	:	10 hr. (19:00 - 5:00 of the next day)
d. Break for transferring lateral lines etc.	:	2 hr. (5:00 - 7:00)
e. Continuing to the third unit	:	10 hr. (7:00 -17:00)

Note: Two units are irrigated in a day

B. Operator's assignment with three shifts of working:

a. 1st shift	:	7:00 -15:00
b. 2nd shift	:	15:00 -23:00
c. 3rd shift	:	23:00 - 7:00 of the next day

In this case, the control, operation and maintenance of a booster pump station covering an irrigation block and the field operation works (like valve operation) shall be managed by a control unit to be newly organized for the respective irrigation blocks in the Project Area or by the existing control organization which may have to be reorganized according to the respective requirements. On the other hand, disconnecting, shifting and reconnecting of the lateral lines shall be done by the farmers themselves.

(5) Irrigation Interval

In due consideration of the site conditions such as climate, soil, topography and the size of an irrigation block to be controlled by a booster pump station , it is judged that the irrigation interval of 12 days which is proposed by MAF for this area is reasonable and that it shall be adopted in the Project.

(6) Size of One Rotation Block

Based on the Romanian standard, the space of lateral lines is set to be 24 m. On the other hand, the length of them is set to be 300-400 m (variable) in accordance with the site conditions of the respective irrigation blocks. So that, the size of one rotation block becomes 17.28 to 23.04 ha.

(7) Size of One Irrigation Block

The size of one irrigation block covered by a booster pump station (SPP) is set based on the topography of the area and administration boundary of the area in consideration of the past O&M experiences in similar projects. The size of the irrigation blocks in the original design is in the range between 69 ha in the minimum to 1,255 ha in the maximum (average: 488 ha). The size of them is reasonable in general judging from the Romanian standard size of an irrigation block (3,000 ha in maximum).

(8) Control System

In the Project, the water-level control systems are planned for the distribution (lift) pumps (SRP) and the booster pumps (SPP) independently. The consideration for adopting in the Project the full-automatic control system to integrated control the SRPs and SPPs should be the theme in the future in consideration of the farmer's share of a part of the Project construction cost and immaturity of operation/maintenance systems for the Project facilities.

(9) Rearrangement of Farm Land

The land ownership within the Project Area is both private and state, with a total number of more than 3,000 of land owners being divided into 3 groups (a: I & AAS, b: AA and c: SCM, SCCP & SCP), and scattered in the Area at random. A grouping and rearrangement of these farm lands in accordance with the irrigation pipeline network to be constructed in the Irrigation Area is definitely necessary for an efficient operation of sprinkler irrigation and the success of the Project accordingly.

4.2.3 Present Condition of the Constructed Project Works

The construction works of the Project facilities have been executed by two Ministries in parallel, namely; a) the Main Canal and intake by MoE and b) the irrigation facilities such as SRP, CD, SPP, CP, A and hydrants for the sprinkler units by MAF. On the other hand, the Calimanesti Dam was constructed by the Ministry of Energy whose duties have been transferred to RENEL with the main objective of hydro-power generation.

General plan of the existing design of the irrigation facilities is shown in **Fig 4.2.1**. The detailed design of the irrigation facilities has already been completed and the construction works are now on-going. Administrative flowchart of the Project implementation is as follows:

a) Planning : MAF
b) Design : ISPIF-SA
c) Construction works : SC ZBOINA-SA, etc.
d) Operation and Maintenance : RAIF-Vrancea

(1) Intake and Main Canal

The intake has already been completed remaining some finishing works. On the other hand, 5.5 km section of the Main Canal from the Intake out of total length of the Main Canal for Phase I of the Siret-Ialomita Project of about 32 km (up to 0.3 km downstream SRP V) have already been completed. Moreover, about 70 % of excavation of the remaining sections of the Main Canal and several crossing works have also already been completed. The construction works are still on-going.

(2) Pump Station

1) Distribution Pump Station (SRP)

SRPs V and IX out of planned ten (10) SRPs are located at the Main Canal and SRP IA is located at the Siret River, while others are located inside the service areas along CDs. The planned pump types are of horizontal single-stage, double suction volute pump (NDS/RDN), horizontal single-stage, mixed flow pump (BRATES) and vertical multi-stage, mixed flow pump (MV/MA), depending upon their design discharge and total head. Only SRP V has both pump house and control house, but others have only control house and pumps/motors are installed in the open air.

The construction works of four (4) SRPs out of ten (10) SRPs have been almost completed and one (1) is under construction. The progress of the construction works of these pump stations are shown in **Annexes**. The following check and repair works will be necessary for the already built SRPs:

a) Check on roller bearing, rubber rings, etc. for both pumps and motors shall be carried out before test operation, because almost five (5) years have passed without operation since the completion of them;
b) Anti-corrosive measures such as painting shall be carried out for the exposed steel pipes as soon as possible; and
c) Repairing works and some final touches are required for the damaged portions of structures and buildings.

2) Booster Pump Station (SPP)

SPP 10 only out of planned forty nine (49) SPPs is located at the upstream area of the Calimanesti dam, and SPPs 11, 20, 20A, 21, 26 and 27 are located at the Main Canal. Others are located inside the service areas along CDs.

Pumps are designed with the types of horizontal single-stage, double suction volute pump (RDN), horizontal single-stage, single suction volute pump (NC and AN), and vertical multi-stage mixed flow pump (MV and MA), depending upon their design discharge and total head. Thirty seven (37) pump units are designed with type of MV and MA (76%). All SPPs except for SPP 25A have only control houses, and pumps/motors are installed in the open air.

The construction works of ten (10) SPPs out of forty nine (49) SPPs have been almost completed and the progress of the construction works of these pump stations are shown in **Annexes**. Same check and repair works will be necessary for the already built SPPs as for SRPs.

3) Drainage Pump Station (SPE)

Two (2) SPEs are planned at the plot 3A in the northeastern part of the service area due to the construction of the reservoir dike for the Calimanesti dam. However, no design work has been carried out.

(3) Distribution Canals (CD)

Thirteen (13) CDs are planned. The total design length of CD is about 74.9 km. The construction works of eight (8) CDs out of thirteen (13) CDs have been executing except for CD11 which has been already completed. The progress of the construction works of these canals are shown in **Annexes**.

(4) Distribution and Sub-distribution Pipelines (CP and A)

CPs and As for forty three (43) irrigation sectors are planned by MAF. The total length of CPs and As is approximately 485 km. The construction works of CPs and As for sixteen (16) out of forty three (43) irrigation sectors have been already started. Five (5) irrigation sectors out of sixteen (16) irrigation sectors : No 10, 11, 25, 25A and 28, have been mostly completed. The progress of the construction works is shown in **Annexes**.

4.3 PROPOSED AGRICULTURAL DEVELOPMENT PLAN

4.3.1 Land Use Plan

The land use plan for ISA has been prepared in accordance with the results of the Land Classification, trend of the land use and in consideration of the present land use. The following are the main features in the land use planning:

(a) Use as arable land but without irrigation is planned for some areas of the present arable land due to the topographical and pedological constraints of the land and in consideration of the proposed reservoir bank of the Calimanesti Dam.
(b) Continuous use as pasture without irrigation is planned for the present pasture.
(c) Use as vineyard without irrigation is planned for some areas of the present vineyard in consideration of the height of land from the Main Canal and probable troublesome soil erosion due to comparatively steep slope of land.
(d) Use as arable land with irrigation is planned for some areas of the present vineyard by changing their land use in consideration of effective land use of the areas and profitability of farming in respective areas.

On the other hand, any development plans for SCSA are not considered in compliance with the objectives of the Study. Therefore, the present land use of SCSA is fixed in the Project.

The hectareage of the planned areas of respective land uses in ISA is summarized below and the distribution of the respective areas are shown in **Fig 4.3.1**.

Present			Plan		
Land Use		Area (ha)	Land Use		Area (ha)
Agricultural Land	Arable Land	20,850	Arable w/ Irrigation		18,780
			Arable w/o Irrigation	(a)	2,070
	Pasture	500	Pasture w/o Irrigation	(b)	500
	Vineyard	5,830	Vineyard w/ Irrigation		2,600
			Vineyard w/o Irrigation	(c)	1,790
			Arable w/ Irrigation	(d)	1,440
	Sub-total	27,180	Sub-total		27,180
Non-agricultural Land		1,720	Non-agricultural Land		1,720
Total		28,900	Total		28,900

Note: w/: with , w/o: without

* The arable land includes the meadow of 20 ha.

** This area includes the urban areas, river courses, etc.

Based on the above results, the area of 24,150 ha consisting of the arable land and vineyard to be irrigated with the Project (22,820 ha), pasture (500 ha) and non-agricultural land such as urban areas and small streams (830 ha) has been selected as the Project Area which is divided into 5 zones by the rivers flowing through the area east to west direction as shown in **Fig 4.3.1**.

Land Use	Present (ha)			Plan (ha)		
	Gross	Net *		Gross	Net *	
Arable	18,780	18,590	w/o irri.	20,220	19,810	w/ irri.
Vineyard	4,040	4,000	w/o irri.	2,600	2,550	w/ irri.
Sub-total	22,820	22,590		22,820	22,360	
Pasture	500	500	w/o irri.	500	500	w/o irri.
Non-agricultural	830	1,060		830	1,290	
Total	24,150	24,150		24,150	24,150	

Note : * The net cultivated area of the present agricultural land is set as 99% of its gross area in consideration of existing small streams/gullies, public and farm roads, etc. in the area. On the other hand, that of the planned irrigation development area is set as 98% of the gross area considering the planned Branch Canals with maintenance roads, farm roads, catch drains against soil erosion, etc. in addition to the present conditions.

4.3.2 Farming Plan

(1) Basic Strategy

To show the direction of farming to a large number of small-scale private farmers who have appeared after the revolution is not only an urgent subject for the Romanian agriculture but also a social problem in this country. From such a point of view, the proposed farming plan focuses on the activation of the agricultural sector and a financial independence of the small-scale farmers in the Project Area and aims at a sustainable and profitable agriculture with careful consideration on environment by the introduction of vegetables, which is the most profitable cash crops for a small-scale irrigation farming, into the proposed basic combination farming of "cereal crops, leguminous crop and livestock". In this case, the present production amount of main crops is maintained in consideration of self-sufficiency of main crops.

Furthermore, the intention of the farmers in the area for future farming, original farming system in the area, the results of the field survey, the proposed future agriculture in the area, etc. are carefully considered in selecting the proposed crops and preparing the proposed cropping pattern and crop rotation.

That is;

(a) Cereal crops (maize, wheat and barley) are the staple food and are also used as feedstuff for livestock. As these crops produce a lot of organic matter which returns to soil, it is possible to raise healthy and illnessless crops with the fertile and physically improved soil

by application of the organic matter. Furthermore, a rapid and large change of the present production amounts of main crops in the Project Area should be avoided in order to secure the amounts of staple food, feedstuff and industrial materials presently required.

(b) Leguminous crop (bush bean or soybean) is introduced in order to provide feedstuff (seeds and whole crop at ripening stage for silo) as well as food and industrial materials. They contribute to the maintenance of soil fertility through their nitrogen fixation of about 150 kg/ha/year. Moreover, they control the growth of weed by covering the soil surface with their broad leaves. Consequently, less use of chemical fertilizer and herbicide can be realized.

(c) Livestock production is expected to increase in the near future as a main protein resource for the Romanian nation. The barnyard manure produced from the excretions of livestock increases soil fertility and improves the physical condition of soil, which makes possible to perform a sustainable agriculture.

(d) Vegetable cultivation is the most profitable irrigation farming. Though it requires intensive farming, it is suitable for the small-scale farmers because of the high profit per unit area. Although the vegetable cultivation requires also fertile soil with high moisture holding ability and well drainage ability, it is possible to supply such soil and maintain it by performing the combined farming of "cereal crops, leguminous crop and livestock".

As mentioned above, the farming with introducing vegetables into the combined cultivation of "cereal crops, leguminous crop and livestock" can realize a sustainable and profitable agriculture with careful consideration on environment by the application of less amounts of fertilizer and agricultural chemicals, because of such farming maintains fertile soil and raises healthy crops.

Regarding the market for vegetables, there are 3 main markets around the Project Area; Focsani with $100x10^3$ in population, Buzau with $150x10^3$ located 100 km south of the Project Area and Bacau with $200x10^3$ located 150 km north. In Bacau, cabbage, tomato, egg plant, green pepper, water melon and melon are promising (SCPL, Bacau). In connection with the market in Bucharest, it is considered that there will be competition with the advanced vegetable production areas on the outskirts of Bucharest and also in the Danube basin located at the southern part of the country in addition to the disadvantage that the market is located at 270 km far from the Project Area. However, the quality of vegetables presently sold at the markets in Bucharest is not good. Furthermore, it is reported that the considerable pollution of groundwater is severely progressing in the Danube basin.

In such situations, it is considered that the production of high quality vegetables with organic fertilizer, non or less application of chemical fertilizers and agricultural chemicals will be able to compete with the vegetables in those areas. The proposed combined farming of "cereal crops, leguminous crop and livestock" makes it possible to produce such high-quality vegetables.

Besides, there exists a food processing factory, SC CONTEC SA, in Tecuci, Galati District, where $45x10^3$ ton of tomato, $10x10^3$ to $15x10^3$ ton of other vegetables and $2.5x10^3$ to $3x10^3$ ton of fruits are processed per year. At present, only 40% of the processing capacity are utilized. So that, it is also possible to supply the vegetables produced in the Project Area to this factory.

There are 5 commercial companies (SCM) in 100 samples for the hearing survey carried out by the Study Team. The average farming scale is 727 ha. In such large-scale farms, the cultivation of such crops as wheat, sunflower and sugar beet which require less labour force per unit area is suitable. It is, therefore, considered that the individual farmers and the associated farmers who have much agricultural labour force in their farming units compared with SCM can coexist with SCM by performing such intensive agriculture.

It is proposed that this Project Area becomes a model area of the financially independent farming by small-scaled farmers with production of high-quality vegetables. To achieve this objective, necessary supporting systems such as producer's organization, facilities for collection and shipping of products, processing facilities, development of marketing, transportation system, equipment of agricultural machinery, maintenance and using system of agricultural machinery, extension services of technology, collection system of information and propaganda activity are to be established. Furthermore, an establishment of a mass-production center for virus-free vegetable seedlings with bio-technology can be considered for the production of high-quality vegetables with mechanization as a future plan.

(2) Cropping Plan

Based on the above basic strategy, the cropping plan in the Project has been prepared in consideration of the following;

(a) Intention of the farmers for future farming;
(b) To ensure the present production amounts of the main crops in the Project Area;
(c) Introduction of leguminous crop (bush bean or soybean) in order to maintain soil fertility and to produce feedstuff and cash crops;
(d) Introduction of vegetables as cash crops;
(e) Effective use of arable land; and

(f) Change of some of the present vineyard into the arable land in consideration of profitability of farming.

1) Area Required for Main Crops

a. Present Production Amount of Main Crops

The present production amount of main crops in the Project Area is estimated by multiplying the areas actually cultivated in 1992 with the average yields in the areas for 8 years from 1986 to 1993 as shown below :

Crop	Wheat	Barley	Maize	Bean Seeds	Sunflower	Sugar Beet
Production (ton)	6,656	1,886	34,825	26	1,011	1,911
Yield (ton/ha)	2.3	2.4	2.7	1.4	1.6	17.1

Crop	Potato	Vegetable	Annual Pasture	Grape	Perennial Pasture
Production (ton)	3,087	12,715	257	26,120	11,877
Yield (ton/ha)	12.8	16.7	13.5	6.5	23.8

b. Yield of Main Crops under Irrigation

The yields of main crops under irrigation in the Project Area and their increase rates compared with the present production have been determined based on the data obtained through 2 sources, that is, the data of the Romanian irrigation experiments carried out under different agro-climatic zones and the data obtained as the maximum yields in the Project Area for the past 8 years as shown below:

Crop	Wheat	Barley	Maize	Sunflower	Sugar Beet	Potato	Grape
Yield (ton/ha)	3.4	3.6	4.5	2.3	30.5	21.3	8.9
Increase (%)	50	50	70	45	78	67	37

It should be noted that there is much difference on yields between the actual farmers' fields and the experimental fields .

c. Area Required for Producing the Present Production Amounts

From the above results, the area required for producing the present production amounts under irrigation and the percentage to the total irrigated arable land are calculated as shown below:

Crop	Wheat	Barley	Maize	Beans	Sun-flower	Sugar Beet	Potato	Vege-tables	Annual Pasture	Total
Area (ha)	1,958	520	7,698	11	436	63	145	305	11	11,145
Ratio (%)	9.9	2.6	38.9	0.1	2.2	0.3	0.7	1.5	0.1	56.3

Based on the above, the ratio to the total arable land of the proposed cropped areas under irrigation with the Project have been determined below. On the other hand, the areas for the vegetables have been determined in consideration of the newly developed areas for vegetables (**Table 4.3.1**).

Crop	Wheat	Barley	Maize	Sunflower	Sugar Beet	Potato	Annual Pasture
Area (%)	12.0	3.0	45.0	2.5	0.5	1.0	0.1

2) Introduction of Leguminous Crop

It is planned in the Project to introduce leguminous crop in order to maintain soil fertility and produce feedstuff and cash crops for the area of 25% of the total irrigated arable land with the condition of 4-year crop rotation and shifting every year to the remaining new area. The leguminous crop to be introduced is bush bean or soybean. Assuming that the amount of nitrogen fixed by the beans is 150 kg/ha/year, around 40 kg/ha of nitrogen are fixed in soil per year.

3) Introduction of Vegetables

At present, sunflower, sugar beet, potato, cabbage, onion and tomato have been cultivated as cash crops. In the Project, cauliflower, cucumber, garlic, green pepper, egg plant and carrot, which have high marketability, storability and transportability are newly introduced in addition to the above presently cultivated cash crops. The total cropped area of vegetables including the area of 2nd cropped area after wheat amounts to 22.9% of the total arable land. The cropped areas of cash crops by crop are as shown below (**Table 4.3.1**):

Crop	Sun-flower	Sugar Beet	Potato	Cabbage and Cauliflower	Cucum-ber	Tomato	Carrot	Onion, Garlic, Green Pepper and Egg Plant	Total
Area (%)	2.5	0.5	1.0	5.5 each *	5.0 *	1.5	1.4	1.0 each	26.9

* including 4.0% for the succeeding crop of wheat

4) Effective Use of Arable Land

For the effective use of arable land, it is planned in the Project to introduce maize-for-silo as a succeeding crop of barley. As an ideal harvesting stage of maize-for-silo is yellow-ripe stage, maize is required to crop after barley which can be harvested at the middle of June. As the succeeding crop of wheat which is harvested at the middle of July, it is planned to introduce late-cabbage, late-cauliflower and late-cucumber, which can be harvested at the time from October to November when higher market price of them can be expected. It is also considered that in the case of introduction of bush bean in stead of soybean, late-cabbage, late-cauliflower and late-cucumber are introduced as a succeeding crop of bush bean. By utilizing the land as planned above, the use rate of land becomes 148%.

5) Change of the Existing Vineyard to Arable Land

For the reason that the grapevine tolerates to water stress, the grapevine has been widely planted in the Project Area. However, under the planned irrigation condition, it is considered that many of the existing vineyards in the Project Area will be changed to arable land from the view point of the profitability of farming for the arable land in consideration of the soil conditions, topography and present plantation scale. Therefore, all the vineyards in the proposed irrigated area except for the big plantation in Odobesti are planned in the Project to change to the arable land.

(3) Cropped Area and Cropping Time

The planned cropped area and cropping time in the arable land in the Project Area are shown in **Table 4.3.1** and **Fig 4.3.2**. The areas for respective crops are expressed in the rate to the total irrigated arable land. In the case of vegetables, the proposed plan shall be sifted to more profitable plans with the progress of grower's technology, the development of market and the improvement of transportation of the products.

(4) Crop Rotation System

The planned crop rotation system is shown in **Table 4.3.2** and **Fig 4.3.3**. In the plan, leguminous crop is always planted once 4 years in the same field, which contributes to the maintenance of soil fertility and also the control the growth of weed. The crop rotation system has 6 different cropping patterns. In these patterns, maize is cultivated continuously for 2 years in the same field but other crops are cultivated in the different fields every year except for a part of vegetable fields where the vegetables are cultivated continuously for 2 years as a succeeding crop of wheat.

(5) Agronomic Countermeasures against Soil Erosion

According to the soil conservation survey, there exist in the Project Area about 6,800 ha of slightly eroded arable land and 1,800 ha of moderately eroded one (Fig 4.5.1). As agronomic countermeasures against the soil erosion in such areas, it is recommended that for the slightly eroded areas, the field of maize where the erosion is raised easily and the field of other crops such as wheat, barley and soybean where erosion is comparatively suppressed be located alternately with a right angle to contour line by adopting contour strip-cropping method in each field.

Furthermore, for the moderately eroded areas, it is recommended that wheat, barley or leguminous crop be introduced in the field in place of maize, or that alley cropping of maize and other crops along contour line be introduced in each field with a convenient planting width for the mechanical cultivation.

(6) Labour and Machinery Requirements

The labour force required for the performance of the proposed crop production plan has been estimated as shown in **Fig 4.3.4**. The maximum labour requirement through a year appears at the middle of September with 174,042 men-days for 10 days. However, the necessary labour force can be supplied only from the labour source within the Project Area due to the available labour force within the Project Area being estimated at 19,000 men.

On the other hand, number of machines required for the practice of the above plan has been estimated to be 235 tractors (65 Hp), 125 disk plows, 72 disk harrows, 16 wheat/barley seeders, 59 maize/sunflower seeders, 8 bean seeders, 18 wheat/barley combine-harvesters, 89 maize combine-harvesters, 12 bean combine-harvesters and 5 sunflower combine-harvesters. These required numbers of machinery can be provided from the presently available numbers of machinery occupied by AGROMEC, ROMCEREAL and private suppliers in the Project Area except for the maize combine-harvesters (**Table 4.3.3**). However, the maize combine-harvesters are not necessarily required, because the harvesting of maize is commonly being done by manual force.

4.3.3 Crop Production Plan

The production amounts of crops to be produced under irrigation with the Project and their increase ratios compared with those of the present condition are estimated based on the above cropping plan as shown below (**Table 4.3.4**):

Crop	Production (ton)	Increase (%)	Crop	Production (ton)	Increase (%)
Wheat	8,080	21	Onion	4,358	68
Barley	2,154	14	Garlic	1,387	new crop
Maize	40,329	16	Green Pepper	4,358	new crop
Sunflower	1,148	14	Egg Plant	6,537	new crop
Sugar Beet	3,021	58	Carrot	10,526	new crop
Beans	10,897	new crop	Tomato	17,829	679
Potato	4,225	37	Annual Pasture	454	77
Maize for Silage	23,166	new crop	Perennial Pasture	11,877	0
Cabbage	64,257	2,489	Grape	22,812	-13 *
Cauliflower	23,268	new crop			
Cucumber	32,081	new crop	Total	292,764	

Note : * Due to the decrease of the cropped area because of change of vineyard to arable land

The total production amount of crops with the Project (292,764 ton) becomes nearly 3 times the present production amount (100,311 ton). The vegetables as cash crop occupy nearly 60% of the total production amount followed by cereal crop (17%), forage crop (12%), grape, leguminous crop and industrial crop. With the implementation of the Project, it is possible to shift from the present agriculture in which cereal crop (43%) and grape (26%) are the main crops to the profitable and sustainable agriculture in which the remarkable increase of income and maintenance of soil fertility can be expected.

Based on the proposed crop production plan, the total benefit from the crop production in the Project has been estimated and summarized as follows:

(Unit: x10^6 Lei)

Crop	with Project				without Project			
	G I	Cost	N I	N I (%)	G I	Cost	N I	N I (%)
Cereals	7,790	4,660	3,130	3.8	6,660	2,781	3,879	28.4
Cash Crop w/o Veg.	11,008	2,959	8,049	9.8	1,579	555	1,024	7.5
Vegetables	89,787	21,105	68,682	83.5	7,916	1,759	6,157	45.2
Forage Crops	810	337	473	0.6	106	52	54	0.4
Grape	3,878	1,928	1,950	2.4	4,441	1,919	2,522	18.5
Total	113,273	30,989	82,284	100.0	20,702	7,066	13,636	100.0
Racio (w / wo)	547	439	603		100.0	100.0	100.0	

Note: G I = Gross Income, Cost = Production Cost, N I = Net Income

4.3.4 Livestock Production Plan

The number of cattle breedable has been estimated based on the amount of feedstuff produced with the Project as follows:

	Feedstuff produced (ton)	Feedstuff required (kg/day/head)	No. of cattle breedable (heads/year)
Wheat	1,424		
Barley	268		
Maize	5,504		
Total of cereal grain	7,196	3	6,572
Maize for silo	23,166		
Annual pasture	197		
Total of silage	23,363	40	1,600

The amount of feedstuff is estimated by adding the amount of maize-for-silo which is newly introduced in the Project to the difference between the production amounts "with Project" and "at present" for wheat, barley, maize and annual pasture. The amounts of feedstuff required for an adult cattle per day are set as both 3kg of cereal grain and 40kg of maize-for-silo (or annual pasture as green forage). As a result of the analysis, 1,600 of adult cattle can be bred per year with the implementation of the Project in addition to the presently bred one.

4.3.5 Farm Household Economy Plan

(1) General

Two types of farm management are predictable in future in the light of current Government policy orientation recommending individual farmers to organize associations or agricultural companies to strengthen their economic viability. They are the associations with handy acreage consisting of member farmers who are mostly small-holders and the remaining individual farmers who prefer independent farming because of their confidence or technical superiority/specialty in farming management. Forming associations can provide member farmers with better access to agricultural inputs, agricultural loans/subsidies and modern technologies both at present and in future. They can more easily follow crop rotation practices that promises them to bring desirable results in their farming activities.

Agricultural income for these two patterns of farming units is projected to increase with the Project not only through increased yields but also through reasonable rotation practices and crop diversification that enables the farmers to stabilize/expand their livestock sector. Livestock production that currently contributes a high share to farm economy within the Project Area will sustain its importance also in future either by providing both individual farmers and

associations with value-added dairy/meat products or by supplying them manure to conserve soil fertility, as well as draught power to cultivate their fields, means to carry inputs/outputs.

Required amounts for agricultural inputs at the project stage are also augmented according to the estimated rates per hectare for sustaining the projected yields including water fee, rental cost of sprinkler sets, transportation cost of increased harvests, etc. In addition, marketing cost is incurred for new or increment part of cash crop production at the said stage.

Land-holding size of a standard individual farm household and that of an association are projected based on the present average and desirable size for the convenience of mechanization. Annual farm budget is estimated based on the proposed production plan for the project stage and annual average within the Project Area for current base. But as regards the unit prices, those prevailed in August-October 1994 are employed for both stages, according to the main producing period of each crop concerned.

The particular limiting factors to be taken into account are available family labor force, projected capacity in marketing outlet and profit increment against additionally required cost. In respect of vineyards, current economic status seems gloomy due to higher labor/input costs and lower wine-grape/wine prices. Therefore, Odobesti state vineyard which covers over half of the existing vineyards in the Project Area only is to remain as it is despite of its relatively or temporarily lower net profit currently prevailing. This could be justified when one duly evaluates down-stream industry related to winery activities, actually creating value-addedness and job creating effect on local population in and around the Project Area. In any case, winery/fruit juice industry can absorb local labor surplus in lingering slack in and around the Project Area.

The above-mentioned preconditions imply the following farming types that will shift from current status to predicted form as given below:

Farming Type	Stage	Land Size	Number of Units	Area Coverage	Labor Force
Individual	present	1.10ha/ household	19,562	21,518ha	2.3/family
	w/ Project	4.00ha/ household	1,422	5,690ha	2.5/family
Association	present	208ha/association	26-by 4,195	5,402ha	169/association
	w/ Project	500ha/association	42-by 22,335	21,000ha	500/association

In the table given above, number of individual farm units is estimated from the rate(%) of households whose land-holding size ranges more than 3ha/household, and the rest is expected to organize associations with appropriate sizes, the average of which will be 500ha or minimum tract to extend an efficient farm-machinery operations.

(2) Economy of Individual Farmers' Household and of Associations

The agricultural annual income is estimated for the above two types of production units expected to exist in the project stage. The estimation is also made for the currently existing small individual farmers that would fail to get organized into members of an association and small associations that will still remain without any expansion at the project stage. Agricultural net benefit as farm budget is estimated as follows, taking full account of salable portion perishable products and salable livestock heads based on available ration including fodder crop, cereal residues/straw and other conventional forage resources:

(Unit: 10^6 Lei)

Type	with Project			without Project			Incre. Net
	Gross In.	Cost	Net In.	Gross In.	Cost	Net In.	
I.Large	14.8	6.1	8.7	3.8	1.3	2.5	6.2 (1.6)
I.Small	2.1	0.7	1.4	1.0	0.4	0.6	0.8 (0.7)
A.Large	1,289.5	581.6	707.9	518.6	329.9	188.7	519.2 (1.0)
A.Small	547.3	268.5	278.8	548.6	360.5	188.1	90.7 (0.4)
Winery	2611.0	1,707.2	903.8	2,021.7	1,348.4	673.3	230.5 (0.5)

Note: In.: income, Incre.: increment,
I.Large: Large-scale Individual Farm (total arable land: 4.0ha incl. 0.2ha vineyard)
I.Small: Small-scale Individual Farm (total arable land: 1.1ha incl. 0.1ha vineyard)
A.Large: Large-scale Association Farm (total arable land: 500ha inc. 56ha vineyard)
A.Small: Small-scale Association Farm (total arable land: 208ha incl. 146ha vineyard)
Winery : 500ha vineyard
* Vineyard in w/o Project condition is changed to arable land in w/ Project condition
( ) show the incremental net income per ha

4.3.6 Marketing Plan

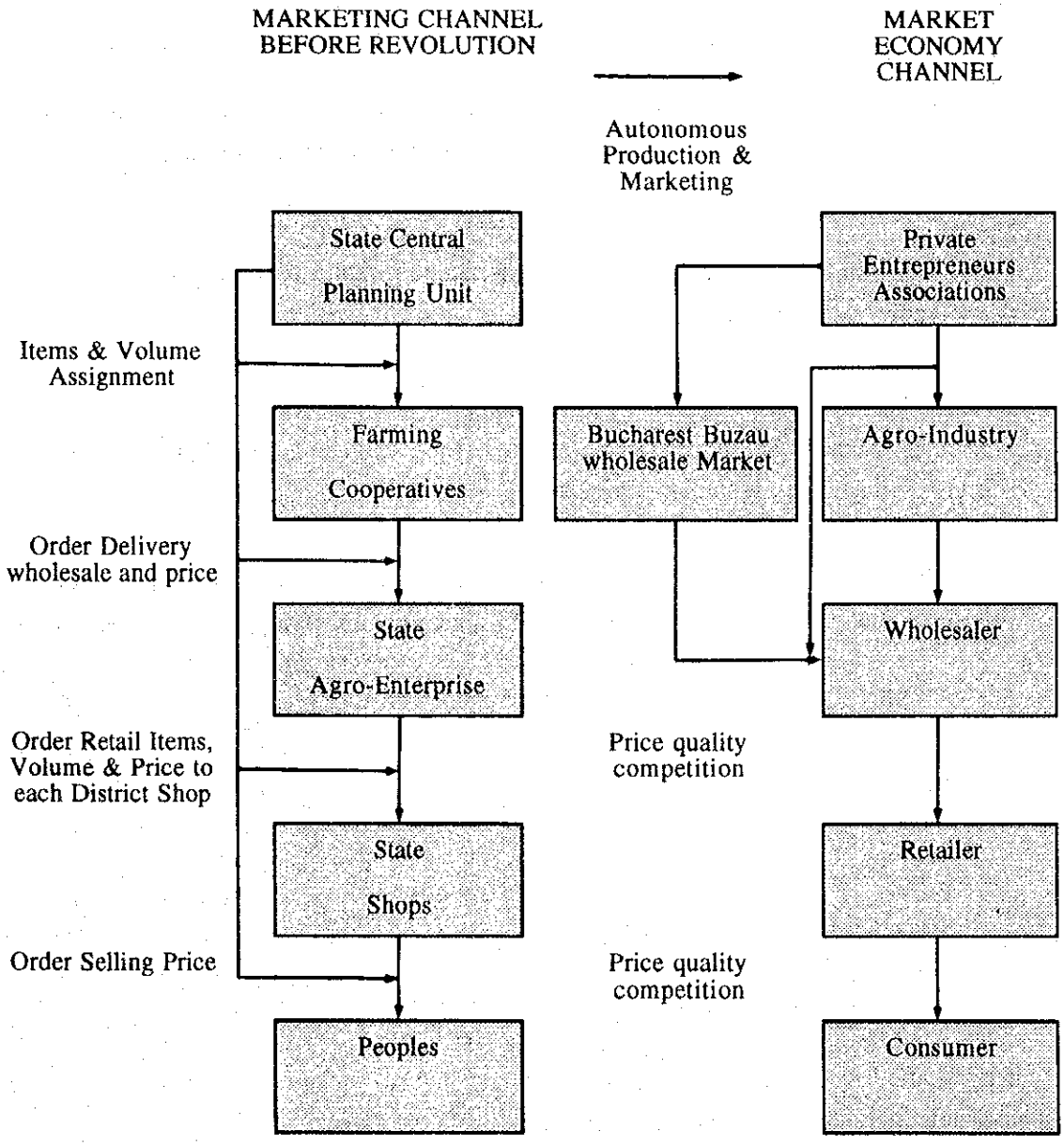
Marketing plan consists mainly of the following two (2) programs as sub-projects :

(1) Promotion Program for Small and Medium Scale Farmers' Organization

Marketing of the agricultural products is the most important sector for the rural development and also the most difficult subject. Marketing development cannot be completed only inside the Project Area without consumers' market. With the market economy penetrates into the rural, marketing channel, facilities required can be certainly expected to be developed. It is, however, difficult to forecast the speed of its progress. It will surely require long time and rather big capital to improve and develop the marketing system.

Also, in the sector of agricultural marketing, it is indispensable to move from the left channel to the right one as drawn in the following figure. Organization of small- and medium-scale farmers is required with top priority by declaring the commercial activity in the articles of the association. In order to secure the success of multipurpose organization of associations, manpower or powerful leadership, produce or most marketable produce with competitive price and quality, and capital or introduction of soft-interest credit for production, marketing and livelihood are required.

Pre-enlightenment and training seminar shall be planned and executed for promoting the advanced farmers and the farming leaders including the transfer of market economy concept and the enterprise management know-how.



(2) Packing House Development Program

Agricultural marketing of the products in the Project Area is summarized as follows:

Cereals

Three (3) grain centers with total storing capacity of 94,000 tons are at Adjud, Padureni and Focsani around the Project Area belonging to the state enterprise ROMCEREAL. Expected volume of 51,000 tons of cereals to be produced in the Project Area can be marketed without any problem.

Oil Seed

Private oil extraction and refinery factories exist in the marketable area with enough capacity to process 16,000 tons oil seed to be produced in the Project Area.

Sugar Beet

3,000 tons of sugar beet to be produced in the Project Area to be delivered continuously to the existing seven (7) private sugar refinery factories having exceeding capacity.

Feeds

Marketable volume excluding stockpile for self-supply is delivered to any one of the seventeen (17) existing feed mills around the Project Area.

Vegetables

Marketing facilities are indispensably required for packing and handling 169,000 tons of vegetables; the biggest crop in the Project Area.

Prospected market to sell about 106,000 tons of net marketable volume of vegetables excluding volume of post-harvest and marketing loss and stockpile for self-supply is targeted as follows:

Market	Population (Person)	Annual Consumption (ton)	Target Volume (ton)	Market Share (%)
Vrancea District.	393,408	113,410	30,259	41.2
Buzau	849,867	158,585	18,000	11.4
Bacau	205,029	38,258	5,000	13.0
Braila	234,110	43,685	5,000	11.4
Tecuci Onesti	115,635	21,577	2,000	9.3
Bucharest	2,086,294	389,302	45,000	11.6
Total	3,884,343	724,817	105,259	14.5

It is required to establish the following packing houses in order to market the volume of vegetables to be produced in the Project Area:

a. Function

Packing houses provided with functions and facilities capable for collecting, grading, washing, packing, pre-cooling, storing and delivering all kinds and volume of vegetables to be produced in the Project Area without quality depreciation.

b. Types of Packing Houses

Three (3) types of packing houses are required; a) for potato and carrot, b) for onion and garlic and c) for other green vegetables, due to collecting and grading methods, harvest period and physical characteristics of each vegetable.

c. Number of Packing Houses

It is required to establish a total of fourteen (14) packing houses consisting of two (2) potato and carrot houses, two (2) onion and garlic houses and ten (10) green vegetable houses inside the Project area to market the volume produced.

d. Collection Capacity

Maximum collection volume per day amounts to 4,405 tons in early October based on the volume produced, harvesting time and types of vegetables.

e. Collection, Grading and Storing Method

The following methods are employed for saving initial investment cost, protecting quality depreciation and securing higher profit:

Vegetable	On-farm Work			Packing House			
Potato	Harvest ⇒	Steel mesh container	⇒	Washing ⇒	Sizing⇒	Packing⇒ (Mesh net)	AC Storage
Cabbage/ Cauliflower	Harvest ⇒	Grading ⇒	Packing ⇒ (Carton)	Pre-cooling	⇒		AC Storage
Cucumber	Harvest ⇒	Plastic container	⇒	Sizing ⇒	Packing (Carton)	⇒	AC Storage
Onion/Garlic	Harvest ⇒	Steel mesh container	⇒	Sizing ⇒	Packing (Carton)	⇒	AC Storage
Bell Pepper/ Eggplant/Tomato	Harvest ⇒	Grading ⇒	Packing ⇒ (Carton)	Pre-cooling	⇒		AC Storage
Carrot	Harvest ⇒	Steel mesh container	⇒	Washing⇒	Sizing⇒	Packing⇒ (Carton)	AC Storage

f. Scale of Packing House

Packing House	Space Required/House (m^2)	Storage Capacity/House (ton)
Potato	4,960	Nominal 5,875
Carrot		Nominal 1,104
Onion	4,200	Nominal 2,780
Garlic		Nominal 975
Green Vegetable	4,880	Nominal 3,350

g. Installation of Packing House and Management System

The packing houses shall be invested and installed by the farmers themselves because of the marketing channel being organized and controlled under the private sector. In the Project, the installation cost of them is included in the production cost of crops. The packing houses shall be managed democratically by private production associations to be organized under the proposed Promotion Program for Small and Medium Scale Farmers' Organization. Daily results of collection, sizing and delivery of products shall be clearly recorded by means of computer system linked with car-operation plan and market information; what is called marketing system. Furthermore, growers' associations shall have the transportation vehicles to support growers whenever they need.

4.3.7 Agricultural Processing Plan

The following shows the corresponding facilities and equipment necessary for the processing of products expected in the project phase:

Cereals

A cereal center has already been established by ROMCEREAL at a site adjacent to the Project Area, equipped with silos with the storage capacity of 94,000 tons and modern mills, corn Sheller and a bakery. Therefore, currently existing facilities can fully meet the expected demand for processing in the project phase through their efficient use, and there is no need of creating additional capacity to the existing ones.

Oil Seeds

There already exists private oil extracting/refining factories that market their product thorough ROMCEREAL, including one in Iasi, as well as seven (7) privatized sugar mills within the reach of transportable radius from the Project Area. These have sufficient capacities to process 16,000 tons of oil seed expected from the Project.

Sugar Beet

The expected production in the project phase amounts to only 3,000 tons, while four (4) sugar mills have been established within the transportable circumference, inclusive of Zaharul Sascut in Bacau with a background of older than 100 years since it was established. This implies that any new investment to establish a new mill will not be needed.

Feed Maize

The capacity that seventeen (17) existing feed-processing and marketing enterprises in and around the Project area will meet the processing and storage of salable portion of the expected production, 25,000 tons less the storage portion for self-consumption.

Annual/Perennial Forage Crops

These are mainly bound to self-consumption, hence currently employed way of treatment, or storage in barns/silos after harvest for annual forages and grazing for perennial ones, is relevant. New investment for a new post-harvest facility would bring a risk of over-investment.

Strawberry

The Project Area is located within the major vineyard tract in Romania, where nine (9) private wineries; in which one of the largest wineries in Romania, Beecon, is found, are distributed. Under such circumstances, there won't be any problem in treating 23,000 tons of wine grape expected in the project phase.

Vegetables

There exists twelve (12) private processing enterprises in and around the Project Area with enough capacity to bottle the produce which failes to meet the standard for raw marketing at the stage of quality selection.

Dairy Products

Two (2) private dairy processing units are available adjacent to the Project Area, producing city milk, cheese, yogurt and butter, and they are capable of treating all the products expected from the Project.

Livestock

Forty six (46) livestock products processing enterprises exist around the Project Area forming the largest sub-sector in the aspect of agricultural processing. Therefore, there is no problem as far as the capacity for slaughtering, treatment or processing the expected herds at the project phase is concerned.

As mentioned above, sufficient facilities with enough capacity are identified for the crops and their quantities expected from the Project, leading to a conclusion that there is no additional need to invest for any new capacity. However, it will be imperative to solve the problems coping with the dilapidated processing facilities, out-dated technology and scarcity of low-interest credit-funds. The best formula to solve these problems will be found in a joint venture with overseas enterprises, envisaging innovation of operational management and technology; faster acquisition of transferable know-how/strategies for sales. In this context, early implementation of plans for promoting joint ventures is advised.

4.3.8 Agricultural Supporting Plan

(1) General

Higher yield levels of crops brought about by irrigation can only be sustained by various supporting systems to which the farmers in the beneficiary are easily available or accessible. These supporting systems include technical, financial and marketing sectors. Since crop diversification by introducing cash crops is inevitable in order to meet the profit-seeking principle in free market economy, it will be essential for the farmers to acquire new cropping techniques through extension media. Of course, new forms of inputs should be properly supplied to them along with the popularization of such techniques. It is also advisable to resort to foreign commercial agents who wish to export their input goods or materials, because they are willing to transfer techniques and in most cases they offer free service.

For the most part, supporting systems have already been established and many of them can be used at the project stage without organizing new ones. However, some of them do not currently exist and hence it is necessary to establish them within the Project Area. They mostly belong to marketing sector already mentioned above, because marketing facility is still a serious bottleneck for national economy and the Project Area is not an exception. It should be reminded that in any part of free economy world up-dated information is indispensable for efficient marketing activities and that, therefore, the farmers should be equipped with sophisticated communication media like CATV system in the project stage.

(2) Technical Supporting

Technical input can be delivered by Camera Agricola established in every town/village, since it is already equipped with horticultural, animal husbandry and cereal cropping experts. There are 19 Cameras existing in the Project Area. The only necessary thing is to add such mobile equipment as motor-cycles/jeeps to visit the farmers more frequently and audio-visual equipment to facilitate better and faster technical diffusion among the farmers.

Technological demonstration farms are also useful to extend new techniques among them, and existing state farms will be available to meet the requirement, because they have already been involved in variety field tests/trials etc. and their land belongs to the state implying no need of paying extra or clearing time-consuming procedures for land acquisition therefor. Currently 4 such state farms are located in and around the Project Area specialized in horticulture/livestock production.

Camera Agricola will have to absorb up-dated technical know-how from nearby research institutes or from abroad. Their staff should frequently have attend in-service training or visiting institutes/universities or more advanced/specialized producing areas to meet the purpose. Especially, since the efficient farm mechanization as well as timely/proper use of chemicals would become key factors for successful farm management particularly in the associations, the staff should have to formulate the best strategy for their utilization.

(3) Financial Supporting and Input Supply

Adequate financial sources will be required for the initiation of crop diversification for both individual farmers and associations. However, needs for financial supports will be more acute for the latter, because of larger area to be allotted for new crop species. Both Banca Agricola and Development Bank (Banca Dezvoltare) provides agricultural loans, but as far as the Project Area is concerned, the former has better network or filial branches.

Currently 7 filial branches are located in the District, of which 3 are available in and around the Project Area. As regards the loan availability, the formal associations would take advantage in the light of provision of mortgages, but it depends on the actual management performance and eligibility of amortization. The more farm management becomes diversified, ranging various crops and sectors inclusive of food/feed crops, livestock and winery etc., the more potential risk can be dispersed and loan suppliers would welcome such efforts to diversify management. For the sake of security of input-supply, the farmers in the beneficiary will be advised to make contract with ROMCEREAL and sugar-mill/vegetable oil-extracting factories through which input/loan requirement can be met, if current contracting system is sustained.

As regards agricultural machinery, current 5 AGROMEC available in and around the Project area are equipped with enough fleet of machinery to cover all the needs that would arise from the beneficiary. However, the key problem lies in dilapidated inventory including meager supply of spare-parts and increasing numbers of out-of-order/non-functioning. On the other hand, purchasing new machinery by the associations or well-off individual farmers never fails to require long-term loans. Therefore, the availability thereof will be the limiting factor on their mechanization.

Anyway, mere dependence on outside suppliers of credits/machinery would not give any radical solution. Only self-help efforts, for example, expanding savings by accumulating from year-to-year farming/off-farm gains could be relied upon, as some sound fruit producers around Focsani are now practicing. Expanding savings is the best convincing mortgage for any banks that supply agricultural loans.

4.4 IRRIGATION AND DRAINAGE PLAN

4.4.1 Irrigation Plan

(1) Net Irrigation Water Requirement

The crop water requirements (ETcrop) are estimated using the crop coefficients (Kc) set based on the measured values in the respective experimental farms of ICITID. The net irrigation water requirements are estimated based on the water balance among ETcrop, effective precipitation and effective soil moisture for 2 cases: 80% probability (5 year probability) for the facility planning and 50% probability (2 year probability) for the estimation of its operation cost. The net irrigation water requirements for respective crops in the Project Area during April to September estimated based on the rainfall records between 1950 and 1993 in Adjud Station and the results of pedological study of the Study Area are shown in **Table 4.4.1**.

The unit irrigation water requirement of 1,460 m^3/month/ha in July for maize, which is the major crop in the Project Area, is set as a net irrigation water requirement for planning the Booster Pumps (SPPs). On the other hand, the maximum weighted unit irrigation water requirement of 1,244 m^3/month/ha in consideration of cultivated-area ratio of crops (excluding grape) to be introduced with the Project, which appears in July, is set as the unit irrigation water requirement for the Distribution Canals (CDs) and the Distribution Pumps (SRPs).

(2) Irrigation Efficiency

The irrigation efficiency (Ep) is estimated using the following formula:

$$Ep = Ea \times Eb \times Ec$$

where; Ea : Field application efficiency
Eb : Distribution efficiency
Ec : Conveyance efficiency

In consideration of the operation conditions of the introduced system and the present conditions of similar irrigation projects in Romania, Ep' (Ea x Eb) is set as 80.8% for SPPs and Ep at 72.7% for CDs and SRPs by assuming Ea=85%, Eb=95% and Ec=90%.

(3) Gross Unit Irrigation Water Requirement

The gross irrigation water requirements for the facility planning are estimated to be 0.810 and 0.305 lit/s/ha for arable land without vineyard and the vineyard at the SPPs level. On the other hand, one for the SRPs level is estimated to be 0.636 lit/s/ha for arable land without vineyard. In the case of vineyard is included in the area, the gross unit irrigation water requirements are calculated in consideration of the ratio of vineyard area against the area of upland crops.

(4) Irrigation Method

In the Project facility plan, all of the irrigation system is planned with the sprinkler method, considering the proposed crops and crop rotation, soil and topographic conditions, O/M costs for the facilities, etc. In the original plan of the Project, the furrow irrigation is proposed for 185 ha and mixed irrigation method for 1,278 ha. In the Project, all of them are changed to sprinkler irrigation areas. In case of furrow irrigation being desired, it can be applied by regulating the water pressure from the hydrants of lateral pipes with pressure regulators.

(5) Irrigation Block

The Project Area divided by 4 major tributaries, the Carecna, Zabraut, Susita and Putna rivers is allotted into 49 irrigation blocks in total by the distribution canals which run along the contour line at 25 to 60 m hight interval and the existing roads in the area as shown in **Table 4.4.2**.

(6) Irrigation System

Based on the irrigation water requirements and the finally allotted irrigation blocks, the proposed irrigation system of the Project is determined as shown in **Fig 4.4.1** and **4.4.2**.

(7) Phasing due to the Progress of Siret-Baragan Canal

The main water source for the Project is the Calimanesti Dam and Siret-Baragan Canal which intakes water from the Calimanesti Dam. The major construction of the Calimanesti Dam was completed by RENEL in 1992. The Siret-Baragan Canal between the intake and 5.5 km point where the main pumping station (SRP-V) of the Project locates and intake gates has completed by the Ministry of Water, Forest and Environmental Protection (MoE).

For the remaining canal portion related to the Project between 5.5 km point and 32 km point where the south-edge booster pumping station SPP-27 locates, MoE does not have any definite construction schedule. Therefore, the implementation of a part of the Project Area to be irrigated with the water directly lifted from the Siret-Baragan Canal section downstream the SRP-V will be deleted due to the probable delay of the construction of that section of the Canal. The total