The field irrigation requirement of each irrigation time is estimated to be 66.49 mm applying field irrigation application efficiency of 85 %. This is equivalent to 1,063.8 lit/min. Unit discharge of sprinkler needs 47.87 lit/min (or 2.87 m3/hr). Considering the availability in the Romanian market, the sprinkler type can be determined to be of diameter 7 mm with pressure 3.5 kgf/cm^2. The required number of sprinklers per line is 22 sets, and water quantity per line becomes 18.8 lit/s. In this case, the irrigation water intensity is 7.1 mm/hr, which is within the allowable intensity for the soil type. The irrigation interval is estimated at 9.4 hr, which is less than the assumed sprinkling time of 10 hr.

2) Lateral Pipes

Lateral pipes distribute pressured water from hydrant to sprinklers. Normally aluminum made pipes with 6 m long and 10mm diameter is used as a lateral pipes considering the manual installation and shifting. They are connected by handle and sprinklers are installed on the pipe. The minimum pressure at 3.5 kgf/cm^2 shall be kept in the lateral pipes.

4.7.2 Drainage Facilities

Totally 69 drains with 136 km long drainage canal are provided. They are discharged to the natural rivers. The field drains are constructed as an earth canal which collects the excess water from field directly and convey to the major drain.
Based on the unit drainage discharge, the drainage canal capacities are determined. They are aligned along the distribution canals, lower side boundary of each irrigation block, roads. Therefore, their slopes are gentle at 1/1,500 to 1/ 2,000. Each drainage canal has shorter distance less than 5.2 km as shown in **Table 4.7.2-A1**. The cross section of the drainage canal is set at the canal bottom of 0.5 and 1.0 m widths with side slope 1 to 1.5 covered with grass. The canal height is changeable from 0 to 2.6 m. Standard section of the drainage canal is shown in **Fig 4.7.2-A1**.

4.7.3 Soil Conservation Facilities

(1) Level Terrace

The terrace cross section consisting of channel and ridge must be proportioned to fit the land slope, the crops grown and farm machinery used. It is made up of three side slopes known as the cut slope, front slope and back slope. The steeper limits for side slopes are generally accepted as 1:5 for row crops and 1:4 for drill crops. Taking into consideration the depth of top-soil in eroded area, the depth of cut desirable to be designed is less than 50 cm. Also, in consideration of the layout of Artery lines of the irrigation network, the spacing between two terraces has been determined to be 120 m (**Fig 4.7.3-A1**).

The storage capacity of terrace area must be equal to or more than runoff volume:

$S \geq V$

where: S : terrace storage capacity (m^3/m)
V : runoff volume (m^3/m)
V = H.C.L
H: maximum daily rainfall at 10% frequency (=67mm)
C: runoff coefficient (=0.3 for 2-5% slope)
L: spacing between two terraces (=120m)

$V = 0.067 \times 0.3 \times 120 = 2.412$ m^3/m

Slope declination in SCPA is mostly less than 3%. Preliminary designs for the level terrace have been studied for the areas of 2%, 3% and 5% slope of the original ground. Typical cross section of the proposed level terrace for each slope is shown in **Fig 4.7.3-A2**. Design dimensions of level terrace are shown below:

Slope of Land	Maximum Depth of Cut (m)	Cut Slope	Front Slope	Back Slope	Terrace Storage (m^3/m)	Runoff Volume (m^3/m)
2%	0.44	1: 6.0	1: 5.0	1: 5.1	3.09	2.41
3%	0.46	1: 5.5	1: 5.0	1: 4.7	2.94	2.41
5%	0.50	1: 4.6	1: 5.0	1: 4.0	2.70	2.41

(2) Grassed Waterway

Taking into consideration the catchment area and actual conditions, the grassed waterway consists of 3 canal types as shown below. Typical cross section of each canal type is shown in **Fig 4.7.3-A3**. Hydraulic calculation of each canal type is summarized in **Table 4.7.3-A1**. To prevent the longitudinal erosion, the concrete cross beams are planned at interval of 300m. Typical cross section of concrete cross beam is shown in **Fig 4.7.3-A4**.

Length of grassed waterway is as follows:

Sub-SCPA	Canal Name	Type A (km)	Type B (km)	Type C (km)	Total (km)
Panciu	PAN-GW1	1.50	2.00	2.00	5.50
	PAN-GW2	1.50	2.00	2.00	5.50
Movilita	MOV-GW1	2.00	2.50	2.50	7.00
	MOV-GW2	2.00	2.00	2.50	6.50
	MOV-GW3	0.00	2.00	2.00	4.00
Paunesti	PAU-GW1	0.00	1.00	1.50	2.50
	PAU-GW2	0.00	1.00	1.00	2.00
Total		7.00	12.50	13.50	33.00

Number of concrete cross beams are as follows:

Sub-SCPA	Canal Name	Type A (nos.)	Type B (nos.)	Type C (nos.)	Total (nos.)
Panciu	PAN-GW1	5	7	7	19
	PAN-GW2	5	7	7	19
Movilita	MOV-GW1	7	9	9	25
	MOV-GW2	7	7	9	23
	MOV-GW3	0	7	7	14
Paunesti	PAU-GW1	0	4	5	9
	PAU-GW2	0	4	4	8
Total		24	45	48	117

(3) Boundary Drainage Canal (BDC)

1) Design Discharge

Based on the Romanian Design Manual for Soil Conservation, the flood of 10-year return period is adopted as design discharge for BDC. Design discharges for BDC have been estimated with the rational formula as follows:

$Q = 0.167 \times c \times i \times A$

where:
- Q: peak discharge (m^3/s)
- c: runoff coefficient (=0.4)
- i: rainfall intensity (mm/min) within time of flood concentration (t) (**Fig 4.7.3-A5 and Table 4.7.3-A2**)
- A: catchment area (ha)

Canal Name	Time of Concentration (min)	Rainfall Intensity (mm/min)	Catchment Area (ha)	Design Discharge (m^3/s)
TIF-BD1	65.3	0.584	345	13.46
MOV-BD1	68.7	0.574	215	8.24
MOV-BD2	66.1	0.582	200	7.77
PAU-BD1	48.4	0.739	325	16.05
PAU-BD2	75.7	0.553	265	9.79

Note: Calculation of time of concentration is shown in **Table 4.7.3-A2**

2) Canal Type and Hydraulic Calculation

TIF-BD1 Canal (L=3.50 km, Qmax=13.46 m^3/s)

Longitudinal profile of TIF-BD1 Canal is shown in **Fig 4.7.3-A6.** Canal types for TIF-BD1 consist of the following 5 types and their typical cross sections are shown in **Fig 4.7.3-A11**. Four drops are required. Two box culverts are required at the cross with regional road and farm road. Hydraulic calculation for each canal type is summarized in **Table 4.7.3-A3**.

Section (m)	0-500	500-1,350	1,350-2,000	2,000-2,850	2,850-3,500
Slope (I)	1/250	1/200	1/200	1/200	1/200
Canal Type	Earth Canal	G	E	B	A
B x H		2200x1200	2000x1000	1000x1000	500x500
Capacity (m^3/s)	13.46	13.46	9.40	6.12	0.96
Related facilities		4 Drops	2 BC	1Drop	1 BC

Note: B=width of canal bed (mm), H=height of sidewall (mm), BC = Box Culvert

MOV-BD1 Canal (L=3.30 km, Qmax=8.24 m^3/s)

Longitudinal profile of MOV-BD1 Canal is shown in **Fig 4.7.3-A7**. Canal types for MOV-BD1 consist of the following 5 types and their typical cross sections are shown in **Fig 4.7.3-A11**. The shute works is required at the most downstream section. Five box culverts are required at the cross with regional road and farm road. Hydraulic calculation for each canal type is summarized in **Table 4.7.3-A3**.

Section (m)	78-300	300-1,300	1,300-2,300	2,300-2,800	2,800-3,300
Slope (I)	1/8	1/200	1/200	1/100	1/100
Canal Type	Chute works	D	C	B	A
B x H		1700x1000	1500x1000	1000x1000	500x500
Capacity (m^3/s)	8.24	8.24	7.79	6.27	1.11
Related facilities	Chute works	1 BC	3 BC	1 BC & 1Drop	

Note: Earth canal has be planned from 0 to 78 m

Based on the jet flow hydraulic calculation of chute works as **Table 4.7.3-A4**, hydraulic conditions at the end of chute are as follows:

Discharge:	Q = 8.24 m^3/s
Canal width:	B = 3.00 m
Unit discharge:	q = 2.75 $m^3/s/m$
Water depth:	d!= 0.260 m
Velocity:	V = 9.962 m/s
Froude number:	F = V/(gd)^0.5= 6.24

USBR type-III (**Fig 4.7.3-A12**) has been selected as stilling basin of the chute works. This type of stilling basin is used in the following cases:

- when there is a low water head and small discharge of under 18.5 $m^3/s/m$ in term of the unit width.
- when the flow speed is below approx. 18 m/s.
- when the Froude number of the inflow nappe is over 4.5.

Design conditions of the stilling basin are as follows:

Height of chute block:	h1 = 1.0 d1 = 0.260 = 0.30 m
Height of baffle pier:	h3 = 1.7 d1 = 0.442 = 0.50 m
Height of endsill:	h4 = 1.3 d1 = 0.338 = 0.40 m
Tailwater depth:	d2 = 1/2*((1+8F2)0.5 -1)*d1 = 2.168 = 2.20 m
Length of stilling basin:	L3 = 2.6 d2 = 5.72 = 6.00 m

MOV-BD2 Canal (L=3.50 km, Qmax=7.77 m^3/s)

Longitudinal profile of MOV-BD2 Canal is shown in **Fig 4.7.3-A8**. Canal types for MOV-BD2 consist of the following 5 types and their typical cross sections are shown in **Fig 4.7.3-A11**. The shute works is required at the downstream. Four bridges are required at the cross with regional road (Movolita-Ciorani). Hydraulic calculation for each canal type is summarized in **Table 4.7.3-A3**.

Section (m)	0-244	244-380	380-1,500	1,500-2,500	2,500-3,500
Slope (I)	1/250	1/2.8 or 1/12	1/200	1/200	1/100
Canal Type	Earth Canal	Chute works	C	B	A
B x H			1500x1000	1000x1000	500x500
Capacity (m3/s)	7.77	7.77	7.77	6.12	1.11
Related facilities		Chute works		2 BC & 1 drop	2 BC

Based on the jet flow hydraulic calculation of chute works as **Table 4.7.3-A5**, hydraulic conditions at the end of chute are as follows.

Discharge:	Q = 7.77 m3/s
Canal width:	B = 3.00 m
Unit discharge:	q = 2.59 m3/s/m
Water depth:	d1= 0.187 m
Velocity:	V = 13.850 m/s
Froude number:	F = V/(gd)^0.5= 7.56

With the same reason for MOV-BD1, USBR type-III has been selected as stilling basin of the chute works. Design conditions of the stilling basin are as follows:

Height of chute block:	h1 = 1.0 d1 = 0.187 = 0.20 m
Height of baffle pier:	h3 = 1.8 d1 = 0.337 = 0.40 m
Height of endsill:	h4 = 1.4 d1 = 0.262 = 0.30 m
Tailwater depth:	d2 = 1/2 * ((1+8F2)0.5 -1) * d1 = 1.908 = 2.00 m
Length of stilling basin:	L3 = 2.7 d2 = 5.40 = 6.00 m

PAU-BD1 Canal (L=2.85 km, Qmax=16.05 m^3/s)

Longitudinal profile of PAU-BD1 Canal is shown in **Fig 4.7.3-A9**. Canal types for PAU-BD1 consist of the following 5 types and their typical cross sections are shown in **Fig 4.7.3-**

A11. Ten drops are required at the downstream. Two box culverts are required at the cross with regional road and farm road. Hydraulic calculation for each canal type is summarized in **Table 4.7.3-A3**.

Section (m)	0-500	500-1,000	1,000-2,000	2,000-2,500	2,500-2,800
Slope (I)	1/200	1/200	1/100	1/100	1/100
Canal Type	H	G	E	B	A
B x H	2500x1250	2200x1200	2000x1000	1000x1000	500x500
Capacity (m^3/s)	16.05	13.93	9.40	6.27	1.11
Related facilities	4 Drops	6 Drops	2 BC	1 Drop	

PAU-BD2 Canal (L=3.20km, Qmax=9.79 m^3/s)

Longitudinal profile of PAU-BD2 is shown in **Fig 4.7.3-A10**. Canal types for PAU-BD2 consist of the following 5 types and their typical cross sections are shown in **Fig 4.7.3-A11**. Two drops are required at the most downstream. One bridge is required at the cross with the regional road (Paunesti-Ruginesti). Hydraulic calculation for each canal type is summarized in **Table 4.7.3-A3**.

Section (m)	0-1000	1,000-2,000	2,000-2,700	2,700-3,200
Slope (I)	1/200	1/200	1/200	1/100
Canal Type	F	C	B	A
B x H	2200x1000	1500x1000	1000x1000	500x500
Capacity (m^3/s)	9.79	7.79	6.12	1.11
Related facilities	1BC & 2Drops	2 BC	2 BC & 1 drop	

3) Canal Length by Type and Related Facilities

Length of each canal type is shown in **Table 4.7.3-A6**. Drops and box culverts are listed in **Table 4.7.3-A7**. Related facilities in BDC are shown in **Fig 4.7.3-A13**.

(4) Gully and Ravine Control Works

1) Sabo Dam

Based on the economical and technical viewpoints, a concrete gravity dam is selected as Sabo dam. It is consist of two types, type-A and type-B, and its preliminary designs are shown in **Figs 4.7.3-A14** and **A15**.

Dam Type	Dam Height	Name of Dam
A	6.0 m	PAU-D4, PAU-D5
B	4.0 m	MOV-D1, PAU-D1, PAU-D2, PAU-D3

2) Soimului Canal

Design Flood Discharge

For the estimation of the 10-year flood discharge at the base point (catchment area=3,420 ha) of the Soimului canal, the following formula is applied. Location of the base point is shown in **Fig 4.7.3-A16**.

$Q = 0.28 \times I \times C \times A^{1-n}$ ..... $10\ km^2 < A < 100\ km^2$

where: Q: peak discharge (m^3/s)
I: rainfall intensity
$I = k \times H_{24} = 0.8 \times 67 = 53.6$ mm
C: runoff coefficient (=0.4)
A: catchment area (=34.2 km^2)
n: coefficient (=0.4)

$Q = 0.28 \times 53.6 \times 0.4 \times 34.2^{(1-0.4)} = 48.3\ m^3/s$

Flow Capacity of Soimului Canal

For the estimation of the flow capacity of the Soimului canal after rehabilitation works, the Manning's formula is applied. Cross section of the Soimului canal after dredging is shown in **Fig.4.7.3-A17**.

$Q = A \times V$
$V = (1/n) \times R^{2/3} \times I^{1/2}$
where: Q: discharge (m^3/s)
A: area of canal (=15.00m^2 : from ISPIF design data)
V: velocity (m/s)
n: coefficient of roughness
earth canal: n=0.035, concrete lining: n=0.015
R: hydraulic radius (=A/P =1.281m)
P:wetted perimeter (=11.711m)
I: gradient of canal (=1/500 : from ISPIF design data)

In the case of earth canal

V = (1/0.035) x (1.281^0.667) x (0.002^0.5)= 1.50 m/s
$Q = 15.00 \times 1.50 = 22.5\ m^3/s < Q_{base\ point} = 48.3\ m^3/s$: a new floodway is required

In the case of concrete lining canal

V = (1/0.015) x (1.281^0.667) x (0.002^0.5)= 3.52 m/s
$Q = 15.00 \times 3.52 = 52.8\ m^3/s > Q_{base\ point} = 48.3\ m^3/s$:a new floodway is not required

4.7.4 Rural and O/M Roads

Totally 29 lines of road are to be improved with length of 85.1 km or newly constructed with length of 97.1 km. Their locations and stretches are shown in **Fig 4.7.4-A1**. Summary of the rural and O&M roads are shown in **Table 4.7.4-A1**. Their standard cross sections are shown in **Fig 4.7.4-A1**.

(1) Artery Road

The improvement of four artery roads is planned for their widths and surface pavement with total length of 31.3 km. The standard width is considered to be of single traffic lane on both directions with asphalt pavement (Romanian standard class V road). Totally 17 canal crossing structures of reinforced concrete culvert type are required newly, and some existing bridges and culverts shall be rehabilitated.

(2) Secondary Road

Eight secondary roads, which are mostly secondary district roads or community roads, shall be improved for their widths and surface pavements with total length of 53.8 km. Their class of the road shall be the same as the above artery road. However, the pavement shall be made with gravel. Totally 10 canal crossing structures are required.

(3) Operation & Maintenance Road

Totally 17 lines of operation and maintenance roads with 97.1 km long shall be constructed newly. They are aligned on hillside along the distribution canals along which most of SRPs/SPPs are located. 8 canal crossing structures of reinforced concrete bridge or culvert types are required.

CHAPTER 5: PROJECT IMPLEMENTATION AND OPERATION & MAINTENANCE

CHAPTER 5 : PROJECT IMPLEMENTATION AND OPERATION & MAINTENANCE

5.1 PROJECT IMPLEMENTATION SYSTEM

5.1.1 Project Implementation Method

The Project Implementation Agency shall execute the detailed design of the Project facilities, preparation of tender documents, tendering and tender evaluation, selection of the contractor, signing the contract and supervision of the construction works with the assistance of the Consultant to be contracted prior to the commencement of the Project. The Consultant shall assist the Implementation Agency mainly for the technical matters involved in the duties of the Implementation Agency.

The construction works shall be performed on the contract basis by the successful contractor(s). All the construction machinery required for the construction works shall be provided by the contractor(s) itself(themselves). The materials necessary for the construction works shall be procured from domestic and/or international markets under the full responsibility of the contractor(s).

5.1.2 Project Implementation Agency

(1) General

The Implementation Agency for the Project shall be RAIF of MAF. Formerly LRD had been responsible for the execution of such construction works. It was reorganized, however, to RAIF together with its full rights and responsibilities as part of the restructuring of MAF in October 1994 (**Fig 5.1.2-A1**). Therefore, RAIF has sufficient capability for fulfilling its responsibilities in implementing the Project without any troubles. Furthermore, RAIF shall establish the Project Office under the branch office of RAIF in Focsani in order to implement the Project successfully in consideration of the distance between the Project Area and the Headquarters of RAIF in Bucharest. The proposed Project Organization Chart is shown in **Fig 5.1.2-A2**.

(2) Project Office

It is recommended that the present RAIF Marasesti Workshop be used as the Project Office by improving its facilities. The proposed staff members of the Project Office are proposed as shown below. This Project Office shall be used as the O/M Office of the Project after the completion of the construction works of the Project facilities.

Position	Number
Manager	1
Asst. Manager (Civil Eng. & Admi.)	2
Civil Engineer	3
Asst. Civil Engineer	3
Mechanical Engineer	2
Asst. Mechanical Engineer	3
Electrical Engineer	1
Asst. Electrical Engineer	2
Secretary	1
Administration	4
Diver	5
Others	3
Total	30

(3) Consultant

The Consultant shall provide the Implementation Agency mainly with the technical services on the contract basis. The consulting services involve the detailed design work and evaluation of tender in the Detailed Design Phase and supervision of the construction works such as their workmanship, programming and safety control in the Construction Phase. The Consultant shall be composed of highly qualified engineers and experts specialized in project planning, detailed design, construction, hydrology, geology, etc. The Consultant is also expected to undertake the technology transfer to local engineers of the Implementation Agency. Above all, seminars on the quality control of workmanship and irrigation water management will be included in the scope of the consulting services. The estimated man-months (M/M) for the above consulting services are 69 M/M and 318 M/M for foreign and local components, respectively, totaling 387 M/M as shown below (**Table 5.1.2-A1**):

(Unit: M/M)

Detailed Design Phase			Construction Phase			Total		
Foreign	Local	Sub-total	Foreign	Local	Sub-total	Foreign	Local	Total
27	57	84	42	261	303	69	318	387

5.2 CONSTRUCTION SCHEDULE

The implementation period of the Project construction works is set as 60 months in total consisting of 12 months for the Detailed Design Phase and 48 months for the Construction Phase. During the Detailed Design Phase, the topographic survey and geological investigation of the sites proposed for the main structures, detailed design work, preparation of tender documents, etc. are to be performed. On the other hand, during the Construction Phase, the acquisition of land for the proposed structures, tendering, the construction works of the Project facilities, procurement of operation/maintenance (O/M) equipment, etc. are to be conducted (**Fig 5.2.1-A1**).

5.2.1 Detailed Design Phase

During the Detailed Design Phase, the detailed design of the required Project facilities is to be completed. The review of the design only is required for some of the Project facilities the design of which has already been finished by MAF. However, some modifications or changes are proposed for some of the Project facilities/structures. For such facilities/structures, redesigning of them based on the results of the detailed topo-survey of the respective sites and/or geological investigation at the sites to be conducted newly is definitely necessary. After the detailed design of the Project facilities is completed, the following documents necessary for the Tendering of the Project construction works are to be prepared. The period required for the Detailed Design is set as 12 months.

- Prequalification Documents
- General Specifications
- Special Specifications
- Technical Specifications
- Tender Drawings
- Bill of Quantities
- Cost Estimation
- Construction Schedule
- Others

5.2.2 Construction Phase

(1) Land Acquisition

Prior to the commencement of the construction works of the Project, the lands required for the Project facilities such as pump stations (SRPs and SPPs), distribution canals (CDs), siphons, farm roads and soil conservation facilities shall be acquired by RAIF, MAF.

(2) Tendering and Contract

After the completion of the tender documents, the prequalification and short listing of the interested contractors are to be conducted. Tendering shall be conducted on the basis of the International Competitive Bidding (ICB) and contract procedures for the above prequalified contractors and the contractor(s) to perform the construction works shall be selected among them. The Project will be divided into 4 civil work lots, based on the present condition and scale of construction volume also the consideration of early start of irrigation, as shown in **Fig 5.2.2-A1**. The tender evaluation and contract signing follow the above tendering. The period required for the Construction Phase is set as 36 months.

(3) Implementation of Construction Works

In order to realize the expected objectives of the Project as soon as possible, the construction works shall be shortened as much as possible by overlapping the respective works in due consideration of the anticipated inconvenience by the overlapping of the construction works. In preparing the proposed construction schedule, the phasing of the construction works by focusing the completed section of the Main Canal and almost completed main distribution pump station SRP-V is also considered in order to facilitate the production of crops under irrigation. The proposed general construction schedule is as shown in **Fig 5.1.3**.

5.3 PROJECT COST

The Project cost consists of the construction cost, land acquisition cost, O/M equipment procurement cost, administration cost, consulting services cost, and physical and economic contingencies.

5.3.1 Condition of Cost Estimate

The Project cost is estimated on the following conditions:

a. The basic costs such as labor cost, material cost and equipment cost are based on the unit costs adopted by RAIF;
b. The requirements per unit work are based on the standard adopted by RAIF;
c. The unit price with indirect cost is estimated by the method and ratio adopted by RAIF as shown in **Table 5.3.1-A1**;
c. The prices of domestic materials are based on those including transportation of them to the construction sites. On the other hand, the prices of the imported materials are based on the material CIF Constanta price plus domestic transportation cost and import tax;
d. The construction cost are estimated with foreign and local components. However, US$ is used for both components. The unit costs for respective work items consist of direct cost and indirect cost, and the indirect cost is set as 35% of the direct cost in accordance with the regulation of RAIF;
e. The exchange rate used is US$ 1.00 = Lei 1,753 as of October 1994; and
f. The physical contingency is set as 10% of the construction cost and other costs. The economic contingency is set as 3% per annum.

5.3.2 Project Cost

(1) Construction Cost

The construction cost is estimated with the foreign and local portions at the proposed tendering lots as shown in **Fig 5.2.2-A1**. The foreign portion covers a part of steel works including pumps, construction equipment, electrical equipment, fuel for construction equipment, etc. The annual disbursement of the construction cost is determined based on the proposed schedule of the construction works.

The construction cost consists of the following construction items:

- Preparatory works for the construction;
- Irrigation works including mechanical works such as pumps and gates;
- Drainage works;
- Soil conservation works;
- Road improvement works; and
- Construction of Project Office .

The total construction cost is estimated to be 72×10^6 US$ which includes the foreign portion of 11×10^6 US$ (15%) as shown below (**Table 5.3.2-A1** and **A2**):

(Unit : 10^3 US$)

Description	L/C	F/C	Total
1. Preparatory Works	2,920	515	3,435
2. Irrigation Works	52,037	9,183	61,220
3. Drainage Works	987	174	1,161
4. Soil Conservation Works	1,654	292	1,946
5. Road Improvement Works	3,369	595	3,964
6. Project Office	336	60	399
Total	61,306	10,819	72,125

(2) Land Acquisition Cost

The acquisition cost of lands necessary for the construction of the Project facilities such as the pump stations (SPPs and SRPs), distribution canals (CDs) including maintenance roads and drainage canals, farm roads and soil conservation facilities including Sabo dams and flood control canals is estimated to be $6,171 \times 10^3$ US$ in total and allotted for the local portion (**Table 5.3.2-A1** and **A2**).

(3) O/M Equipment Procurement Cost

The following O/M equipment for the operation and minor repair works is to be procured by the Project Implementation Agency at the 2nd year of the construction period and it shall be renewed at times when its useful life is expired. The procurement cost of the O/M equipment is estimated to be 494×10^3 US$ and allotted for the foreign portion and, and 25×10^3 US$ of handling charge and other expenses in Romania for the local portion (**Table 5.3.2-A3**).

Name	Requirement	No.	Name	Requirement	No.
Bulldozer	11 ton	1	Pick-up Truck	2 ton	5
Back Hoe	0.6 m^3	1	Motorcycle	125 cc	10
Dump Truck	6 ton	1	Concrete Mixer	350 lit	1
Motor Grader	3.1 m	1	Communication Equip.		5

(4) Administration Cost

The administration cost necessary for the operation of the Project Office includes procurement of office supplies, payment to the office staff, general expenses, etc. The annual administration cost is estimated to be $430x10^3$ US$ and allotted local portion (**Table 5.3.2-A4**).

(5) Consulting Services Cost

The cost for the provision of the consulting services is estimated to be $4,115x10^3$ US$ consisting of $1,456x10^3$ US$ for the Detailed Design Phase and $2,659x10^3$ US$ for the Construction Phase. The proportion of the foreign component is 56.6% and that of the local one is 43.4% (**Table 5.3.2-A5**)

(Unit: 10^3 US$)

Detailed Design Phase			Construction Phase			Total		
Foreign	Local	Sub-total	Foreign	Local	Sub-total	Foreign	Local	Total
950	506	1,456	1,378	1,281	2,659	2,328	1,787	4,115

(6) Project Cost

As a result of the above and disbursement schedule, the Project Cost is estimated to be $93x10^6$ US$, the foreign component of which represents $15x10^6$ US$ (16.2%) and the local component $78x10^6$ US$ (83.8%).

(Unit : 10^3 US$)

Description	L/C	F/C	Total
1. Construction Works	61,307	10,818	72,125
2. Land Acquisition	6,171	0	6,171
3. Procurement of O/M Equipment	25	494	519
4. Administration	1,507	0	1,507
5. Consulting Services	1,787	2,328	4,115
Sub-total (1-5)	70,797	13,640	84,437
6. Physical contingency (10%)	7,080	1,364	8,444
Sub-total (1-6)	77,877	15,004	92,881
7. Economic Contingency	11,637	2,248	13,885
Total (1-7)	89,515	17,254	106,769

The disbursement of the Project Cost is to be made in 5 years. The proportions of the disbursement for each year are 0.1% for the first year, 3.5% for the second, 36.6% for the third, 43.7% for the forth and 16.1% for the fifth (**Table 5.3.2-A6**).

5.4 OPERATION AND MAINTENANCE

5.4.1 Operation and Maintenance Method

The operation and maintenance (O/M) of the irrigation facilities from the main and re-pumping pump stations (SRPs) to the booster pump stations (SPPs) and also the maintenance of the soil conservation facilities shall be made by RAIF. The control system of the above pumps shall be the same as the one having been adopted by the former SCELIF for the time being. The improvement of the control system shall be considered step by step with the improvement of the farming technology and the financial level-up of the farmers involved in the Project. On the other hand, the O/M of the lateral lines (As) including the control of valves at hydrants are to be made by the water users' associations which shall be organized newly by the beneficiaries within the respective irrigation blocks. The proposed O/M organization is shown in **Fig 5.4.1-A1**.

Furthermore, it is recommended that the duties and responsibilities of RAIF for the O/M of the Project facilities shall be transferred item by item and step by step to the water users' associations with the aggressive improvement of the organization of the water users' associations through confirming the improvement of capability of the associations for dealing with the objective items.

5.4.2 Operation and Maintenance Office

RAIF shall have the overall responsibility for the O/M of the main Project facilities. The O/M Office shall be reorganized from the above-mentioned Project Office. The main duties of the O/M Office are as follows:

- Operation and maintenance of the main Project facilities such as SRPs and SPPs;
- Maintenance of the CDs including the O/M roads along CDs and other farm roads;
- Maintenance of the soil conservation facilities;
- Instruction to the water users' associations on O/M of valves at hydrants, etc.; and
- Collection of water charge from the users.

The required staff members of the O/M Office are proposed as follows:

Management Section		Pump Operation Section		Irrigation Facility Maintenance Section		Soil Conservation Facility Maintenance Section	
Position	No.	Position	No.	Position	No.	Position	No.
Manager	1	Chief	1	Chief/Mech. Eng.	1	Chief/Civil Eng.	1
Asst. Manager	1	Asst. Chi.	2	Asst. Mech. Eng.	2	Asst. Civil Eng.	3
Accountant	1	Operator	156	Electric Engineer	2	Driver	1
Driver	2	Monitor	10	Equip. Operator	4	Others	2
Others	2	Others	2	Asst. Equip. Oper.	4		
				Welder	1		
				Driver	5		
				Others	2		
Sub-total	7	Sub-total	171	Sub-total	21	Sub-total	7
						Total	206

5.4.3 Operation and Maintenance Cost

Based on the proposed staff of the O&M office, actual expenditure of similar project and estimated pump operation electricity fares, the annual operation and maintenance cost is 2,472,900 US$ as shown below (**Table 5.4.3-A1**):

Item	Amount (US$)
1. Salary	309,400
2. Repayment of O/M Equipment	51,900
3. Cost of Spare Parts	18,400
4. Other Office Running Cost	547,600
5. Electricity for Pumps Operation	1,545,600
Total	2,472,900

Furthermore, some of the mechanical items and heavy equipment shall be renewed due to their shorter durability than the Project life. Sixty percent (60%) of the initial cost of pump equipment, pipes and gates or $1,500 \times 10^3$ US$ as the partial replacement in 15 years after new installation and the total replacement at $2,500 \times 10^3$ US$ in 25 years after new installation is estimated and used for the evaluation of the Project.

CHAPTER 6: PROJECT EVALUATION

CHAPTER 6 : PROJECT EVALUATION

6.1 BASIS OF EVALUATION

6.1.1 Approach

The project evaluation method to assess the Project for validity of its implementation includes economic evaluation, financial evaluation, socio-economic evaluation (effect) and environmental analysis. Emphasis is placed on the economic evaluation since the main objective of the Project is agricultural development, and public profitability is also emphasized. The financial evaluation is oriented to the investment and disbursement plan and farm households economic analysis. The basic approach of the project evaluation conforms to the methodology and criteria adopted by the international organizations and the adopted parameters are related to MAF.

6.1.2 Conditions of Evaluation

The evaluation criteria used in the economic and financial evaluations are as follows:

a. The project life is set as 50 years from the commencement of the Project including detailed design period and construction works period, considering the vital life periods of the Calimanesti Dam and the Siret-Baragan Canal.
b. The currency used for the estimation is US$.
c. The exchange rate used is US$ 1.00 = Lei 1,753 as the official exchange rate of the National Bank of Romania as of October 1994.
d. The prices of agricultural products are farm-gate prices and the prices of agricultural production materials and construction materials are prices on delivery at the production and construction sites.

Problems involved in determining prices in Romania in this moment are rapid inflation and Romanian currency depreciation (**Table 6.1.1-A1**). It is evident that all the costs and benefits based on Romanian internal price in this period must be treated carefully. As a result of the considerable difficulties associated with internal economic instability of Romania, all the prices for the project evaluation are calculated in US$ with reference to actual market price in October 1994, and Lei values have been converted to US$ at the rate appropriate to the time when lei value was observed.

6.2 BENEFIT OF THE PROJECT

6.2.1 Estimation of Benefit

The benefit of the Project refers to a difference of net profit expected between with Project and without Project conditions under irrigation and soil conservation developments through the whole project life. The project benefit consists of quantifiable benefit; i.e. an increase in agricultural production and unquantifiable benefit such as stabilized food supply, creation of employment opportunities and improvement of living standard of rural people. Quantifiable benefit is directly subjected to economic and financial evaluations, while unquantifiable benefit is integratedly analyzed for socio-economic effects.

The benefit from the construction of operation and maintenance roads along the canals and the improvement of existing farm roads is considerable as a saving of transportation time and cost, decrease of damage on transportation goods etc. and they can be tangible at some part. Therefore, improvement of transport facilities will be uncertain and the benefit is judged

extremely small as compared with the main one, and is not taken into account. Furthermore, the agricultural production benefit is considered only for the primary production and the benefit from the value-added secondary production such as wine and livestock productions is not considered.

6.2.2 Agricultural Production Benefit

(1) Generation of Benefit

The agricultural production benefit including wine and livestock productions is derived from an increase in cropping rate, a change of cropping pattern and an increase in unit yield which is resulted from introduction of the irrigation system and effective production practices. 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.

(2) Annual Variation of Benefit Accrual

On the with-Project condition, the gestation period before maturing of production depends on two constituents as follows:

a. Secular change in irrigation area which occurs in the process of construction works and in accordance with the maturity of irrigation control system.
b. Secular change in yield in the course to the maturity of production practice.

The estimated progress of the construction works by year order is as shown below:

Year order	Area (ha)	Portion (%)	Accumulation (%)
1	0	0	0
2	0	0	0
3	0	0	0
4	7,132	31.9	31.9
5	10,881	48.7	80.6
6	4,347	19.4	100.0
Total	22,360	100.0	100.0

The benefit is generated from the next year of the completion of construction works the farm land of which can be irrigated and the targeted benefit can be attained on the third year after completion of construction. Annual variation of the total irrigation area including Phase I (17,409 ha) and Phase II (4,951 ha) is as follows: 5th year of the Project is 7,132 ha (32%), 6th year is 18,013 ha (81%) and 7th year is 22,360 ha (100%). While the proportion of the reduced benefits until the third year is 40% on the first year and 20% on the second year (**Table 6.2.2-A1 and Fig 6.2.2-A1**).

On the other hand, on the without-Project condition, some increase in agricultural production is considerable by effects except for the implementation of the Project, but at the same time, some decrease of production is prospected on account of the reducing trend on national level and long term, the trend of drought, etc. Accordingly, the production on the without-Project condition is not changed and remains constant as same as the present condition.

The agricultural production benefit in financial price is summarized below:

(Unit: 10^3 US$)

Item	With Project	Without Project	Increased Value
Gross Production Value	64,071	11,763	52,308
Production Cost	17,767	4,056	13,710
Net Production Value	46,305	7,707	38,598

Annual net production value on the with-Project condition is about $46x10^6$ US$, about 6.0 times that of the without-Project condition, and the annual agricultural production benefit is about US$ $39x10^6$ US$ (**Table 6.2.2-A2** up to **A8**).

6.2.3 Soil Conservation Benefit

(1) Generation of Benefit

The soil conservation countermeasures are closely related to the agricultural production concerning stability and recovery of the productivity of soils. In this sense, the project benefit from the soil conservation plan is considered as an avoided damage of agricultural production to be caused by soil erosion in the arable land, including a concept of soil productivity, damage of irrigation facilities, efficiency of production works and transportation, etc. It means that the benefit is a deference of decreased net production values between without-Project and with-Project conditions. The benefit is generated only from a part of the arable land.

(2) Annual Variation of Benefit Accrual

According to the existing ISPIF's soil conservation projects, the countermeasure works against the soil erosion resulted in some higher crop yields, obtaining as an average increment of 15-20% or 20-25% against the yields obtained before countermeasure. Furthermore, according to the report "Instructions for Studies and Necessary Calculations for Soil Erosion Control Design, MAF", the yield decreases averagely by 15% on moderately eroded soils and 50% on strongly eroded soils. The decreasing rates of agricultural productivity used in the estimation as compared with normal yields are as follows:

a. Without Project on the moderately eroded area (1,839 ha): from 15% of the present condition to 50% for the strongly eroded area and on the slightly eroded area (6,822 ha):from 0% of the present condition to 15% for the moderately eroded area in 10 years.
b. With project on both areas: the productivity recovers to the same rates as those of the present condition in 2 years after the completion of countermeasure works (**Table 6.2.3-A1** and **Fig 6.2.3-A1**).

The soil conservation project area is the same as the irrigation development area, and the benefit is generated only from the Phase 1 area. The annual net production value in financial price on the with-Project condition is $7,707x10^3$ US$, 1.12 times that of the without-Project condition, and the annual increase of soil conservation benefit is $835x10^3$ US$ as shown below (**Table 6.2.3-A2** and **A3**):

(Unit: 10^3 US$)

Item	With Project	Without Project	Increased Value
Gross Soil Conservation Value	11,763	10,928	835
Soil Conservation Cost	4,056	4,056	0
Net Soil Conservation Value	7,707	6,872	835

6.3 ECONOMIC EVALUATION

6.3.1 Evaluation Criteria

The economic evaluation is to analyze economic effect of the Project on the basis of economic benefit and economic cost as computed at economic prices in the light of national economy. Based on the incremental benefit and the Project cost (initial investment cost or capital cost),

operation and maintenance cost and replacement cost of the Project, all the prices are converted into economic prices.

The evaluation uses three interrelated indexes: economic net present value (ENPV), economic benefit-cost ratio (E.B/C) and economic internal rate of return (EIRR). The benefit and cost of the Project which are estimated based on implementation schedule of the Project are discounted by the opportunity cost of capital through the project life. The term ENPV is a difference between accumulated benefit and accumulated cost, and E.B/C is the ratio of the former to the latter. The term EIRR means a discount rate by which accumulated benefit is equalized to accumulated cost.

The criteria to economically validate the implementation of the Project are that ENPV is positive, B/C is more than 1 and EIRR exceeds the opportunity cost of capital. The opportunity cost of capital (discount rate) is social marginal productivity of capital input in the Project, and the discount rate in agricultural sector is considered to be 12%. This figure has also been used in all cash flow analyses of " the Study of Irrigation and Drainage in Romania, 1994 " financed by the World Bank. Therefore, it is selected as a reasonable guide to the level of returns that are considered acceptable world widely in agricultural development projects.

6.3.2 Price Conversion

The evaluation in economic prices corrects financial prices (market prices) to reflect distortions in foreign exchange rate, the impacts of taxes, subsidies and rents, and possibly to reflect shadow (economic) wage rates. The adjusted set of prices is used in the evaluation of the costs and benefits of the Project, reflecting their true resource values and thus determining the true economic returns from the Project to Romania.

The economic prices used in the economic estimation correspond to shadow prices. To obtain shadow prices, market prices are subtracted by transfer items other than real resources used for the Project, and the differences obtained are multiplied by the conversion factors to correct distortions of the market prices. However, these conversion factors are not established by the Romanian Government

The prices of import goods such as construction materials are economically estimated using the shadow foreign exchange rate. The inter-bank foreign exchange rate (parallel rate) or the foreign exchange rate of the private money changer (open market) is substantially higher than the official exchange rate. Originally, the parallel rate is not equal to the shadow exchange rate, but has influence on formation of trade commodity prices as taxes and subsidies. Therefore, this evaluation applies the mean inter-bank exchange rate as of October 1994, US$ 1.00 = Lei 1,875 as the shadow exchange rate converted international prices (border parity prices) into prices calculated in the official exchange rate (US$ 1.00 = Lei 1,753). The conversion factor is 1.07.

Main crop farm-gate prices used in the economic evaluation are based on estimated Romanian border parity prices. These crops such as wheat, maize and beans offer foreign exchange benefits. They are either themselves imported or exported or they are direct inputs into livestock feed, thus supporting livestock exports, which remain one of Romanian main sources of export revenues. International trade items in production cost are based on international prices, but otherwise are based on Romanian internal prices, converted to US$, if quantity is extremely small (**Table 6.3.2-A1**). Standard conversion factor and shadow wage rates are not applied for this economic evaluation because of obtainable difficulty on basic and adequate economic data. Opportunity cost of land purchase and compensation are regarded as 0.0.

Salvage value or residual value is considered as a negative cost on the principal structures and equipment which have vital life period at the end of the project life. Sunk cost is taken into consideration for a part of former investments on the Calimanesti Dam and the Siret-Baragan

Canal constructions and the existing irrigation system (Ruginesti-Pufesti-Panciu Project) in the Project Area (**Table 6.3.2-A2**).

(1) Estimation of Benefit

Transfer items to be subtracted in the estimation of the benefit of the Project are as follows:

- Agricultural tax and sales tax (30% of net production value) occupied in production cost;
- Water charge occupied in production cost;
- Subsidy occupied in seed prices (30%) of wheat and sugar beet, and chemicals (70kg/ha) for wheat production;
- Agriculture loan interest occupied in other costs (50%) of production cost;
- Value added tax (18%) imposed and occupied in production cost items; and
- Depreciation cost (80%) of marketing cost occupied in the production cost.

Shadow prices to be applied in the estimation of the benefit of the Project are as follows:

- Farm-gate price of main crops of wheat, maize and beans to be converted to the international prices; and
- Agricultural chemical price in production cost; conversion factor 1.07.

Furthermore, self-labor force of the farmer is valued as a part of production cost and depreciation cost of marketing cost is converted into a part of the initial cost (the total economic price is $11{,}712 \times 10^3$ US$ at the 3rd and 4th year) in economic evaluation. The annual net production value in economic price on the with-Project condition is 59.70×10^6 US$, 5.9 times that of the without-Project condition, and the increase of the annual agricultural production benefit is 49.51×10^6 US$ as follows (**Table 6.3.2-A3** up to **A7**):

(Unit: 10^3 US$)

Item	With Project	Without Project	Increased Value
Gross Production Value	67,985	15,122	52,863
Production Cost	8,285	4,932	3,353
Net Production Value	59,701	10,190	49,510

On the other hand, the annual net soil conservation value in connection with the soil conservation works in economic price on the with-Project condition is 10.19×10^6 US$, 11.3 times that of the without-Project condition, and the increase of annual soil conservation benefit is 1.14×10^6 US$ as shown below (**Table 6.3.2-A8**):

(Unit: 10^3 US$)

Item	With Project	Without Project	Increased Value
Gross Soil Conservation Value	15,122	13,981	1,141
Soil Conservation Cost	4,932	4,932	0
Net Soil Conservation Value	10,190	9,049	1,141

(2) Estimation of Cost

The Project cost is composed of the costs for construction works, land acquisition, equipment procurement for operation and maintenance, project administration, consultant service and physical and price contingencies. However, price contingency is excluded from the project evaluation. Transfer items to be subtracted in estimation of the cost of the Project are as follows:

- Social charge and unemployment fund of salary on labors in the project cost, operation and maintenance cost and replacement cost;
- Some fund charges in the project cost;

- Value added tax (18%) imposed in the project cost, operation and maintenance cost and replacement cost; and
- Facility depreciation cost in the operation and maintenance cost.

Shadow prices applied in estimation of the cost of the Project are as follows:

- Land acquisition and compensation cost; conversion factor 0.0; and
- Foreign exchange rate; conversion factor 1.07.

Transfer items and shadow prices of the sunk cost are also considered. The Project cost in economic price is the sum of $59,110 \times 10^3$ US$ for local currency and $13,735 \times 10^3$ US$ for foreign currency, totaling $72,844 \times 10^3$ US$ as shown in the table below. On the other hand, annual operation and maintenance cost is $5,112 \times 10^3$ US$ and the replacement cost is $2,500 \times 10^3$ US$ (**Table 6.3.2-A9** up to **A10**).

(Unit: 10^3 US$)

Year order	Local Currency	Foreign Currency	Project Cost
1	0	0	0
2	98	0	98
3	812	956	1,768
4	20,825	4,260	25,085
5	27,548	6,293	33,842
6	9,826	2,225	12,052
Total	59,110	13,735	72,844

6.3.3 EIRR, ENPV and E.B/C

The period of evaluation is 50 years of the whole project life. Therefore, replacement cost is required for some machines and equipment with shorter service life at the end of economic vital life of them. These machines and equipment have small residual values at the final year of the project life. If the evaluation proves that EIRR exceeds the opportunity cost of capital in agriculture sector of 12%, ENPV is positive and B/C exceeds 1, it will be judged that implementation of the Project is economically validated.

Table 6.3.3-A1 shows a flow of project cost, operation and maintenance cost and replacement cost and the all the project benefit. Where EIRR of the Project is 20.5% and at discount rate of 12%, ENPV is $137,884 \times 10^3$ US$ at price in October 1994, E.B/C is 2.19 at the same discount rate (**Table 6.3.3-A2**). The Project evaluation has proven that EIRR exceeds the opportunity cost of capital in agriculture sector of 12%, ENPV is positive and E.B/C exceeds 1.0. It is judged that the implementation of the Project is economically validated.

6.3.4 Sensitivity Analysis

The sensitivity analysis shows the sensibility on estimation for variation of the main assumed factors in the project evaluation, and the analysis has been made under the following conditions: 1) 10% increase of the project cost, 2) 10% decrease of the project benefit and 3) 1 year delay of the completion of the construction works.

Increase of the estimated project cost is attributable to the rise of construction material cost and wage and increase of work volume. Decrease of the project benefit is attributable to the increase of the estimated production cost, reduction in the expected yield and fall in farm-gate price of agricultural products, and delay of the completion of the construction works means the delay of occurrence of the benefit. The results of sensitivity analysis of economic evaluation is summarized below (**Table 6.3.4-A1** up to **A6**):

Item	EIRR (%)	ENPV (10^3 US$)	E.B/C
Base	20.5	137,884	2.19
Project cost increased by 10%	20.2	137,776	2.18
Project benefit decreased by 10%	19.4	113,529	1.98
Construction delayed for 1 year	18.8	113,291	2.00

Sensitivity analysis has proven that a change in the construction period has stronger influence on economy of the Project than a change in project cost and project benefit. Furthermore, the implementation of only Phase I portion, EIRR of the Project is 20.2% and at discount rate of 12%, ENPV is 105,195x10^3 US$ at the price as of October 1994, E.B/C is 2.10 at the same discount rate (**Table 6.3.4-A7** up to **A10**).

6.4 FINANCIAL EVALUATION

6.4.1 Evaluation Criteria

The financial evaluation is to evaluate soundness of financial state of the Project, which will generate the justifiable profit with the implementation of the Project, from the viewpoint of the project implementation organization and beneficiary based on financial benefit and financial cost with financial prices (market prices).

The evaluation in financial prices utilizes the actual market prices for inputs and outputs faced by the farmers to calculate their expected gross income and farm profit in order to explore the farm level economic surplus and farmers' ability to contribute to cost recovery of the Project. The financial prices are also used to analyze the cash flow and balance sheets of the whole Project including the operation and maintenance cost and replacement cost, and to analyze the cash flow of project investment and repayment.

6.4.2 FIRR, FNPV and F.B/C

The evaluation uses three same relevant indexes as for the economic evaluation: financial net present value (FNPV), financial benefit-cost ratio (F.B/C) and financial internal rate of return (FIRR). The benefit and cost of the Project which are estimated based on the implementation schedule of the Project are discounted by the financial discount rate through the project life. The term FNPV is a difference between accumulated benefit and accumulated cost, and F.B/C is the ratio of the former to the latter. The term FIRR means a discount rate by which accumulated benefit is equalized to accumulated cost. The criteria to financially validate the implementation of the Project are that FNPV is positive, F.B/C is more than 1.0 and FIRR exceeds the financial discount rate. As the financial discount rate in the agricultural sector, the effective rate of interest on the National Bank of Romania of 10% is used.

The governmental subsidy for the Project is considered as income of the Project. Accordingly, it is possible to evaluate the validity of the implementation of the Project based upon proportion of the governmental subsidy. However, the Project is to be implemented on condition that the subsidy of the Government of Romania covers almost all the part of the project cost, operation and maintenance cost and replacement cost except for a part of the operation and maintenance cost which is to be borne by the farmers as water charge.

Table 6.4.2-A1 shows a flow of the project cost, operation and maintenance cost and replacement cost and all the project benefit. Where FIRR of the Project is 29.9% and at discount rate of 10%, FNPV is 150,851x10^3 US$ at the price as of October 1994, F.B/C is 2.46 at the same discount rate (**Table 6.4.2-A2**). Project evaluation has proven that FIRR exceeds the financial discount rate in agriculture sector of 10%, FNPV is positive and F.B/C exceeds 1.0. It is judged that the implementation of the Project is also financially validated.

Sensitivity analysis in the financial evaluation for three cases stated previously is also carried out under the same condition as for the economic evaluation. The results of sensitivity analysis of financial evaluation are summarized below:

Item	FIRR (%)	FNPV (10^3 US$)	F.B/C
Base	29.9	150,851	2.46
Project cost increased by 10%	27.5	144,308	2.31
Project benefit decreased by 10%	26.8	127,401	2.21
Construction delayed for 1 year	24.7	130,862	2.31

Sensitivity analysis has proven on finance of the Project that a change in the construction period has stronger influence at FIRR and a change in project benefit has stronger influence at FNPV and F.B/C than a change of other items. Furthermore, the implementation of only Phase 1 portion, FIRR of the Project is 28.3% and at discount rate of 10%, FNPV is 115,638x10^3 US$ at the price as of October 1994, F.B/C is 2.35 at the same discount rate (**Table 6.4.2-A9** up to **A11**).

6.4.3 Investment and Repayment

For the implementation of the Project, it is necessary to procure the project cost including the price contingency (price escalation) in foreign and local currencies.

The Project attempts to introduce external loan from an international financial organization to cover expenses mainly to be paid in foreign currency or a certain portion of the total project cost. Expenses to be paid in local currency are to be budgeted in the frame of the public investment account under the responsibility of the Government of Romania. An example of investment and repayment conditions of the foreign loan for the Project indicates that proportion of the foreign loan covers 75% of the total project cost with the annual interest rate of 3%, loan maturity of 30 years, grace period of 10 years and equal annual payment in principal (**Table 6.4.3-A1**).

In the 12th project year, the sum of equal annual reimbursement and interest becomes the maximum of 6,286x10^3 US$. In the 5th project year, the sum of the reimbursed interest of the foreign loan and investment to the Project becomes the maximum of 11,677x10^3 US$. This amount accounts for about 0.17% of the national budget in 1995 (US$ 1.0 = Lei 2,001) and about 1.61% of the budget of MAF (**Table 6.4.3-A2**).

6.4.4 Analysis of Farm Economy

From the results above, the economic impact to an unit farm management expected from the proposed Project is briefly recapitulated as below:

The production cost structure indicates that the major cost components will shift from machinery plus seed/manure costs to water cost for conventional crops and sales tax for perishable cash crops. If a new rate of taxation (30-45%) is employed instead of currently employed rate of 30% of the net profit, the margin derived from vegetables would be considerably eroded from the given estimation. Introduction of vegetables in a state-sponsored project will be ideal for increasing fiscal revenue prior to promising their benefit.

On the other hand, net benefit ratios of crop production are improved by 10-20% through the Project, while those of animal husbandry decline in the case of individual management but increase in the case of associations. Those for winery/vineyard remains at the level of 33-35%. Cropwise ratios show quite mixed results, but generally those for cereals and other

Cropwise ratios show quite mixed results, but generally those for cereals and other conventional crops show a negative gain. Meanwhile, those for vegetables result in a positive gain owing to augmented yield level and constant price levels for inputs.

So far as the net annual agricultural income per farm unit is concerned, contribution from the crop sub-sector including vegetables accounts for an overwhelmingly greater share, reaching 80-90% of the total net income at with-Project stage, or virtually the entire portion of project gain. Whereas, that from livestock sub-sector is limited, because its cost-benefit ratio is quite low as compared with that of crop and the acreage under forage crop is also limited. As regards vineyard and winery sub-sectors, the management will have to be radically rationalized in view of lower per-hectare gain, as proceeded currently in west European countries.

This is the main reason why vineyard is forecast to disappear in the phase of post-Project in all the farm units except for those specialized in winery activities. The reason-d'etre of livestock sub-sector lies in the necessity of maintaining soil fertility and conserving/absorbing capacity of farm labor in its surplus season. While that of vineyard/winery sub-sector resides in its asset-value and the traditional credit as well as local labor-absorbing capacity in winery activities.

Eventually, it should be recalled that the majority of the existing farm households whose acreage falls in around 1 ha will not be able to sustain their living expense only by the irrigated agriculture, as widely observed throughout the developed economy in the world. The possible solution is either expanding their holding or organizing associations to enhance labor- and capital-productivity so that opportunities to seek for off-farm earnings are created. Most of the small-holders cannot but rely on other incomes than farm, pension, remittance, artisan activities or itinerant vending for instance. Both organizing associations and investing in such facilities as irrigation, mechanization, etc. will facilitate diversification of local activities by economizing farm labor as well as foster improvement in profitability/marketability of farm production. Estimated farm incomes are compared in the following way:

Management Type	Area/Farm (ha)		Farm Income (1000 Lei)		Growth Rate (%)	
	w/o Project	w/ Project	w/o Project	w/ Project	per Farm	per ha
Individual Farm	1.1	4.0	1,851	8,681	1,606	469
Association	208	500	452,142	707,966	276	157
Private Winery	500	500	680,183	896,883	32	32

In this context, it should be kept in mind that the price levels and relative values of perishable products are dependent on quantity levels of supply and purchasing power/marketing capacity of suppliers/consumers. Accordingly, large share in cropping acreage tends to detrimental results such as collapse in market price and increasing rate of spoilage.

It may also foster the deterioration of land fertility. After all, cash crop is not at all a panacea but a sword of Damocles with an extremely speculative side that may cause a serious loss of inputs once a glut supply slumps the market price. The estimation shown above is based on an optimistic outlook assuming that current price levels to be maintained even at the stage of highly expanded supply.

Finally, the relative share or role of the farm income playing in the farm household economy will become by far important in the with-Project stage, provided that off-farm income remains constant at the current level as shown below:

Farm Type	Farm Size	Stage	Farm Income		Off-farm Income		Total Income	
			Value	%	Value	%	Value	%
Individual	4.0 ha	w/ Project	8.68	90	0.99	10	9.67	100
		w/o Project	1.86	65	0.99	35	2.85	100
Individual	1.1 ha	w/ Project	1.30	54	1.10	46	2.40	100
		w/o Project	0.51	32	1.10	68	1.61	100
Association	500 ha	w/ Project	707.97	59	492.50	41	1200.47	100
		w/o Project	452.14	48	492.50	52	944.64	100
Association	208 ha	w/ Project	278.83	63	162.86	37	441.69	100
		w/o Project	188.09	54	162.88	46	350.95	100
Winery	500 ha	w/ Project	896.88	67	445.00	33	1341.88	100
		w/o Project	680.18	60	445.00	40	1125.18	100

6.5 SOCIO-ECONOMIC EVALUATION

As stated before, the Project brings about the following secondary or indirect intangible benefits which are important in reviewing validity of the implementation of the Project as well as the direct or tangible benefits:

(1) Contribution to the national development plan

Implementation of the Project contributes to the national development in ensuring accomplishment of many objectives of the agricultural irrigation development and soil erosion control plans, which are ones of the important political terms on the agricultural sector of the national development plan.

(2) Stable supply of food

The stable production of maize and wheat, which are basic major crops, is maintained with the introduction of irrigated farming method. Furthermore, the diversity of agricultural production occurs around the Project Area because of new crops such as vegetables being introduced in the Project, and answers to the stable supply of food to the people and contributes to the improvement of self-sufficiency rate.

(3) Increase in employment opportunity

The agricultural production requires annually about $1,200 \times 10^3$ man/day of agricultural laborers, and about 250 man/day in agricultural laborers increase annually compared with the case of without-Project (**Table 6.5.3-A1** up to **A3**). Implementation of the Project absorbs excess labor in and around the Project Area, reduces unemployed laborers and improves the living standard of employed laborers, thus contributes to the stabilization of civil living in and around the Project Area.

(4) Improvement of living standard

As evidently proven by the financial evaluation, the farmer's economic surplus is increased to a great extent with the implementation of the Project, even if a part of the operation and maintenance cost is borne to the farmers as water charge. A rapid increase in funds in farmer's economy by far exceeds cost of improving living environments.

(5) Promotion of marketing and processing of agricultural products

Increased production of agricultural products stimulates the marketing system and opens a door to the improvement of the system. In addition, processing of vegetables ensures increased values added. Stable supply of raw materials effectively utilizes the existing processing facilities that would otherwise be left in poor utilization efficiency, thereby contributing to the promotion of the agricultural product processing sector.

(6) Correction of differences among areas

Construction of the maintenance roads along the canals and improvement of agricultural roads not only serve to the operation and maintenance of canals but reduce economic differences among areas by stimulating distribution of goods among areas.

(7) Agriculture for environmental consideration

Introduction of leguminous crop and diversified farming by combining cultivation of crops and animal husbandry is judged as an environmental and sustainable agricultural system with preventing soil erosion.

(8) Economic stimulation

The implementation of the Project increases the income of local farmers and improves the living standard of them to a great extent. Improved income further increases purchase power of the local farmers and vitalizes local commercial activities. Increased purchase power and vigorous commercial activities are expected to promote local industries. In this way, the implementation of the Project will bring about significant repercussive effect to Vrancea District and finally to the economy of Romania, not limited to the Project Area.

6.6 ENVIRONMENTAL EVALUATION

6.6.1 Impact Sources of the Project

Main impact sources can be classified according to the impact elements of the Project (**Table 6.6.1-A1**). Irrigation activity in the field is expected to be the most important impact source. Construction of civil works is a limited impact source since the main works, Calimanesti Dam and Main Canal, are the elements of the initial state. These civil works are, however, taken into account as possible impact factors through the operational phase of the Project, namely at the stage of conveyance of irrigation water. Quality of irrigation water is identified as the main possible source of impact in the Project.

Soil conservation works are not retained as a source of impact. While such works enhances environmental quality of the initial state, eventual impacts would be a consequence of retained soil conservation techniques. If, for example, the adopted methods present a risk of failure of water drainage or control of sediments, new degradation like erosion or water logging would occur as negative effects. These problems have to be solved by propositions adaptable to the detailed situations in the field.

(1) Impact Sources due to Construction Works

Possible sources of impact related to the construction works of the Project facilities are limited to geomorphologic aspects. The construction works on the sloped land is a possible source of impact for erosion. However, the Project irrigation works are completed or under construction as already mentioned. Accordingly, the construction of remaining works will not become a significant source of negative impact on environment.

(2) Impact Sources due to Irrigation Activity

In the field of irrigation activity, the main impact sources are the following:

- Quality of irrigation water;
- Method of irrigation (sprinklers);
- Practice of irrigation.

Quality of irrigation water is still uncertain because of lack of data for toxic compounds. However, the collected data show that several quality indicators often did not meet the quality o required for irrigation use. It is clear that water quality is periodically unsuitable for irrigation

use in recent years. Accordingly, irrigation water is thought to be the main source of possible impact on environment with the implementation of the Project.

Sprinkling method might be harmful for environment if used in the sloped vineyards. Such a method might increase the risk of grapevine diseases in some cases and result in an increased use of appropriate pesticides. Vineyards included in the Irrigation Study Area also lie on a zone considered as particularly vulnerable for the quality of groundwater.

Irrigation itself might be a source of impact through increasing humidity of soil, which might be a factor starting erosion on certain conditions like existence of runoff concentration zones and slopes. If torrential rains occur on saturated soils, runoff increases and leads to erosion even on gentle slopes of not more than 5%.

(3) Impact Sources due to Agricultural Development

The Project will include new agricultural developments and activities in parallel with using the Project facilities. With increased crop production and processing of crops, and in relationship with a change in the living standards of the people, new economic and social conditions will be realized in the future with the following possible sources of impacts on environment:

- Increased use of water resources for domestic purposes;
- Development of commercial activities;
- Increased use of industrial water;
- Increased amounts of waste water and solid waste (agro-industrial activity); and
- Use of agrochemicals as a result of agricultural intensification.

6.6.2 Impacts on Natural Environment

A summary of possible impacts is provided in Table 6.6.2-A1, giving main findings of the study as follows:

- Environmental conditions of the initial state;
- Main elements of the Project;
- Main impact sources;
- Receptors of natural and social environments; and
- Main impacts.

(1) Water Quality

Within the set of possible impacts of the irrigation scheme on natural environment, main issues will be contamination of soil and groundwater with industrial or agricultural pollutants by using water of the Calimanesti Dam for irrigation. Several patterns of impact on water quality could be distinguished:

- Ground infiltration of contaminated water by irrigation in the fields;
- Ground infiltration of contaminated water by conveyance of irrigation or drainage water through the canals; and
- Increased use of agrochemicals with improvement of agricultural production.

Surface water quality might also be impaired at the downstream section with the following reasons:

- Discharge of contaminated groundwater into the Siret valley; and
- Discharge of used water with high nutrients content.

There are both limiting and strengthening factors which must be considered in the process of degradation of water quality.

Strengthening factors are:

- Existence of extremely vulnerable zones due to the high permeability of non-saturated zones;
- Existence of artificial hydrological conditions which increase the effect of water pollution due to low dilution of pollutants in the downstream section of the Siret River;
- Probable tendency of eutrophication of Calimanesti reservoir with future use of agrochemicals in the upstream areas. According to the Environmental Branch Agency of Vrancea, eutrophication trends can already be observed at Calimanesti. Eutrophication of water in the Main Canal might also be predicted; and
- On the long term, increased use of agrochemicals for achieving the expected agricultural outputs with the Project would be the most important source of negative impact on water quality.

Limiting factors are:

- The Danube River Protection Convention provides that point and non-point sources of pollution shall be prevented or reduced through setting the emission limits based on the best available techniques for abatement at source and/or for wastewater purification;
- Action plans have been launched in the upstream area with a special focus on improving industrial and municipal wastewater treatment systems. Such projects for environmental protection should result in the improvement of water quality in a few years; and
- New environmental law will regulate the future use of agrochemicals.

There are also additional environmental factors to be considered for the long term evolution, namely climate change, possible deforestation of sub-Carpathian hills and future use of water resources at the upstream section. The Project Area belongs to a dry climate zone, which makes irrigation important but also indicates that any low variation in water availability due to precedent factors may disturb the planned water balance.

It is concluded that irrigation water might affect groundwater quality on the existing conditions of surface water quality at the upstream part of the Project Area. However, it may be expected that recent launching of an action plan will reduce industrial contamination to the acceptable levels. At long term, use of agrochemicals would represent the next challenge for limiting impact on water quality. The coming environmental law on use of agrochemicals is expected to limit contamination risk.

(2) Soil Quality

Soil quality might be impaired by contaminants of industrial or agricultural origin. With inappropriate drainage and erosion conditions, transportation of sediments containing agrochemicals or residual industrial pollutants would contribute to the contamination of sediments at the downstream section.

Soil quality might also be locally impaired by sheet erosion. Slopes between 3 and 7% are vulnerable to sheet erosion in the Project Area. Sloped zones of around 2-3% and more than 800m wide are considered to be vulnerable to sheet erosion in the "sub-Carpathian Elbow" zone, according to ISPIF. The risk of clogging of canals by sediments in the Project Area will be high.

(3) Natural Habitats and Wildlife

Given the environmental conditions of the initial state of the Project (intensive land use and complete or partial existence of the civil works of the Project), the Project construction works will not involve a significant loss or change of natural habitats. Natural habitats and wildlife at the downstream section of the Project Area would indirectly be threatened by the way of degraded water quality through irrigation. However, on a whole, the Project cannot be regarded as having significant impacts on natural habitats and wildlife.

6.6.3 Impacts on Social Environment

(1) Water Resources

As regards to the water resources problem, indirect effects of the Project would be water shortage or conflicts as a result of increased needs for use of domestic water and municipal or industrial water. Since groundwater represents 100% of water resources in towns (Panciu, Marasesti, Odobesti) and villages, the possible contamination of groundwater due to the implementation of the Project would threaten health of consumers and lead to the search of new water sources. Withdrawal of deep groundwater will certainly be an alternative. On a whole, scarcity of potable water will imply new water resources development and water supply systems, with as a major consequence a drastic increase in the water price.

(2) Health and Sanitation

Contamination of crops and water by heavy metals is the first source of impact on health and sanitation. However, as mentioned above, there are reasons to expect that this problem will be solved at the source in the short term. Agricultural development will, however, result in an increasing number of point sources of pollution, involving an increased quantity of solid waste, wastewater and sludge of breeding cattle activity in the mean term. Consequences are mixed alternatives between an acceptable increased risk on health and increased costs for waste treatment.

6.6.4 Main Measures to Improve Environmental Quality

The following proposed measures deal with water quality as being the major possible impact of the Project, and with improvement of environmental quality through implementation of the Project. While the former is a preventive measure, the latter aims at carrying out environmental positive impact.

(1) Measures to Mitigate Water Quality Degradation

Since the water quality problem must be solved at its source (upstream industries), there is no measure to mitigate the impact at the Project level except for the use of agrochemicals. However, an appropriate monitoring of water quality seems to be necessary, particularly during the transition period of implementation of action plans at the upstream industries.

(2) Measures to Enhance Quality of Environment

The Branch Environmental Agency of Vrancea is considering the possibility of combining irrigation with ecological rehabilitation of forest. This action would consist in establishing forested corridors in order to rebuild natural forest within the Project Area. This is still a general concept without clear proposition, but is regarded as a complementary functional element of the irrigation scheme.

Advantages or contributions would be the following:

- Protection against north/south wind;
- Positive effects on micro-climate (maintenance of humidity of air);
- Countermeasures against drought;
- Decrease in the needs of energy, water and materials input, since irrigation water is partly compensated by natural humidity;
- Better quality of the water equivalent humidity, compared with irrigation water; and
- Decreased risk of groundwater contamination.

In other words, this measure would be considered as an element of environmental sustainability of the Project. Since the Agency is the authorized entity for delivering environmental approval

of the operation of the Project, a proposition for afforestation will be received very favorably. This measure would be a very positive aspect of the Project from the standpoint of environment.

Furthermore, in spite of the fact that impact on natural habitats is insignificant, reforestation might be the main measure to be considered for justifying the Project from the environmental point of view with the following reasons:

- Romania is expected to take measures for sustainable use of water resources, conservation of ecological resources and improvement of aquatic ecological conditions (the Danube River Protection Convention). Reforestation measures within the Project would appear as measures in compliance with these stipulations;
- Since reforestation strengthens the positive effects of irrigation, the Project would appear as providing an important element of environmental sustainability and a way for being positive on the natural environment; and
- Within the scope of the Project, it is not possible to propose countermeasures against the negative impact on water quality, because it goes beyond the Project construction and management capacity. Accordingly, rebuilding of natural habitats would appear as a good compensation.

Given the actual environmental conditions of the Project Area, the Siret tributaries would certainly be the most appropriate locations for reforestation with the following reasons:

- The Siret tributaries are the only remaining natural corridors in the Project Area;
- Such natural corridors would make possible moving of wildlife between the Siret plain and sub-Carpathian hills. This function may be regarded as a good compensation to the barrier effect of the Main Canal;
- These rivers are the sites of scenic landscapes with possible touristic valorization in the future;
- These river corridors are the site of land degradation on river banks because of gully erosion.

6.7 COMPREHENSIVE EVALUATION

The implementation of the Project allows prediction that the living standard of local people in and around the Project Area is greatly improved, which results from an increase in agricultural production, soil conservation, stable supply of food, increase in employment opportunity, expansion of income, etc. All these benefits are attained mainly by an increase in cropping rate, a change of cropping pattern, an increase in unit yield and an introduction of cash crops owing to the irrigation system. The implementation of the Project is highly evaluated to serve to stabilization of civil living and welfare in Project Area, to give an intensive impact to production activities and to contribute to the national economy.

Thus, the implementation of the Project is judged as valid with the result of economic and financial evaluations as computed from tangible benefit. In addition, socio-economic impact evaluated from intangible benefit is also judged as sufficiently expectable. Any remarkable negative impact from the implementation the Project is not confirmed on the environmental evaluation, and the Project is evaluated as a sustainable agricultural development plan considering the environmental situation. Moreover, the implementation of the Project is justified to be feasible from technical and organizational operational viewpoints. Accordingly, it is recommended that a high priority should be given to the Project for its implementation in the early stage.

TABLES

Table 2.1.1-A1 Consumer Price Indices and Price of Major Foods

(Unit: index and Lei/kg or Lei/lit)

Year	1987	1988	1989	1990	1991	1992	1993
INDICES							
Total Goods	100.0	102.2	103.4	108.6	298.1	926.8	2,763.1
Foods	100.0	102.4	104.0	105.1	315.6	1,000.8	3,132.2
Clothing	100.0	101.4	102.6	110.4	291.1	739.8	2,153.9
Fuel/Lightning	100.0	100.8	98.1	74.6	97.9	321.2	788.9
Household Items	100.0	100.0	100.0	108.7	439.2	1,348.2	2,215.7
Transport	100.0	100.0	100.4	110.4	248.1	925.0	-
Water/Sewer	100.0	100.0	99.9	192.3	552.5	1,554.7	1,700.3
UNIT PRICES							
Wheat Grains	1.71	1.71	1.73	2.14	6.89	26.72	141.38
Potatoes	1.16	1.13	1.13	2.61	18.75	57.18	146.51
Apples	2.79	2.79	2.79	4.35	16.96	39.23	152.43
Beef meat	13.30	13.30	13.30	21.55	42.19	198.75	1,498.14
Hen eggs	1.40	1.40	1.40	1.51	4.05	13.47	406.80
Cow's milk	2.72	2.72	2.72	5.75	11.02	33.41	360.90

Month/Year	Dec.90	Dec.91	Dec.92	Mar.93	June	Sept	Dec.93
RECENTFLUCTUATION							
Bread (1kg)	8.1	20.6	59.8	66.1	190.7	275.9	293.3
Vegetable oil	18.4	39.2	300.8	310.9	435.3	718.9	1273.3
Pork (1kg)	38.1	280.7	968.8	968.9	1599.2	1994.0	342[illegible].4
Sugar (1kg)	14.0	32.0	207.2	214.3	329.3	739.5	95[illegible].8
Wine (1ltr)	89.3	146.3	314.4	619.1	896.6	1714.3	2588.4

Source : Statistical Yearbook 1993 etc.
Notes : Figures in 1987 taken as 100 for indices indices and for 1993, index in July.

Table 2.1.1-A2 Gross Domestic Product by Branch and Estimated GNP

(Unit: 10^6 Lei current price)
for indices in brackets 1987 = 100

Year	1986	1987	1988	1989	1990	1991	1992
G.D.P Total Sector	839	845	857	800	858	2,199	5,982
	(99.2)	(100)	(99.6)	(93.7)	(88.5)	(77.0)	(66.6)
Agriculture/	107	103	116	113	155	412	1,130
Forestry	(110.8)	(100)	(109.1)	(102.8)	(118.5)	(108.3)	(95.2)
Industry/	476	477	472	433	435	953	2,674
Cottage Ind.	(99.3)	(100)	(96.1)	(91.0)	(78.7)	(67.1)	(56.4)
Commerce	40	43	47	51	58	311	790
	(99.3)	(100)	(107.5)	(112.1)	(118.9)	(93.2)	(77.0)
Constructions	60	61	60	44	46	104	261
	(101.0)	(100)	(99.3)	(83.5)	(84.4)	(66.0)	(60.2)
Transport/	57	58	60	61	54	138	383
Communication	(98.5)	(100)	(105.2)	(103.7)	(79.2)	(67.7)	(56.1)
						(Unit : 10^3 Lei)	
Per Capita GDP	36.7	36.8	37.1	34.6	37.0	94.8	262.5
Per Capita GNP	-	-	-	-	33.7	91.4	240.3
PC-GNP(inUS$)	-	-	-	-	1,453	1,240	736

Source: Statistical Quarterly Bulletin, 1993-1994

Table 2.1.1-A3 Average Numbers of Employees/Unemployment

(Unit: 10^3 persons)

Sector	1987	1988	1989	1990	1991	1992
Total Employed	10,719	10,805	10,946	10,840	10,786	10,458
(share in %)	(100)	(100)	(100)	(100)	(100)	(100)
Agriculture	3,017	3,024	3,012	3,056	3,095	3,362
(share in %)	(28,2)	(28.0)	(27.5)	(28.2)	(28.7)	(32.1)
Industry	4,014	4,065	4,169	4,015	3,817	3,301
(share in %)	(37.4)	(37.6)	(38.1)	(37.0)	(35.4)	(31.6)
Transport	653	670	675	655	585	556
(share in %)	(6.1)	(6.2)	(6.2)	(6.0)	(5.4)	(5.3)
Trade	633	635	649	679	872	754
(share in %)	(5.9)	(5.9)	(5.9)	(6.3)	(8.1)	(7.2)
Municipal Service	479	504	534	528	706	711
(share in %)	(4.5)	(4.7)	(4.9)	(4.9)	(6.5)	(6.8)
Construction	791	772	767	653	463	579
(share in %)	(7.4)	(7.1)	(7.0)	(6.0)	(4.3)	(5.5)
Others	1,132	1,135	1,140	1,254	1,248	1,195
(share in %)	(10.5)	(10.5)	(10.4)	(11.6)	(11.6)	(11.5)
Registered	0	0	0	0	337	929
Unemployment(in %)	-	-	-	-	(4.6)	(8.4)

Note:Registered unemployment has reached 1,165 (10.5%) in January 1994.
Source: Statistical Yearbook 1992 and 1993

Table 2.1.2-A1 Statistical Data of the Land Reclamation Works

No.	Name of District	Total Area (km2)	Agriculture Area * (ha)	Types of Works in ha.							Ratio Irrigated *
				Irrigations Area *	Surface drainage works		Tile drainage works		Fish Pond	Soil erosion control	
					Large Scale	Small Scale	Large Scale	Small Scale			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(9)	(10)	(11)	(12)	(13)=(5)/(4)
1	Alba	6,242	324,290	4,676	7,455	3,370	500	-	100	-	1.44%
2	Arad	7,754	511,660	29,130	222,394	4,348	654	-	2,000	-	5.69%
3	Arges	6,826	345,071	35,816	33,309	-	3,020	-	300	-	10.38%
4	Bacâu	6,621	323,343	24,042	3,623	-	-	-	630	-	7.44%
5	Bihor	7,544	499,433	10,034	165,731	4,049	855	-	1,410	-	2.01%
6	Bistrita N.	5,355	284,502	186	8,384	10,142	805	-	110	-	0.07%
7	Botosani	4,986	387,682	24,773	9,150	1,391	5,839	1,391	3,820	-	6.39%
8	Brasov	5,363	297,519	2,653	75,837	4,404	11,817	-	570	-	0.89%
9	Brâila	4,766	380,815	379,579	255,628	-	28,860	-	2,450	1,721	99.68%
10	Buzâu	6,103	402,477	41,808	111,994	-	3,446	-	1,850	1,000	10.39%
11	Caras-Severin	8,520	399,620	-	25,317	-	829	-	200	-	#VALUE!
12	Câlârasi	5,088	430,697	371,961	168,590	679	5,494	-	2,250	17,595	86.36%
13	Cluj	6,674	424,377	7,681	3,786	6,304	-	-	1,150	-	1.81%
14	Constanta	7,071	566,696	431,187	14,801	690	269	-	2,950	45,947	76.09%
15	Covasna	3,710	186,416	4,789	37,702	6,668	4,528	-	160	-	2.57%
16	Dâmbovita	4,054	249,759	38,272	60,912	7,620	627	30	950	-	15.32%
17	Dolj	7,414	584,026	314,506	140,986	-	2,433	-	3,910	7,510	53.85%
18	Galati	4,466	357,117	141,727	59,218	-	5,858	-	2,310	67,000	39.68%
19	Giurgiu	3,526	275,589	170,470	86,296	3,539	6,564	-	1,630	9,630	61.86%
20	Gorj	5,602	250,254	7,247	7,559	-	-	-	125	-	2.90%
21	Harghita	6,639	406,443	305	18,284	19,158	-	-	225	-	0.08%
22	Hunedoara	7,063	348,846	9,692	14,115	7,273	223	100	200	-	2.78%
23	Ialomita	4,453	372,860	213,229	165,984	-	9,059	-	4,200	1,000	57.19%
24	Iasi	5,476	376,513	51,791	42,325	5,187	2,082	102	4,400	-	13.76%
25	Maramures	6,304	311,235	-	27,178	-	3,289	-	220	-	#VALUE!
26	Mehedinti	4,933	293,977	79,628	37,971	1,026	775	-	1,540	1,000	27.09%
27	Mures	6,714	409,750	2,973	10,895	2,814	645	45	1,350	-	0.73%
28	Neamt	5,896	282,626	10,550	10,811	320	2,121	-	800	-	3.73%
29	Olt	5,498	442,377	193,160	71,364	6,228	-	-	220	11,303	43.66%
30	Prahova	4,716	279,119	24,900	45,677	6,831	644	-	970	528	8.92%
31	Satu Mare	4,418	317,519	4,704	232,155	-	8,051	-	730	-	1.48%
32	Sâlaj	3,864	239,424	-	13,477	-	2,111	-	220	-	#VALUE!
33	Sibiu	5,432	307,974	2,700	27,729	5,498	3,196	-	800	-	0.88%
34	Suceava	8,553	349,502	4,050	43,750	4,948	15,532	3,916	1,060	-	1.16%
35	Teleorman	5,790	496,353	238,136	95,322	-	-	-	1,710	21,350	47.98%
36	Timis	8,697	702,370	15,870	432,448	-	10,920	-	1,450	-	2.26%
37	Tulcea	8,499	362,007	166,728	30,606	2,184	1,756	-	49,500	36,290	46.06%
38	Vaslui	5,318	388,472	28,944	41,847	1,200	-	-	2,100	-	7.45%
39	Vâlcea	5,765	251,652	11,747	12,991	-	-	-	1,200	5,850	4.67%
40	Vrancea	4,857	255,329	40,965	50,057	4,117	5,188	-	1,950	-	16.04%
41	M.Bucuresti	1,821	117,372	62,193	52,733	1,583	3,920	-	1,750	-	52.99%
Total		238,391	14,793,063	3,202,802	2,975,891	121,571	151,910	5,584	105,470	227,725	21.65%

Source : ISPIF 1992, * (Data on Dec. 31, 1993) Romanian Statistic Yearbook 1994

Table 2.1.2-A2 Agricultural Production Value in Romania

(Unit: 10^6 Lei in current prices)

Year	1988	1989	1990	1991	1992	1993
Total Production	203.2	196.9	265.6	750.6	2,103.9	7,370.7
Crop Production	108.0	107.1	140.6	494.8	1,219.3	4,637.2
(share of crop)	(53.2)	(54.4)	(53.0)	(65.9)	(58.0)	(63%)
Animal Production	95.2	89.8	125.0	255.8	884.5	2,733.5
(share of animal)	(46.2)	(45.6)	(47.0)	(34.1)	(42.0)	(37%)

Source: Romanian Statistical Yearbook 1994 and Quarteriy Bulletin 1993
Note : share in % of the total, estimated for 1993

Table 2.1.2-A3 Per-Capital Production of Agricultural Outputs

(Unit: kg/year/population)

Item	1988	1989	1990	1991	1992	1993
Food Cereals	837	794	738	833	540	681
wheat/rye	374	343	317	240	142	235
Maize	311	292	293	453	300	351
Sunflower	31	28	24	26	34	31
Sugarbeet	211	293	141	103	127	78
Potatoes	157	191	137	81	114	163
Fruits	178	161	101	96	116	126
Meats	100	83	96	87	83	96
Milk	227	196	190	199	198	208
Eggs(14pcs=1kg)	25	22	25	22	19	18

Source: Romanian Statistical Yearbook 1994

Table 2.1.2-A4 Agricultural Production Area by Major Crop

(Unit: area;10^3 ha)

Crop	1988	1989	1990	1991	1992	1993
Cropped Area						
Total	9,700	9,846	9,402	9,197	8,909	-
Food cereals	5,907	6,027	5,704	6,049	5,774	-
Peas and Beans	310	311	130	81	69	-
Fibercrops	113	123	38	25	22	-
Oilseeds	992	1,072	655	643	810	-
Industeial crops	295	313	188	217	194	-
Potatoes	326	351	290	235	219	-
Vegetables	267	253	216	195	223	-
Fodder crops	1,118	1,149	1,962	1,552	1,442	-
Silage crops	154	153	593	247	287	-
Wheat/Rye	2,415	2,359	2,298	2,217	1,475	2,307
Maize	2,579	2,733	2,467	2,575	2,336	3,066
Sunflower	466	434	395	477	615	589
Soyabean	414	512	190	108	166	75
Sugerbeet	248	256	163	202	180	97
Autumn Potato	280	289	246	205	192	250
Tomato	58	52	51	46	52	83

Source: Romanian Statistical Yearbook 1994

Table 2.1.2-A5 Major Crop Production

(Unit:10^3 ton)

Crop	1988	1989	1990	1991	1992	1993
Foodgrains	19,286	18,379	17,174	19,307	12,289	15,493
Wheat/Rye	8,632	7,935	7,379	5,559	3,228	5,355
Maize	7,182	6,762	6,810	10,497	6,828	7,988
Beans/Peas	262	256	112	80	75	85
Fiber Crops	113	127	53	15	26	15
Oilseeds	1,069	1,034	739	823	920	821
(Sunflower)	(705)	(656)	(556)	(612)	(774)	(696)
(Soyabean)	(295)	(303)	(142)	(179)	(126)	(95)
Sugerbeet	4,869	6,771	3,278	4,703	2,897	1,776
Potatoes	3,621	4,420	3,186	1,873	2,602	3,709
Vegetables	4,097	3,727	2,358	2,214	2,632	2,873
Tomato	1,086	1,011	814	693	831	799
Green Fodder	18,189	18,057	12,963	15,229	10,990	11,758

Source: Romanian Statistical Yearbook 1994

Table 2.1.2-A6 Area and Production of Bearing Vineyards

(Unit: 10^3 ha,10^3 tons and ton/ha)

Year	1988	1989	1990	1991	1992
Total Area	217.5	213.4	223.6	225.3	235.4
grafted/local	165.5	162.2	161	159.3	161.5
hybrid varieties	52.0	51.2	62.6	66.0	73.9
Grape production	1,196	915	954	849	905
grafted/local	921	695	709	639	635
hybrid varieties	275	220	245	209	270
Average Yields	5,425	4,171	4,245	3,756	3,815
grafted/local	5,551	4,270	4,403	4,013	3,926
hybrid varieties	5,021	3,858	3,838	3,134	3,571

Source: Romanian Statistical Yearbook 1994

Table 2.1.2-A7 Livestock Herds in Romania

(Unit: 10^3 heads, fowls, families)

Year	1988	1989	1990	1991	1992	1993
Bovine Total	6,559	6,416	6,291	5,381	4,355	3,683
of which						
Milk cows	2,727	2,758	2,468	2,123	2,266	2,025
Pigs	14,328	14,351	11,671	12,003	10,954	9,852
breedsows	1,091	1,099	1,023	951	771	792
Sheep	16,839	16,210	15,435	14,062	13,879	12,079
ewes	9,805	9,890	9,292	9,050	11,496	8,854
Goats	990	1,078	1,017	1,005	954	805
she-goats	707	756	706	697	734	613
Horse	693	702	663	670	749	721
adult-mares	213	222	210	212	-	-
Poultry	127,304	127,561	113,968	121,379	106,032	87,725
laying-hens	51,742	52,498	49,390	51,475	50,213	42,406
Bees	1,357	1,418	1,201	1,091	1,207	780

Source: Romanian Statistical Yearbook 1994

Table 2.1.2-A8 Number of Animal per Hectare (carrying capacity)

(Unit: heads/ha,ha/head in brackets)

Year	1988	1989	1990	1991	1992	1993
Bovine	0.454	0.444	0.441	0.380	0.309	0.261
	(2.2)	(2.2)	(2.3)	(2.6)	(3.2)	(3.8)
Cows only	0.189	0.191	0.173	0.150	0.161	0.144
	(5.3)	(5.2)	(5.8)	(6.7)	(6.2)	(6.9)
Sheep/Goats	1.235	1.195	1.154	1.063	1.053	0.914
	(0.81)	(0.83)	(0.87)	(0.94)	(0.95)	(1.09)

Source: D.O.

Table 2.2.1 - A1 Social Infrastructure in Vrancea District

(Unit:number of units)

Station	Post Office	Clinics	School	Agricultural Center
3	221	96	648	20

Retail Units			Shops				
Total	Private	Public	Total	Food	non-Food	Mixed	Kiosks
1,470	718	752	663	193	181	289	89

Source : DO

Table 2.2.1-A2 Structure of Employment

Year	1991	1992	Year	1991	1992
Total Employees	101.4	84.8	Commerce	5.9	3.8
Agriculture	16.0	10.1	Restaurant	1.3	0.9
Silviculture	3.2	1.9	Transport	10.6	7.3
Fishery	0.1	0.1	Education	6.8	6.5
Extracting Ind.	0.9	0.3	Health Care	4.0	4.3
Processing Ind.	39.8	27.5	Administaration	1.6	1.9
Electricity	1.6	1.7	Dealing of	1.4	0.9
Construction	5.2	5.0	immobile assets		

Source : DO

Table 2.2.2-A1 Status of Land Tenure in Vrancea District

Land Type	Total area		Public Property (%)		Private Property (%)		
	(ha)	(%)	Public	State	Individual	Commercial	Association
Arable land	147,747	(21)	1.1	12.2	75.6	1.3	9.8
Pasture	44,458	(9)	81.7	2.9	15.2	0.2	0.0
Meadow	30,417	(6)	2.2	0.8	96.8	0.1	0.0
Vineyards	28,104	(6)	2.1	24.4	71.1	0.8	1.6
Orchard	4,602	(1)	-	-	-	-	-
Agricultural	255,328	(52)	15.9	10.4	66.9	0.8	6.0
Forest land	191	(39)	92.3	0.0	7.6	0.1	0.0
Other land	211	(43)	72.1	6.9	20.7	0.3	0.0
Total land	486	(100)	50.5	6.0	39.8	0.5	3.1

Source : DO

Table 2.2.2-A2 Area and Yields of Major Crops in Vrancea District

Crop	Year	Wheat/Rye	Barley	Oats	Maize	Beans	Sunflower	Suger Beet
Area	1991	38.3(91)	10.0(71)	1.1(68)	50.6(89)	0.3(73)	6.8(80)	3.0(93)
Area	1992	24.8(85)	5.5(58)	1.0(38)	80.5(97)	0.2(80)	7.3(77)	2.4(92)
Yield	1991	2,035(94)	2,680(88)	891(99)	3,843(100)	503 (97)	1,233(91)	18,513(98)
Yield	1992	1,839(88)	2,193(75)	2,833(57)	1,374(101)	745(108)	1,147(94)	14,847(99)

Crop		Potatoes	Vegetables	(Tomato)	Fodder	Perennial Hay	Grape
Area	1991	4.6(92)	2.9(91)	0.7(90)	22.3(65)	13.8(70)	25.7(76)
Area	1992	1.3(85)	3.5(92)	0.9(95)	14.6(54)	10.6(61)	26.2(74)
Yield	1991	7,746(91)	-	17,582(101)	21,215(93)	19,456 (95)	7,723(90)
Yield	1992	8,891(82)	-	11,197 (96)	20,866(89)	30,757(101)	3,920(85)

Source : DO

Table 2.2.2-A3 Livestock Herds and Products in Vrancea District

(Unit: 10^3 heads,fowls and families,10^3 ton,h.lit)

Livestock	Cattle	Milk-Cow	Pig	Sheep	Goat	Horse	Poultry	Bee
Head 1991	26.6	33.2	113.6	174.9	34.9	15.4	1,806.9	24.9
1992	29.6	34.1	133.3	235.3	27.0	14.9	1,854.2	12.1

Products	Beef	Milk	Pork	Wool	Mutton	Fowl	Egg	Honey
Total 1991	7.25	601.0	12.86	0.42	3.61	12.70	6.71	0.07
(Private %)	(82.4)	(85.5)	(75.3)	(75.2)	(90.1)	(64.8)	(76.0)	(99.2)
1992	7.34	774.6	12.70	0.42	3.97	14.28	6.49	1.24
(Privete %)	(91.0)	(70.2)	(73.3)	(82.5)	(93.6)	(70.2)	(75.2)	(98.2)

Source: DO

Table 2.2.2-A4 Supply of Fertilizers,Chemicals and Availability of Farm Machinery in Vrancea District

(Unit: number,ha/machine,ton,kg/ha)

Year	Tractor	Cultivator	Seeder	Manure Spreader	Sprayer	Combine Harvester			Hay Bailer
						Grain	Maize	Fodder	
1991	2,952	374	536	146	695	492	62	70	325
1992	3,078	382	565	127	746	479	66	76	316
Coverage by a macine									
1991	49ha	474ha	331ha	1,215ha	49ha	101ha	816ha	434ha	247ha
1992	47ha	466ha	315ha	1,403ha	44ha	66ha	1,220ha	400ha	196ha

Year	Nitrogen	Phosph-orus	Potassium	Organic Manure	Chemicals
1990	23,715	5,038	3,720	4,953,000	6,953
Rate	115	24	18	24/ton/ha	40kg/ha

Source: Statistic Yearbook 1993,Estimated from Fragmental Collection

Table 2.2.2-A5 Food Availability to Population in Vrancea District

(Unit: kg/year P/C/F for farmers,P/C/T for district inhabitant)

Food	Cereals	Vegetables	Fruits	Meats	Milk	Egg	Honey
P/C/F	1,631	486	360	368	738	62	1.2
P/C/T	435	130	96	98	196	17	0.3

Table 2.3.1 - A1 Siret-Ialomita (Baragan) Agricultural Development Project.

No.	Name of System	Irrigation (ha)					Drainage			Sub-surface Drainage	Soil Erosion Control				Fish Pond (ha)	Salinity Control (ha)	River Training (km)
		Classification			Stages		Total	New	Rehabilitation		Shallow (ha)			Gully (km)			
		Total	New	Reabilitation	Phase I	Phase II					Total	New	Rehabilitation				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1	Rugineşti-Pufeşti-Pascu	23,295	20,095	3,200	23,295	-	1,700	1,700	-	-	28,440	7,596	20,844	40.3	-	-	15
2	Cotesti-Rm.Sarat Nord	24,075	22,190	1,885	17,055	7,020	2,200	2,200	-	300	7,450	-	7,450	40.0	-	-	37
3	Rm.Sarat Sud	34,720	33,720	1,000	-	34,720	10,000	5,780	4,220	1,350	3,010	-	3,010	42.7	-	-	41
4	Buzau-Sarata	122,500	103,400	19,100	-	122,500	87,400	7,500	79,900	12,400	-	-	-	-	-	9,350	-
Total I - Canal's Western Part		*204,590*	*179,405*	*25,185*	*40,350*	*164,240*	*101,300*	*17,180*	*84,120*	*14,050*	*38,900*	*7,596*	*31,304*	*123.0*	*0*	*9,350*	*93*
5	Biliesti-Sl.Ciorasti and Marasesti	23,550	10,250	13,300	23,550	-	2,700	2,000	700	1,500	-	-	-	-	300	1,400	15
6	Gologanu-Nanesti	24,500	22,000	2,500	24,500	-	11,650	-	11,650	5,900	-	-	-	-	-	3,500	-
7	Ciorasti-Maicanesti	10,880	-	10,880	10,880	-	-	-	-	-	-	-	-	-	930	-	-
8	Namoloasa-Galati	5,600	-	5,600	-	-	-	-	-	-	-	-	-	-	-	1,700	-
9	Namoloasa-Maxineni	31,990	-	31,990	31,990	-	-	-	-	-	-	-	-	-	2,000	-	-
10	Bogza-Balta Alba	56,000	54,000	2,000	25,000	31,000	35,000	10,500	24,500	2,100	-	-	-	15.0	-	6,050	-
11	Gradistea-Faurei-Jirlau	10,140	-	10,140	-	10,140	-	-	-	-	-	-	-	-	-	-	-
12	Pogoanele-Fundata	132,750	115,345	17,405	-	132,750	63,000	20,600	42,400	5,100	-	-	-	-	-	13,890	-
Total II - Canal's Eastern Part		*295,410*	*201,595*	*93,815*	*115,920*	*173,890*	*112,350*	*33,100*	*79,250*	*14,600*	-	-	-	*15.0*	*3,230*	*26,540*	*15*
TOTAL		*500,000*	*381,000*	*119,000*	*156,270*	*338,130*	*213,650*	*50,280*	*163,370*	*28,650*	*38,900*	*7,596*	*31,304*	*138.0*	*3,230*	*35,890*	*108*

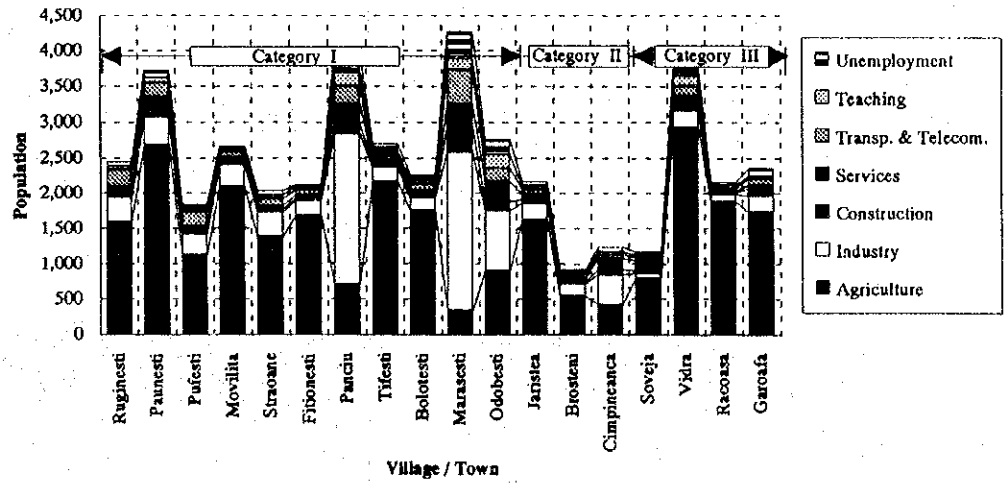
Source : C.M.C. Conectari, Modernizari, Completari

Table 3.1.3-A1 Population by Age and Working Population by Occupation in the Study Area (1992)

No.	Villages	Total Area (km2)	Total Population	Population Density (capita/km2)	Age Group			%		
					less than 15	15 - 59	more than 60	less than 15	15 - 59	more than 60
1	Ruginesti	89.13	4,515	50.66	920	2,717	878	20.38	60.18	19.45
2	Paunesti	73.66	6,919	93.93	1,533	3,958	1,428	22.16	57.20	20.64
3	Pufesti	56.85	3,856	67.83	810	2,262	784	21.01	58.66	20.33
4	Movilita	57.88	4,229	73.06	725	2,478	1,026	17.14	58.60	24.26
5	Straoane	53.54	4,161	77.72	608	2,291	1,262	14.61	55.06	30.33
6	Fitionesti	79.45	3,291	41.42	600	1,895	796	18.23	57.58	24.19
7	Panciu	61.85	10,016	161.94	2,478	5,922	1,616	24.74	59.13	16.13
8	Tifesti	77.75	5,264	67.70	867	3,071	1,326	16.47	58.34	25.19
9	Bolotesti	96.43	4,612	47.83	802	2,595	1,215	17.39	56.27	26.34
10	Marasesti	87.10	12,370	142.02	3,472	7,308	1,590	28.07	59.08	12.85
11	Odobesti	57.54	8,572	148.97	2,067	5,240	1,265	24.11	61.13	14.76
	Sub-total	791.18	67,805	85.70	14,882	39,737	13,186	21.95	58.60	19.45
12	Jaristea	38.74	4,310	111.25	676	317	1,230	15.68	7.35	28.54
13	Brosteni	96.43	2,040	21.16	389	1,183	468	19.07	57.99	22.94
14	Cimpineanca	19.57	2,798	142.97	519	1,717	562	18.55	61.37	20.09
	Sub-total	154.74	9,148	59.12	1,584	3217	2,260	17.32	35.17	24.70
15	Soveja	95.45	3,025	31.69	407	1,577	1,041	13.45	52.13	34.41
16	Vidra	122.17	7,537	61.69	1,515	4,228	1,794	20.10	56.10	23.80
17	Racoasa	89.90	3,626	40.33	684	1,993	949	18.86	54.96	26.17
18	Focsani	48.15	101,335	2,104.57	27,879	65,639	7,817	27.51	64.77	7.71
19	Garoafa	71.44	4,411	61.74	860	2,564	987	19.50	58.13	22.38
	Sub-total	427.11	119,934	280.80	31345	76,001	12,588	26.14	63.37	10.50
	Total	1,373.03	196,887	143.40	47,811	118,955	28,034	24.28	60.42	14.24

No.	Villages	Active Population by Occupation							Unemployed population	Inactive population
		Total	Agriculture	Industry	Construction	Services	Transp. & Telecom.	Teaching		
1	Ruginesti	2,582	1,587	359	79	62	250	46	59	1,933
2	Paunesti	3,898	2,682	381	181	113	194	68	104	3,021
3	Pufesti	2,026	1,124	288	76	46	192	26	88	1,830
4	Movilita	2,778	2,088	318	47	51	83	38	38	1,451
5	Straoane	2,178	1,383	345	44	53	92	46	73	1,983
6	Fitionesti	2,202	1,676	215	27	47	82	42	27	1,089
7	Panciu	4,591	709	2,126	137	280	259	185	271	5,425
8	Tifesti	2,838	2,160	211	52	48	61	52	113	2,426
9	Bolotesti	2,387	1,751	186	68	37	89	50	75	2,225
10	Marasesti	4,784	344	2,243	354	313	480	151	385	7,586
11	Odobesti	3,303	891	861	129	285	195	182	217	5,269
	Sub-total	33,567	16,395	7,533	1,194	1,335	1,977	886	1,450	34,238
12	Jaristea	2,306	1,630	224	56	73	71	44	64	2,004
13	Brosteni	968	547	167	30	36	49	27	52	1,072
14	Cimpineanca	1,362	425	415	69	160	58	42	63	1,436
	Sub-total	4,636	2,602	806	155	269	178	113	179	4,512
15	Soveja	1,289	792	71	28	157	43	34	39	1,736
16	Vidra	4,117	2,923	237	102	113	133	139	146	3,420
17	Racoasa	2,237	1,878	106	26	29	32	44	40	1,389
18	Focsani	51,024	2,284	23,959	3,144	4,790	2,983	2,591	2,095	50,311
19	Garoafa	2,468	1,728	232	99	54	90	33	111	1,943
	Sub-total	61,135	9,605	24,605	3,399	5,143	3,281	2,841	2,431	58,799
	Total	99,338	28,602	32,944	4,748	6,747	5,436	3,840	4,060	97,549

Source: The Census of population and houses in January, 1992



Note : excluding Focsani

Table 3.1.4-A1 Rural Infrastructure in the Study Area

NO.	Name of Town or Village	Roads: Main Length (pavement)	Roads: Secondary Length (pavement)	Facilities of post- harvest: Processing facilities	Facilities of post- harvest: Cereal Storehouse	Facilities of post- harvest: Free market	Post Office	Number of telephone sets	Electric supply: Network of supply (km)	Electric supply: Amount used by household (kwh/m/house)
1	Ruginesti	1 km (paved)	12 km (paved)	0	0	0	1	165	13	100
2	Paunesti	2 km (paved)	16 km (paved)	0	0	0	1	220	24	120
3	Pufesti	8 km (paved)	48 km (paved)	0	0	0	1	84	48	200
4	Movilita	8 km (paved)	24 km (paved)	0	0	0	1	144	32	100
5	Straoane	16 km (paved)	35 km (paved)	0	0	0	2	284	60	80
6	Fitionesti	1 km (paved)	22 km (paved)	0	1	0	1	180	23	120
7	Panciu	18 km (paved)	30 km (paved)	0	0	0	1	2,200	96	300
8	Tifesti	5 km (paved)	25 km (paved)	0	0	0	1	220	30	130
9	Bolotesti	10 km (paved)	15 km (paved)	0	0	0	1	124	25	50
10	Marasesti	20 km (paved)	18 km (paved)	0	1	0	1	2000	38	120
11	Odobesti	18 km (paved)	31 km(90% not paved)	0	0	0	1	1,400	49	120
	Total	107 km (paved)	276 km	0	2	0	12	7,021	438	131

NO.	Name of Town or Village	Schools: Number of Schools: Primary school	Schools: Number of Schools: High school	Schools: Number of class rooms	Schools: Number of pupils	Schools: Number of teachers	Medical institutions: Number of clinics	Medical institutions: Number of Hospitals	Medical institutions: Number of beds	Medical institutions: Number of doctors	Stores: Number of big stores	Stores: Number of small stores
1	Ruginesti	4		28	540	30	1	0	0	1	3 (mixed)	8
2	Paunesti	5		42	980	70	1	0	0	4	1 (mixed)	10
3	Pufesti	3		14	348	32	1	0	0	3	3	many
4	Movilita	5		25	360	22	1	0	0	1	0	10
5	Straoane	5		30	450	43	2	0	0	3	2	15
6	Fitionesti	5		32	520	33	2	0	4	2	1	7
7	Panciu	6	1	32	1,650	102	2	1	76	19	8	40
8	Tifesti	5		28	560	52	4	0	0	4	7	16
9	Bolotesti	6			250	45	1	0	0	4	15	-
10	Marasesti	7		104	2,800	120	3	1	125	20	6	73
11	Odobesti	6		65	1,548	104	3	1	270	-	many	many
	Total	57	1	400	10,006	653	21	3	475	61	many	many

Source : JICA Study Team, 1994

Table 3.2.2-A1 Mean Monthly Precipitation in Romania (1901-1990)

No.	Station Name	Mean Monthly Precipitation in mm												Annual	Total of Apr. -Sep.	
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total(mm)	Amount(mm)	Ratio
1	Satu Mare	40.7	35.8	36.3	44.3	63.1	82.4	69.7	64.1	43.7	45.2	47.9	52.1	625.3	367.3	58.7%
2	Suceava	25.1	25.1	24.3	47.0	74.6	92.9	90.4	68.5	42.5	29.4	34.3	24.6	578.7	415.9	71.9%
3	Oradea	37.5	32.2	36.7	47.5	66.0	84.3	61.9	56.4	45.1	43.4	48.5	51.0	610.5	361.2	59.2%
4	Iasi	30.4	27.2	27.4	44.0	55.8	82.8	68.6	55.3	43.0	31.3	37.4	29.5	532.7	349.5	65.6%
5	Cluj-Napoca	26.6	26.9	25.6	45.9	74.4	90.0	78.9	74.3	40.8	37.0	31.4	29.9	581.7	404.3	69.5%
6	Targu-Mures	29.7	29.5	26.8	49.6	74.5	89.1	80.0	71.5	42.1	41.7	37.7	31.7	603.9	406.8	67.4%
7	Bacau	25.9	26.3	25.7	37.3	66.6	85.4	80.8	63.4	46.7	35.6	34.0	29.5	557.2	380.2	68.2%
8	Timisoara	40.2	38.6	37.6	48.1	64.6	81.1	57.7	50.9	42.9	49.5	49.3	48.9	609.4	345.3	56.7%
9	Deva	32.7	30.3	28.6	47.9	64.7	78.6	70.2	59.5	42.2	41.6	37.8	37.8	571.9	363.1	63.5%
10	Sibiu	29.2	26.8	30.7	54.7	78.6	107.6	86.3	72.0	53.5	44.4	34.0	28.8	646.6	452.7	70.0%
11	Varfu Omu	75.8	84.0	78.3	88.8	109.9	142.4	136.1	105.8	65.3	60.5	56.8	70.9	1,074.6	648.3	60.3%
12	Galati	30.7	26.6	23.6	37.4	49.2	66.3	47.3	40.5	38.7	33.4	34.5	32.3	460.5	279.4	60.7%
13	Targu Jiu	53.9	52.0	46.6	64.3	85.3	93.0	61.9	56.9	51.5	66.3	64.9	62.9	759.5	412.9	54.4%
14	Buzau	27.3	27.1	22.8	40.5	63.6	79.6	61.2	50.5	37.0	34.7	39.7	33.1	517.1	332.4	64.3%
15	Calafat	40.0	38.0	38.0	47.9	61.0	65.6	45.6	35.6	38.7	48.9	53.1	48.8	561.2	294.4	52.5%
16	Turnu Magurele	37.4	32.5	35.0	42.2	56.9	67.1	50.8	38.7	37.3	41.3	46.3	41.3	526.8	293.0	55.6%
17	Bucuresti-Filaret	40.6	34.0	37.4	44.4	68.1	86.0	57.8	51.2	39.1	41.1	48.5	41.1	589.3	346.6	58.8%
18	Constanta	29.4	27.1	23.5	27.9	36.0	41.7	33.4	29.5	28.0	33.7	38.4	34.0	382.6	196.5	51.4%

Source : Romanian Statistical Yearbook 1993

Table 3.2.2-A2 Mean Monthly Temperature in Romania (1901 - 1990)

(Unit : ℃)

Station No.	Name	Item	Mean Monthly Temperature in ℃ Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual	Average Apr-Sep.
		Abs. Max.	14.7	17.9	26.0	30.7	32.4	35.5	37.2	39.4	37.3	28.3	24.2	18.0	39.4	39.4
1	Satu Mare	Mean	-2.9	-0.6	4.5	10.4	15.7	18.7	20.4	19.7	15.6	10.1	4.9	0.2	9.7	16.8
		Abs. Min.	-29.3	-27.6	-20.6	-6.4	-2.6	0.6	4.9	3.5	-4.7	-9.3	-19.6	-30.4	-30.4	-6.4
		Abs. Max.	15.0	20.4	26.6	28.4	34.5	33.4	35.2	38.6	32.9	32.0	21.8	17.6	38.6	38.6
2	Suceava	Mean	-5.1	-3.4	1.3	7.8	13.4	16.8	18.5	17.7	13.6	7.8	2.8	-2.2	7.4	14.6
		Abs. Min.	-29.6	-31.0	-21.9	-9.2	-2.0	1.5	5.9	4.6	-3.5	-8.0	-21.2	-25.0	-31.0	-9.2
		Abs. Max.	17.1	19.5	26.4	32.6	33.4	36.6	39.5	39.5	37.0	32.7	23.6	19.2	39.5	39.5
3	Oradea	Mean	-2.0	0.3	5.3	10.8	15.9	18.9	20.8	20.3	16.3	10.9	5.3	0.9	10.3	17.2
		Abs. Min.	-29.2	-24.5	-18.6	-10.0	-4.0	1.0	5.0	4.2	-1.9	-10.5	-17.2	-27.9	-29.2	-10.0
		Abs. Max.	16.7	22.5	27.0	31.5	36.5	38.0	40.0	39.7	38.0	33.9	28.5	19.5	40.0	40.0
4	Iasi	Mean	-3.7	-2.0	3.1	10.1	16.0	19.4	21.1	20.4	16.0	10.0	4.2	-0.7	9.5	17.2
		Abs. Min.	-30.6	-36.3	-22.7	-9.4	-3.0	3.5	6.3	4.6	-3.5	-9.6	-18.6	-29.5	-36.3	-9.4
		Abs. Max.	14.0	19.3	26.6	30.2	32.5	36.0	37.0	38.0	33.7	32.6	26.0	18.5	38.0	38.0
5	Cluj-Napoca	Mean	-4.3	-2.2	3.6	9.2	14.4	17.4	19.1	18.3	14.2	8.8	3.3	-1.3	8.4	15.4
		Abs. Min.	-34.2	-32.5	-22.0	-8.4	-3.5	0.4	5.2	3.5	-3.0	-7.7	-22.3	-27.9	-34.2	-8.4
		Abs. Max.	14.0	18.7	27.0	32.5	34.4	35.3	39.0	38.5	38.2	41.5	26.5	18.3	41.5	39.0
6	Targu Mures	Mean	-4.1	-1.8	4.0	9.7	14.8	17.6	19.3	18.7	14.6	9.2	3.7	-1.3	8.7	15.8
		Abs. Min.	-32.8	-32.0	-27.3	-7.5	-1.6	0.3	5.8	2.7	-3.3	-8.4	-19.6	-25.9	-32.8	-7.5
		Abs. Max.	18.2	22.4	29.6	30.8	35.6	36.5	39.6	38.8	35.8	34.6	26.6	19.0	39.6	39.6
7	Bacau	Mean	-3.8	-2.3	2.8	9.6	15.2	18.8	20.5	19.7	15.3	9.5	3.8	-0.9	9.0	16.5
		Abs. Min.	-30.8	-32.5	-21.5	-11.3	-3.0	2.7	6.0	3.0	-4.5	-10.0	-17.5	-27.8	-32.5	-11.3
		Abs. Max.	17.4	19.7	28.2	32.0	34.5	38.4	39.6	41.0	39.7	33.8	24.8	20.2	41.0	41.0
8	Timisoara	Mean	-1.6	0.5	5.7	11.1	16.3	19.5	21.4	20.8	16.8	11.2	5.7	1.2	10.7	17.7
		Abs. Min.	-35.3	-29.2	-20.0	-5.2	-5.0	2.2	5.9	5.0	-6.5	-6.8	-15.4	-24.4	-35.3	-6.5
		Abs. Max.	15.3	20.8	28.5	32.3	34.6	35.6	39.4	39.7	38.2	32.7	27.4	19.8	39.7	39.7
9	Deva	Mean	-2.6	0.0	5.4	10.7	15.6	18.6	20.4	19.8	15.8	10.2	4.8	0.4	9.9	16.6
		Abs. Min.	-31.6	-28.1	-20.1	-6.0	-2.4	2.2	3.7	4.4	-4.2	-6.5	-16.6	-24.1	-31.6	-6.0
		Abs. Max.	15.6	21.3	30.6	30.2	32.1	35.4	37.5	38.4	39.5	32.5	27.0	19.3	39.5	39.5
10	Sibiu	Mean	-3.7	-1.4	4.0	9.5	14.4	17.4	19.2	18.5	14.6	9.2	3.9	-1.0	8.7	15.6
		Abs. Min.	-31.8	-31.0	-24.5	-12.0	-3.6	1.0	5.2	1.0	-3.6	-9.0	-21.3	-29.8	-31.8	-12.0
		Abs. Max.	5.6	6.0	12.2	12.8	16.6	22.0	22.1	20.8	19.0	20.0	13.6	8.2	22.1	22.1
11	Varfu Omu	Mean	-10.7	-10.8	-8.4	-4.4	0.3	3.4	5.4	5.6	2.8	-0.8	-4.8	-8.4	-2.6	2.2
		Abs. Min.	-32.3	-38.0	-29.6	-26.0	-16.0	-12.0	-8.0	-7.0	-15.0	-49.8	-32.4		-49.8	-26.0
		Abs. Max.	17.0	22.4	27.8	32.5	36.2	36.7	38.6	39.0	35.4	33.5	25.6	20.0	39.0	39.0
12	Galati	Mean	-2.7	-1.1	4.0	10.7	16.5	20.3	22.4	21.8	17.4	11.3	5.2	0.1	10.5	18.2
		Abs. Min.	-26.5	-28.6	-17.2	-5.2	-0.1	4.8	7.6	6.4	-0.5	-6.7	-17.9	-20.2	-28.6	-5.2
		Abs. Max.	18.3	21.7	26.4	31.8	37.5	36.6	39.3	39.0	40.6	31.5	26.4	20.0	40.6	40.6
13	Targu Jiu	Mean	-2.5	-0.4	0.8	10.9	15.9	19.3	21.4	20.8	16.6	10.5	4.9	0.1	9.9	17.5
		Abs. Min.	-31.0	-28.3	-24.7	-4.6	-1.2	2.0	5.5	2.6	-4.0	-9.0	-15.1	-26.9	-31.0	-4.6
		Abs. Max.	18.4	22.2	27.9	31.5	37.3	38.5	39.2	39.6	37.0	35.3	25.0	21.6	39.6	39.6
14	Buzau	Mean	-2.4	-0.3	4.4	10.8	16.6	20.2	22.2	21.8	17.4	11.2	5.1	0.5	10.6	18.2
		Abs. Min.	-29.6	-25.5	-17.0	-5.3	-2.0	4.6	7.5	5.4	-2.0	-8.0	-17.6	-23.0	-29.6	-5.3
		Abs. Max.	20.4	22.4	27.6	34.5	36.5	39.5	41.5	41.3	39.8	31.3	25.9	21.2	41.5	41.5
15	Calafat	Mean	-1.6	0.4	5.6	11.9	17.3	20.9	23.2	22.7	18.2	11.9	5.8	1.1	11.5	19.0
		Abs. Min.	-29.2	-24.6	-15.7	-3.0	1.6	6.2	9.0	7.3	-1.3	-6.2	-16.2	-21.8	-29.2	-3.0
		Abs. Max.	18.0	22.6	29.6	34.2	38.8	38.2	43.2	41.4	40.0	36.4	26.0	22.0	43.2	43.2
16	Turnu Magurele	Mean	-2.4	0.2	5.6	12.2	17.6	21.1	23.2	22.4	18.1	11.8	5.8	0.6	11.4	19.1
		Abs. Min.	-30.0	-26.0	-22.2	-4.6	0.5	5.0	9.0	6.6	-2.5	-5.8	18.8	-25.0	-30.0	-4.6
		Abs. Max.	16.8	21.0	28.8	34.4	36.6	40.3	40.6	41.1	39.6	35.5	29.4	20.8	41.1	41.1
17	Bucuresti-Filaret	Mean	-2.4	-0.3	5.2	11.6	16.9	20.6	22.8	22.3	17.8	11.8	5.5	0.4	11.0	18.7
		Abs. Min.	-30.0	-24.2	-13.6	-5.5	-0.2	4.2	8.6	6.6	-1.6	-10.7	-17.8	-26.4	-30.0	-5.5
		Abs. Max.	18.8	23.3	30.8	31.9	36.5	36.9	38.5	36.8	34.8	31.0	26.5	21.0	38.5	38.5
18	Constanta	Mean	0.0	1.1	4.4	9.5	15.1	19.6	22.1	21.9	18.2	13.2	7.6	2.8	11.3	17.7
		Abs. Min.	-24.7	-25.0	-12.8	-4.5	1.8	6.4	7.6	8.0	1.0	-12.4	-11.7	-21.6	-25.0	-4.5

Source : Statistical Yearbook of Romania 1993

Table 3.2.2-A3 Summary of Meteo-Hydrological Data in the Study Area

Mean Monthly Discharge of the Siret River at Cosmesti (1950-93)

(in m3/s)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Mean Dischrage (m3/s)	70.5	93.4	172.9	329.8	318.7	296.5	229.4	191.6	122.5	102.3	90.8	86.6	175.4
Minimum Discharge (m3/s)	11.0	21.9	36.7	47.7	42.2	38.9	40.1	32.8	30.0	27.0	29.0	22.3	31.6

Mean Monthly Temperature in Focsani (1977-92)

(in ℃)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Mean Maximum	11.0	12.9	21.8	25.2	29.5	32.6	34.5	33.7	31.1	25.8	18.5	13.0	34.5
Mean	-2.0	-0.8	4.6	10.6	16.5	20.2	21.9	21.3	16.9	10.8	4.4	0.0	10.4
Mean Minimum	-14.2	-12.7	-7.6	-0.5	4.2	9.1	10.9	9.7	3.9	-2.7	-6.8	-9.7	-14.2
Absolute Maximum	15.0	24.6	26.2	29.8	32.5	35.7	38.5	37.4	35.6	30.5	27.4	21.4	38.5
Absolute Minimum	-28.0	-22.0	-19.3	-4.2	-0.8	7.0	7.6	6.4	-1.8	-8.4	-11.8	-15.6	-28.0

Mean Monthly Relative Humidity in Adjud (1961-78)

(in %)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Relative Humidity	86.0	86.0	80.0	71.0	72.0	71.0	71.0	72.0	75.0	79.0	83.0	86.0	77.7

Mean Monthly Sunshine Duration in Focsani (1951-65)

(in hours)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Daily Monthly Mean	2.4	3.0	4.4	5.6	7.0	8.4	9.6	9.4	7.5	5.6	2.5	2.0	5.6

Mean Monthly Precipitation in Focsani (1962-93) and Adjud (1948-93)

(in mm)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Mean Monthly in Focsani	30.5	35.6	36.2	46.3	66.9	72.3	60.1	47.3	37.0	31.3	39.5	35.8	538.8
Mean Monthly in Adjud	27.2	27.5	25.4	44.6	70.0	75.8	63.4	50.8	41.9	30.2	35.5	38.5	530.8

Source : INMH/ISPIF

Table 3.2.3-A1 River Basins in Romania

River Code	Name of River Basin	No. of Tributaries	River Course Length (km) All Rivers	Main River	%	Catchment Area (km2)	River Density (km/km2)	Average Main River Discharge (m3/s)	Unit Mean Discharge (m3/km2)	Remarks
I	Tisa Superioara	116	1,491	402	27%	4,640	0.321	125.0	0.027	
II	Somes	417	5,510	1,460	26%	17,740	0.311	121.0	0.007	
III	Crisuri	329	4,887	955	20%	14,880	0.328	21.7	0.001	The flow of White Cris
IV	Mures	714	9,367	1,409	15%	27,830	0.337	157.0	0.006	
	Aranca	8	205	104	51%	990	0.207	1.8	0.002	
	Galatea	1	25	-	-	120	0.208	-	-	
	Ier	1	43	-	-	530	0.081	-	-	
V	Bega	57	1,007	247	25%	4,500	0.224	10.6	0.002	The flow of Bega canal
	Timis	102	1,751	676	39%	7,260	0.241	40.4	0.006	
	Caras	24	457	76	17%	1,270	0.360	6.7	0.005	
VI	Nera	26	422	125	30%	1,400	0.301	14.0	0.010	
	Cerna	34	439	114	26%	1,380	0.318	23.0	0.017	
VII	Jiu	194	3,176	1,110	35%	10,070	0.315	92.0	0.009	
VIII	Olt	564	8,465	2,529	30%	24,010	0.353	165.0	0.007	
IX	Vedea	53	1,478	906	61%	5,450	0.271	13.0	0.002	
X	Arges	161	3,665	2,322	63%	12,590	0.291	65.0	0.005	
XI	Ialomita	118	2,589	1,553	60%	10,430	0.248	41.0	0.004	
XII	**Siret**	**972**	**13,965**	**3,966**	**28%**	**42,830**	**0.326**	**210.0**	**0.005**	
XIII	Prut	238	4,183	1,028	25%	10,990	0.381	80.0	0.007	
XIV	Dunare	134	2,431	936	39%	33,260	0.073	6,300.0	0.189	The flow at Ceatal Ismail
XV	Litoral	32	473	238	50%	5,330	0.089		-	
TOTAL ROMANIA		4,295	66,029	20,156	31%	237,500	0.278		-	

Source : Atlasul Cadastrului Apelor Din Republica Populare Romina Vol. I, 1964

Table 3.2.3-A2 Summary of Mean Monthly River Discharge in the Siret-Ialomita Agricultural Development Project Area

(Unit : m3/sec)

Name of River	Item	Description		Mean Monthly Discharge												Annual	Seasonal Average			
				Jan.	Feb.	Mar	Apr.	May	Jun	Jul.	Aug.	Sep.	Oct.	Nov.	Dec	Mean	I-XII	X-IX	IV-IX	X-III
Ialomita	No. of Station	546	n	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	43
	Name of Station	Cosereni	Mean	29.3	36.1	47.7	59.6	63.3	56.4	43.8	29.4	22.9	25.8	26.3	30.1	39.2	39.2	39.1	45.9	32.9
	Catchment Area	6,265 km2	Max.	120.0	109.0	145.0	156.0	179.0	125.0	192.0	71.9	97.3	298.0	80.1	79.3	82.4	82.4	84.5	88.6	102.4
	period	1950 - 1993	Min.	8.1	10.2	13.5	10.3	11.3	6.5	5.5	5.3	5.1	5.7	8.8	7.4	11.8	11.8	11.2	10.0	12.2
	No. of Station	547	n	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	43
	Name of Station	Slobozia	Mean	33.1	38.9	55.6	67.2	68.0	63.0	49.4	33.9	26.1	27.5	28.6	32.7	43.7	43.7	43.6	51.3	36.5
	Catchment Area	9,154 km2	Max.	145.0	110.0	147.0	242.0	164.0	128.0	214.0	83.7	97.6	282.0	81.6	88.3	86.8	86.8	94.1	101.6	111.3
	period	195- -1993	Min.	10.6	11.0	14.7	11.1	12.2	8.3	9.0	4.0	3.7	5.0	9.4	8.5	12.8	12.8	13.0	10.8	13.0
Siret	No. of Station	579	n	34	34	34	34	34	34	34	34	34	34	34	34	34	34	32	34	32
	Name of Station	Racatau	Mean	61.6	74.1	118.2	203.2	221.3	218.5	183.8	148.1	98.2	88.5	79.3	74.8	130.8	130.8	132.5	178.8	82.7
	Catchment Area	19,492 km2	Max.	145.0	145.0	252.0	433.0	924.0	633.0	672.0	844.0	247.0	372.0	174.0	179.0	246.8	246.8	251.0	370.3	195.5
	period	1950 -1985	Min.	11.8	24.1	43.5	66.7	63.6	50.9	41.5	36.0	28.4	31.8	31.3	18.7	60.2	60.2	60.9	68.0	33.9
	No. of Station	580	n	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	43
	Name of Station	Cosmesti	Mean	70.5	93.4	172.9	329.8	318.7	296.5	229.4	191.6	122.5	102.3	90.8	86.6	175.4	174.0	173.1	245.2	102.6
	Catchment Area	25,666 km2	Max.	236.0	215.0	470.0	917.0	1151.0	762.0	819.0	939.0	360.0	686.0	243.0	278.0	327.9	327.9	327.1	492.0	290.2
	period	1950 - 1993	Min.	11.0	21.9	36.7	47.7	42.2	38.9	40.1	32.8	30.0	27.0	29.0	22.3	52.0	52.0	51.3	61.5	30.8
	No. of Station	581	n	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	43
	Name of Station	Lungoci	Mean	88.6	114.6	208.3	368.2	352.4	330.2	254.7	211.0	139.4	119.1	107.8	104.2	199.9	199.9	198.9	276.0	123.6
	Catchment Area	36,036 km2	Max.	265.0	242.0	517.0	1000.0	1253.0	833.0	894.0	998.0	399.0	751.0	272.0	310.0	363.9	363.9	363.0	540.8	323.6
	period	1950 - 1993	Min.	19.1	33.5	49.5	61.4	55.5	51.9	44.7	45.3	38.0	37.4	29.8	29.1	66.0	66.0	64.8	76.2	44.8
Putna	No. of Station	665	n	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
	Name of Station	Colacu	Mean	4.7	5.8	10.9	24.7	27.7	17.2	13.3	10.7	7.9	6.5	5.7	5.4	11.7	11.7	11.9	16.8	6.6
	Catchment Area	1,100 km2	Max.	18.8	17.9	32.8	51.0	101.0	39.1	51.4	49.6	48.3	53.3	15.8	17.1	21.5	21.5	21.9	31.5	15.6
	period	1950 - 1993	Min.	0.9	1.0	3.4	4.6	5.6	3.3	2.2	2.1	1.1	1.2	1.2	1.5	5.5	5.5	4.6	3.4	1.7
Buzau	No. of Station	677	n	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	48
	Name of Station	Sageata-Banita	Mean	14.7	21.5	34.6	52.2	46.8	41.3	36.6	21.1	13.8	13.0	15.5	17.0	27.3	27.3	27.3	35.3	19.5
	Catchment Area	3,980 km2	Max.	60.7	76.5	99.0	108.0	151.0	116.0	154.0	110.0	44.6	125.0	98.4	67.6	49.7	49.7	51.5	68.1	50.7
	period	1945 - 1993	Min.	3.4	3.1	7.0	7.9	5.3	4.8	4.0	0.9	0.5	3.1	2.5	3.1	9.8	9.8	8.9	10.1	5.4
	No. of Station	678	n	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	48
	Name of Station	Racovita	Mean	15.9	21.9	34.8	52.2	46.5	40.3	36.0	20.9	14.3	14.3	15.5	16.9	27.4	27.3	27.3	35.0	19.8
	Catchment Area	5,240 km2	Max.	85.5	76.5	96.0	133.0	175.0	116.8	167.0	110.0	57.9	154.0	57.7	67.8	54.1	54.1	55.6	71.1	53.9
	period	1945 - 1993	Min.	1.5	2.1	7.0	7.9	5.3	1.4	4.0	0.9	0.5	3.2	2.5	3.1	9.9	9.9	8.9	10.2	3.7

Source : INMH/ISPIF