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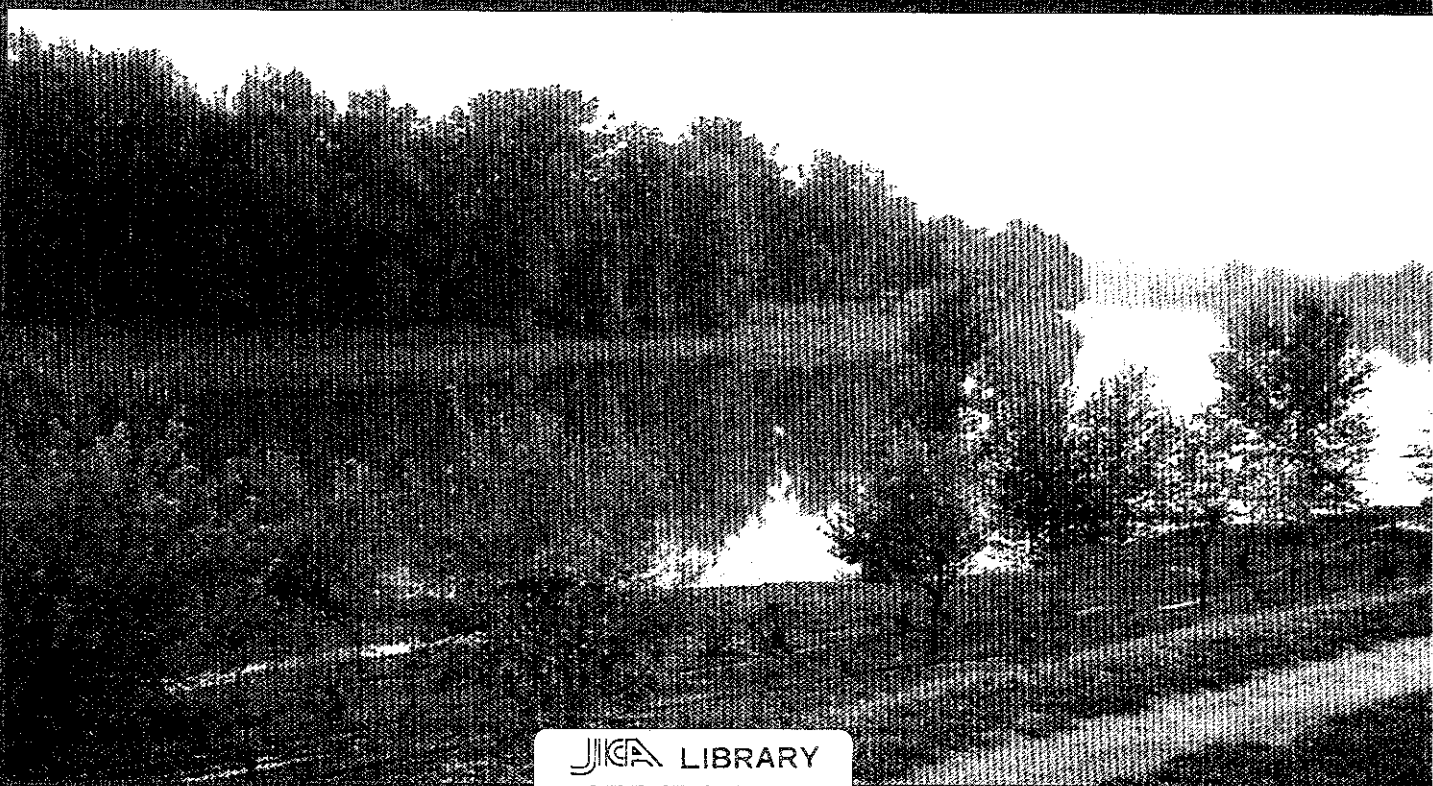
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

No.

MINISTRY OF ECONOMY
MINISTRY OF AGRICULTURE AND FOOD INDUSTRY
THE STATE WATER RESOURCES MANAGEMENT CONCERN
"APELE MOLDOVEI"
THE REPUBLIC OF MOLDOVA

THE STUDY ON WATER SUPPLY SYSTEMS FOR THE NORTHERN REGION IN THE REPUBLIC OF MOLDOVA

FINAL REPORT Main Report



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January 2003

PACIFIC CONSULTANTS INTERNATIONAL, TOKYO
TOKYO ENGINEERING CONSULTANTS, TOKYO

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EXCHANGE RATES

In this report, project costs are estimated base on the following exchange rates:

Master Plan Stage: 1 US\$ = 12.80 Lei = 125 Japanese Yen (August 1, 2001)

Feasibility Study Stage: 1 US\$ = 13.60 Lei = 120 Japanese Yen (August 1, 2002)

PREFACE

In response to a request from the Government of the Republic of Moldova, the Government of Japan decided to conduct a master plan and feasibility study on Water Supply Systems for the Northern Region and entrusted the study to the Japan International Cooperation Agency (JICA).

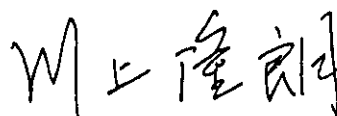
JICA selected and dispatched a study team headed by Dr. Akira UCHIDA of Pacific Consultants International (PCI) and composed of PCI and Tokyo Engineering Consultants (TEC) to Moldova three times between March 2001 and November 2002. In addition, JICA set up an advisory committee headed by Mr. Yoshiki OMURA, Senior Advisor, Institute for International Cooperation, JICA between March 2001 and January 2003, which examined the study from specialist and technical point of view.

The team held discussions with the officials concerned of the Government of Moldova and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Moldova for their close cooperation extended to the team.

January 2003



Takao Kawakami

President

Japan International Cooperation Agency

January 2003

Mr. Takao Kawakami
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit to you the final report entitled "The Study on Water Supply Systems for the Northern Region in the Republic of Moldova." This report has been prepared by the Study Team in accordance with the contracts signed on 21 March 2001 and 26 April 2002 between the Japan International Cooperation Agency (JICA) and the consortium of Pacific Consultants International and Tokyo Engineering Consultants.

The report examines the existing conditions related to water supply in the northern region, proposes a master plan for the water supply systems, and presents the results of the feasibility study on the priority project which was identified in the master plan.

The report consists of the Summary, Main Report, Supporting Report, and Drawings. The Summary summarizes all the results of the Study. The Main Report presents the existing conditions, the proposed master plan, the results of the feasibility study, and recommendations. The Supporting Report includes technical details to support reasoning of the contents of the Main Report. The Drawings volume contains principal design drawings of the priority project.

We wish to express grateful acknowledgements to the Japan International Cooperation Agency, JICA Advisory Committee, Ministry of Foreign Affairs, Ministry of Health, Labour and Welfare, Embassy of Japan in Ukraine, and also to Moldovan officials and individuals concerned for their assistance and cooperation extended to the Study Team. We sincerely hope that the results of the Study will contribute to the promotion of the water supply improvement projects in the northern region.

Yours faithfully,

内田 顕

Akira Uchida
Team Leader

ABBREVIATIONS

ACB	Apa Canal Balti (Balti Municipal Water Supply and Sewerage Utilities)
ACF	Apa Canal Falesti (Falesti Municipal Water Supply and Sewerage Utilities)
ACR	Apa Canal Riscani (Riscani Municipal Water Supply and Sewerage Utilities)
ACS	Apa Canal Soroca (Soroca Municipal Water Supply and Sewerage Utilities)
ACSB	Apa Canal Soroca-Balti (Soroca-Balti Water Supply Corporation)
AGeoM	State Agency of Underground Resources and Geology
Apele Moldovei	The State Water Resources Management Concern
BOD	Biochemical oxygen demand
COD	Chemical oxygen demand
CN & R	Construction Norms and Rules in Moldova
DAPRE	District Association for Production, Repair and Exploitation (under Apele Moldovei)
DHPU	Department of Housing and Public Utilities, MECTD
DWQS	Drinking water quality standard
EBRD	European Bank for Reconstruction and Development
ELA	Environmental impact assessment
EIRR	Economic internal rate of return
FIRR	Financial internal rate of return
GDP	Gross domestic product
GNP	Gross national product
GOST	National Standards (of the former Soviet Union)
GWh	Giga watt-hour
IEE	Initial environmental examination
MAFI	Ministry of Agriculture and Food Industry
MECTD	Ministry of Environment, Construction and Territorial Development
NPV	Net present value
O/M (or O&M)	Operation and maintenance
PS	Pumping station (e.g., PS-1: Pumping Station No. 1)
RWQS	Raw water quality standard
TR	Transmission Reservoir (e.g., TR-1: Transmission Reservoir No. 1)
WS	Water supply
WSS	Water supply service
WTP	Water treatment plant
WWTP	Wastewater treatment plant

UNITS

m	meter
cm	centimeter
mm	millimeter
km	kilometer
m ²	square meter
ha	hectare
km ²	square kilometer
m ³	cubic meter
cm/s	centimeter per second
m ³ /s (or m ³ /sec)	cubic meter per second
m ³ /min	cubic meter per minute
m ³ /h	cubic meter per hour
m ³ /d (or m ³ /day)	cubic meter per day
m ³ /y (or m ³ /yr)	cubic meter per year
Lcd	liter per capita per day (specific water consumption of people)
Lhd	liter per head per day (specific water consumption of livestock)
kW	kilowatt
MW	megawatt
kWh	kilowatt-hour
TWh	terawatt-hour
V	volt
kV	kilovolt
kgf	kilogram force
kg-m ²	kilogram square meter
mg/l	milligram per liter
r.p.m.	revolution per minute

**The Study on Water Supply Systems for the Northern Region
in the Republic of Moldova**

**FINAL REPORT
Main Report**

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PART 1
INTRODUCTION AND PRESENT CONDITIONS

CHAPTER 1 INTRODUCTION

1.1 Background to the Study

Bordered by Romania and Ukraine, the Republic of Moldova lies around latitude 47 degrees north and longitude 28 degrees east. Prut River, a tributary of the Danube, and Nistru River run along the western and the eastern borders of the country, respectively, and flow into Black Sea. The country has a total area of 33,800 km² and a population of 4.26 million.

During the regime of the Soviet Union, infra-structural and industrial developments were considerably active. However, after the disintegration of the Soviet Union, most of development projects in Moldova including water supply projects halted. It has been difficult for the Republic of Moldova, a newly established independent state, to resume those development projects on its own, under the deep decline of the national economy associated with the transition from planned economy to market economy.

In the northern region of the country, the economic decline after the independence has been deeper in comparison to other regions. There are many problems in water supply systems in cities/towns and villages of the region. The water supply system, which was developed by 1984 using Nistru River water and operated by Apa Canal Soroca-Balti to supply treated water to the cities of Soroca, Balti and neighbouring communities, stopped its operation completely in September 2000 because of financial difficulties. For the towns of Riscani and Falesti, new water supply systems utilising the Prut River water were under construction by late 1980s, but the construction works suddenly halted corresponding to the disintegration of the Soviet Union.

Facing such situations, the municipal water supply and sewerage corporations (Apa Canals) in above cities/towns have been forced to supply water from groundwater resources, which are not adequate in quantity and not satisfactory in quality.

Under above stated circumstances, it has become necessary to conduct the current study, the Study on Water Supply Systems for the Northern Region in the Republic of Moldova (hereinafter called "the Study"), in order to improve the state of water supply in the region.

The Scope of Work for the Study was agreed in December 2000 between Japan International Cooperation Agency (JICA) and the Moldovan authorities concerned. The Study in Moldova started in April 2001 with the arrival of the Study Team selected by JICA.

This report, Final Report, presents the complete content of the water supply master plan and the feasibility study on the priority project. The report consists of the following volumes:

- (1) Main Report (English)
- (2) Supporting Report (English)
- (3) Drawings (English)
- (4) Summary (English)
- (5) Summary (Moldovan)

1.2 Objectives of the Study

The objectives of the study are as follows:

- (1) To formulate a master plan for water supply systems for four cities/towns (Balti, Soroca, Falesti and Riscani) in the northern region of Moldova with the target year of 2015
- (2) To conduct a feasibility study on priority project(s) which will be selected from projects constituting the master plan
- (3) To pursue technology transfer to the counterpart personnel in the course of the Study

1.3 Study Area

The Study will cover the following four cities/towns in the northern region of Moldova. Their locations are shown in Figure 1.3.1. Figure 1.3.2 shows a proposed scheme of water supply for these 4 cities/towns.

Balti	Population	163,000
Soroca	Population	46,000
Falesti	Population	19,000
Riscani	Population	16,000

(Note: The population figures are approximation of 1998 data.)

In the development of the master plan, however, other towns/villages are also taken into consideration for determination of capacities of relevant water supply facilities.

When planning the rehabilitation and expansion of the existing Soroca-Balti pipeline, the following towns/villages are also taken into consideration.

- Town of Drochia and the villages existing along the route from Soroca to Drochia
- Towns of Floresti and Singerei, and the villages existing along the route from Balti to Singerei
- Villages existing along the present Soroca - Balti pipeline
- Villages existing along the route from Balti to Falesti
- Villages existing along the route from Balti to Riscani

When considering independent water supply systems for Falesti and Riscani using Prut River water as water source, the following villages are also taken into consideration.

- Villages existing along the route from the possible treatment plant site to Town of Falesti
- Villages existing along the route from the possible water treatment plant site to Town of Riscani

1.4 Outlines and Schedule of the Study

The Study is composed of 2 phases and 6 stages as shown in Figure 1.4.1, which also shows major items of the Study and general time schedule.

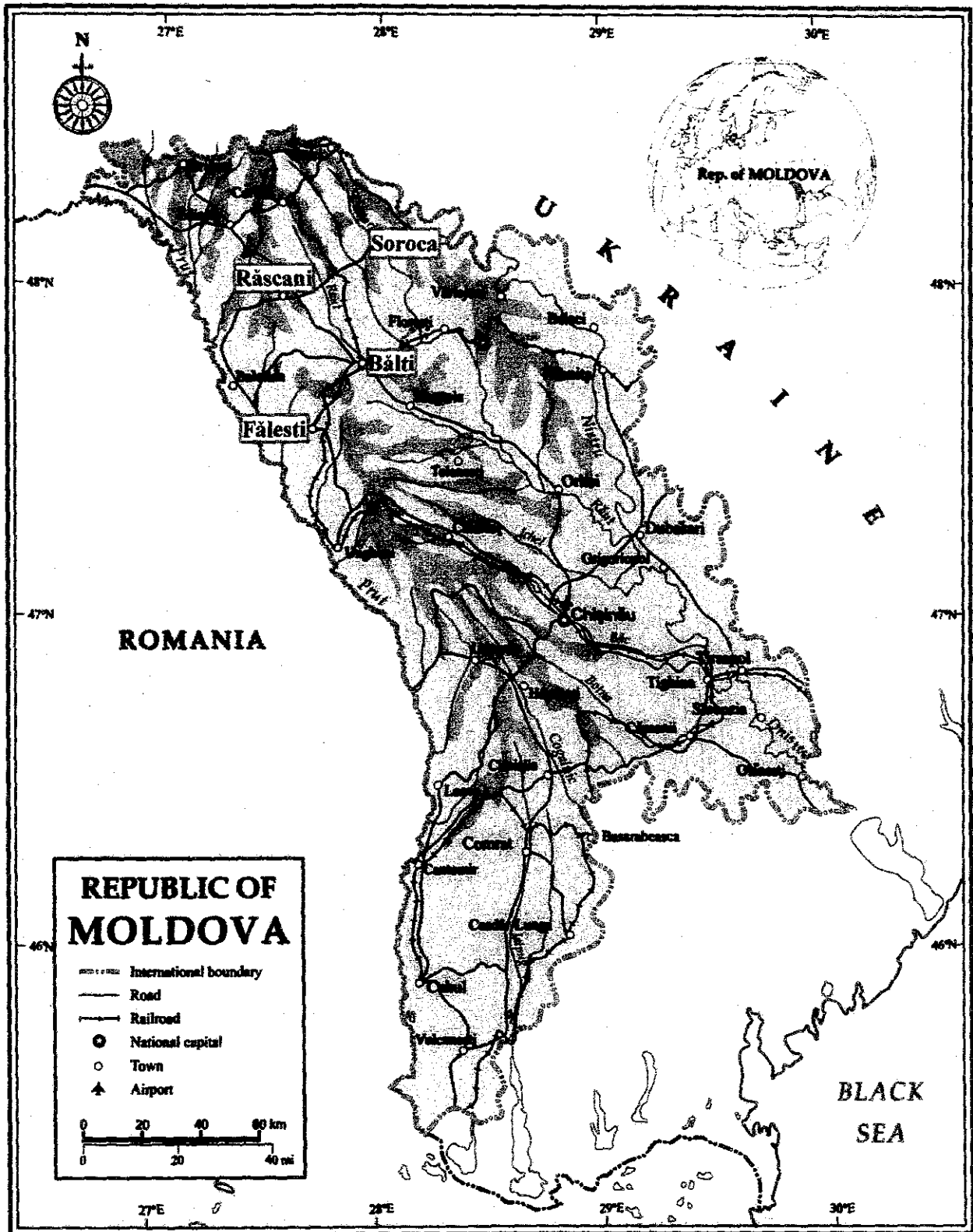
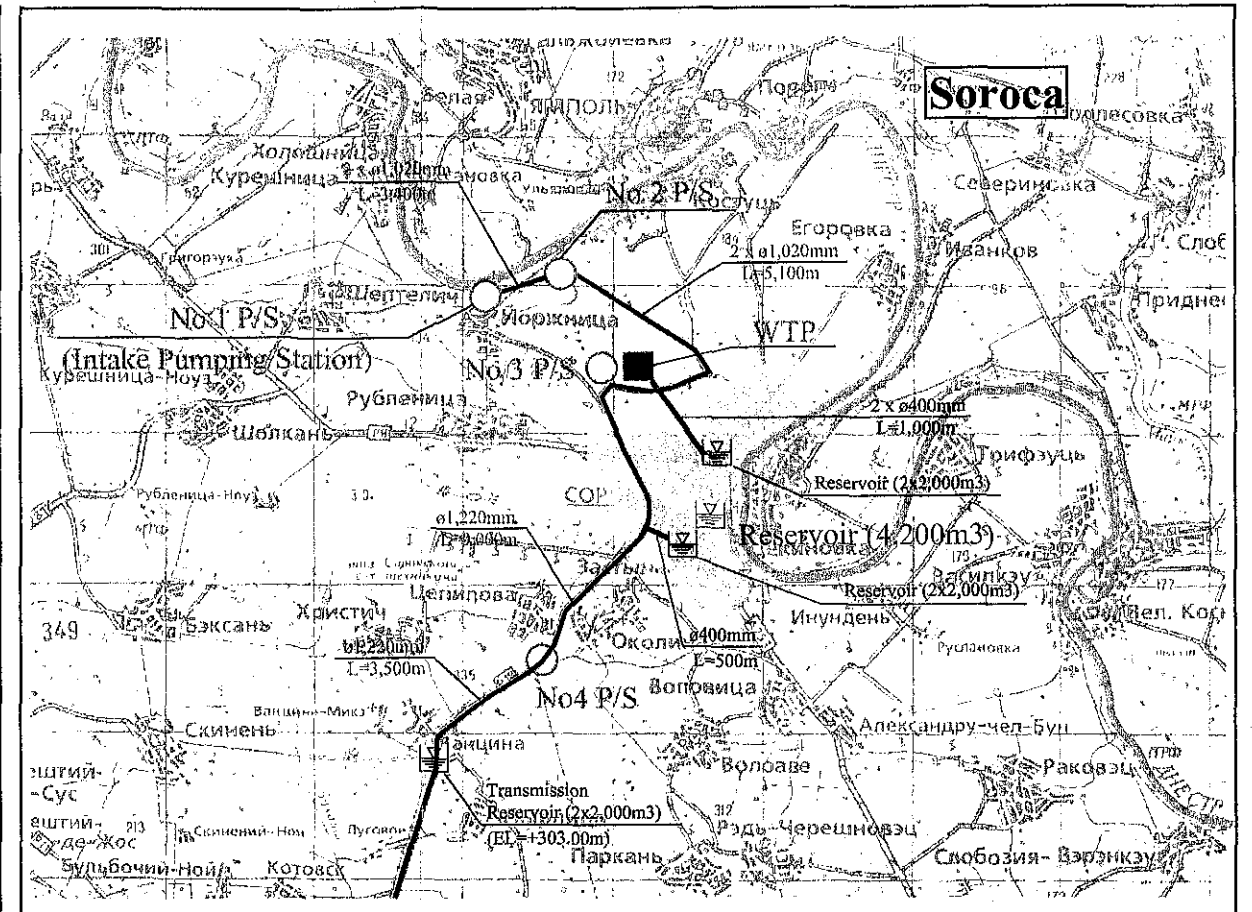
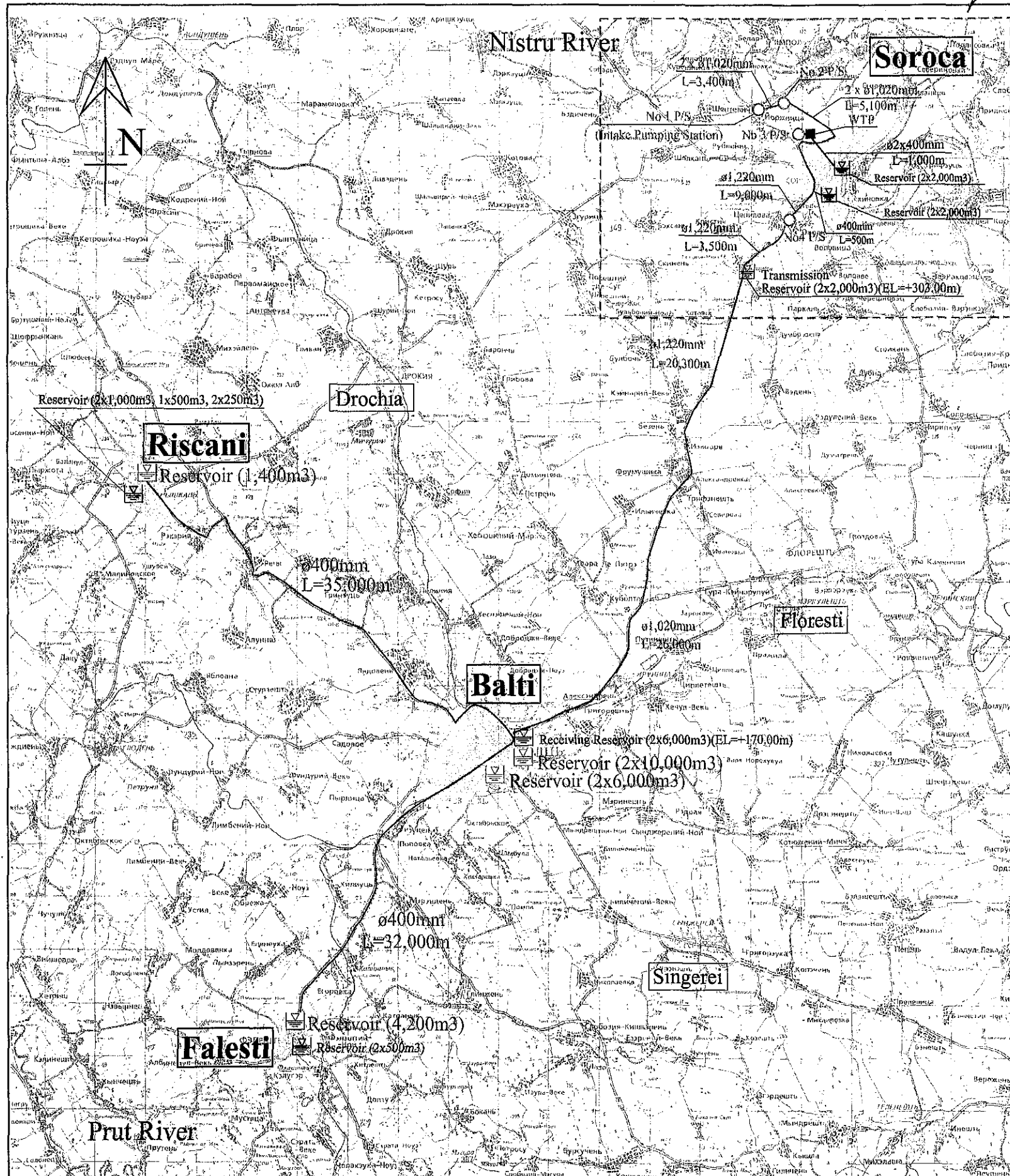


Figure 1.3.1 Location of Study Area



LEGEND

○	Pumping Station (Existing / to be rehabilitated)
■	Water treatment Plant (to be rehabilitated)
▽	Reservoir (Existing)
▽	Reservoir (Unfinished/to be completed)
▽	Reservoir (New)
—	Pipeline (Existing)
—	Pipeline (Existing / to be rehabilitated)
—	Pipeline (New)
	Served Area

Figure 1.3.2 Proposed Scheme of Water Supply

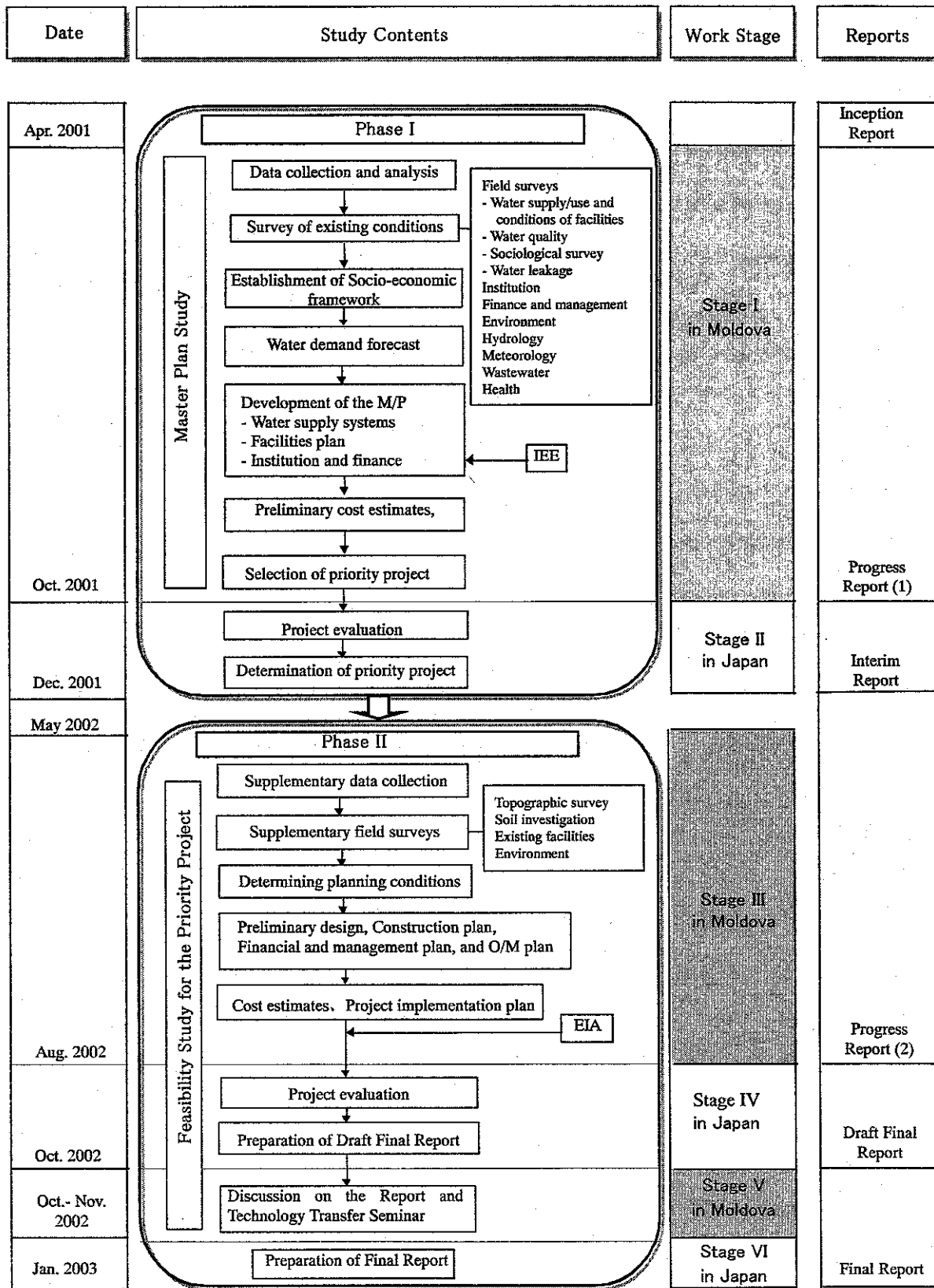
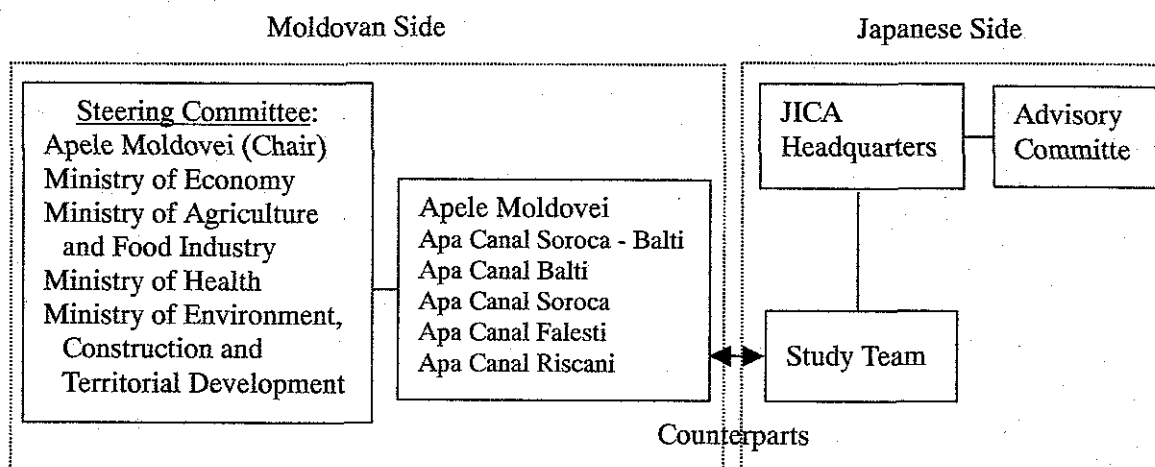


Figure 1.4.1 Study Outlines and Time Schedule

1.5 Study Organization

(1) General

General organisation for the Study is as shown below.



(Note) Apele Moldovei:	The State Water Resources Management Concern
Apa Canal Soroca-Balti:	Soroca-Balti Water Supply Corporation
Apa Canal Balti:	Balti Municipal Water Supply and Sewerage Utilities
Apa Canal Soroca:	Soroca Municipal Water Supply and Sewerage Utilities
Apa Canal Falesti:	Falesti Municipal Water Supply and Sewerage Utilities
Apa Canal Riscani:	Riscani Municipal Water Supply and Sewerage Utilities

In the Japanese side, the Study Team is responsible for executing the Study under the supervision of the JICA Headquarters. The Advisory Committee, which has been set up specifically for the Study, provides technical advice to the JICA Headquarters.

Among the Moldovan counterparts to the Study Team, Apele Moldovei is the focal point and it also chairs the Moldovan Steering Committee which provides state-level guidance for the Study in coordination among the members.

(2) JICA Members

1) Study Team

The members of the Study Team are as follows:

Name	Field in Charge	Organization
Dr. Akira UCHIDA	Team leader / Water supply planning	PCI
Mr. Kiyoshi NAKAHARA	Water supply facility planning	PCI
Mr. Katsuyoshi TOMONO	Institutional analysis	TEC
Prof. Kunimasa NISHIGAYA	Finance and management analysis	KSU
Mr. Shimao HIDAKA	Water transmission and distribution planning	PCI
Mr. Yarai SATOH	Mechanical facilities design	KPE
Mr. Takao FURUKAWA	Electrical facilities design	TOYO
Mr. Masahiro KAWACHI	Water quality survey / Environmental analysis	PCI
Mr. Yuichi HASHIMOTO	Environmental analysis	PCI
Mr. Akira OGIHARA	Sociological analysis	PCI
Mr. Naoto TOHDA	Water leakage survey	PCI
Mr. Shinya NAKAI	Water intake planning	TEC
Mr. Takayuki ARAKI	Work coordination	PCI
Mr. Tomikazu KITAZUME	Interpreter / Translator	Hokuto

Note: PCI Pacific Consultants International
TEC Tokyo Engineering Consultants
TOYO Toyo Engineering Corporation
KPE KPE Corporation
KSU Kanazawa Seiryu University
Hokuto Hokuto Translation, ltd.

2) Advisory Committee

The members of the JICA Advisory Committee are as follows:

Name	Field in Charge	Present Position
Mr. Yoshiki OMURA	Chairman / Water supply planning	Senior Advisor, Institute for International Cooperation, JICA
Mr. Tsuyoshi ITO	Water supply administration	Water Works and Sewerage Bureau, City of Nagoya

(3) Moldovan Members

The major Moldovan counterpart members are as follows:

Name	Field in Charge	Position
Dr. ing. Mihail S. PENCOV	Overall supervision	President, Apele Moldovei
Mr. Victor CORCODEL	Water supply in Balti	Director, Apa Canal Balti
Mr. Ion DUCA	Water supply of ACSB	Director, Apa Canal Soroca-Balti
Mr. Alexandru SOROCEAN	Water supply in Soroca	Director, Apa Canal Soroca
Mr. Dumitru ROTARU	Water supply in Falesti	Director, Apa Canal Falesti
Mr. Mihai NOVAC	Water supply in Riscani	Director, Apa Canal Riscani
Mr. Valeriu CATRINESCU	General supervision	Director General, Acvaproiect
Mr. Anatol CALASNIC	General coordination	Acvaproiect
Mr. Sergei CHIRILOVICI	Water supply engineering	Acvaproiect
Mr. Valentin BORDENIUC	Water supply facility planning	Acvaproiect
Ms. Tatiana IVANOVA	Water supply planning	Acvaproiect
Dr. Ruslan MELIAN	Environmental impact assessment	Acvaproiect
Dr. Ion SALARU	Water quality survey	Ministry of Health
Mr. Mihail VOLC	Water sources planning	Apele Moldovei
Mr. Anton STEPANOV	Institutional investigation	Acvaproiect
Ms. Maria BUJOR	Financial investigation	Acvaproiect
Mr. Ion BEGLET	Legislative investigation	Acvaproiect
Mr. Anton MONASTIRSKI	Electrical facilities survey	Acvaproiect
Mr. Nicolai COLOTILOV	Mechanical facilities survey	Acvaproiect

CHAPTER 2 PRESENT CONDITIONS OF THE STUDY AREA

2.1 Socio-economic Conditions

2.1.1 Overview of the Country

(1) Population

The total population of the country was 4,264,300 in January 2001. The past trend of the population is shown in Table 2.1.1.

Table 2.1.1 Trend of Population in Moldova

	1970	1979	1989	1990	1991	1996	1997	1998	1999	2000	2001
Total (1,000 persons)	3,568.9	3,947.4	4,337.6	4,361.6	4,366.3	4,334.4	4,320.0	4,304.7	4,293.0	4,281.5	4,264.3
Growth (%)				0.55	0.11		- 0.33	- 0.27	- 0.27	- 0.27	- 0.40
Urban (%)	32	39	47		47	46	46	46	46	46	45
Rural (%)	68	61	53		53	54	54	54	54	54	55
Male (%)	47	47	47	48	48	48	48	48	48	48	48
Female (%)	53	53	53	52	52	52	52	52	52	52	52

Source: Refs. 25, 26

The population has been steadily decreasing in the latest several years. It decreased since 1991 to 2001 by about 100,000. The population density in 2001 is 126.2 persons/km². The population emigrated to foreign countries in the latest 4 years is as follows (Ref. 26):

	1997	1998	1999	2000
Emigrated population (persons)	5,503	4,783	6,318	9,128

Top 3 countries of the destination are Germany, the USA, and Israel. These countries absorbed 40% of the total emigrant population in 2000.

Table 2.1.2 shows the population by county in 2001 together with the population of Chisinau City.

Table 2.1.2 Population by County (1 January 2001)

County	Total	Urban		Rural	
	Persons	Persons	%	Persons	%
Chisinau (City)	778,800	713,400	91.6	65,400	8.4
Balti	504,100	213,200	42.3	290,900	57.7
Cahul	190,700	47,800	25.1	142,900	74.9
Chisinau	383,100	52,700	13.8	330,900	86.2
Edinet	284,000	72,200	25.4	211,800	74.6
Lapusna	277,500	64,200	23.1	213,300	76.9
Orhei	301,800	67,300	22.3	234,500	77.7
Soroca	277,900	80,200	28.9	197,700	71.1
Taraclia	46,000	15,500	33.7	30,500	67.3
Tighina	170,000	34,500	20.3	135,500	79.7
Ungeheni	261,300	76,200	29.2	185,100	70.8
UTA Gagauzia *1)	159,300	64,200	40.3	95,100	59.7
Sub-total	3,634,500	1,501,400	41.3	2,133,100	58.7
UATSN *2)	629,800	432,500	68.7	197,300	31.3
Total	4,264,300	1,933,900	45.4	2,330,400	54.6

Source: Ref. 26.

*1): Administrative - Territorial Unit Gagauzia

*2): Administrative - Territorial Unit on the left bank of Nistru River. The table in Reference 26 gives the population figures up to the sub-total. The difference between the total and sub-total is deemed to be the population of UATSN.

The population share of City of Chisinau is 18.3% in the total, and the share of the City and Chisinau County together constitutes 27.2% of the total. Balti County is second to Chisinau City in the population and urbanization when excluding UATSN.

(2) Geography

Some geographic features of the Republic of Moldova are shown below (Refs. 25, 26).

Area	:	33,800 km ²
Location	:	latitude 45°28' - 48°28' north Longitude 26°40' - 30°06' east
Capital	:	Chisinau
Wood coverage of the land	:	9%
Major rivers	:	Nistru River, Prut River, Raut River
Main lakes	:	Beleu, Bic, Dracele
Natural reserves	:	Codru, Plaiul Fagului, Iagorlic, Prutul de Jos, Padurea, Domneasca

Average annual temperature	:	8.2 - 10.3°C
Average annual precipitation	:	584.1 - 890.5 mm
Number of days with precipitation	:	113 - 147 in a year

(3) Administrative-Territorial Organization

As of January 2001, administrative-territorial units in the Republic are organized as shown below (Sources: Refs. 28, 29):

County (Judete)	:	10
Autonomous territory	:	1 (Administrative-Territorial Unit Gagauzia: UTA Gagauzia)
Other territory	:	1 (Administrative-Territorial Unit on the Left Bank of Nistru River: UATSN)
Large City (Municipe)	:	15
City/town (Orase)	:	50
Village and Commune	:	886 Villages constitute 663 Communes

The territory of Moldova is organized, in the administrative aspect, into 2 levels. Cities/towns and villages constitute the first level, and counties, the autonomous territorial unit Gagauzia, and Chisinau constitute the second level.

The village is an administrative-territorial unit. Two or more villages can unite and create one administrative-territorial unit, which is called the commune. The city/town is an administrative-territorial unit of urban type, more developed than the village. Certain cities/towns may be declared municipes.

The municipe Chisinau is the capital of the Republic of Moldova, and its status is regulated by organic law.

The county is an administrative-territorial unit, composed of communes and municipes. The municipe, on the territory of which the authorities of the local public administration of the county are located, is called a county center.

The county has a council composed of a council president and councillors who are both elected by public votes. Governor of the county is appointed by the state government (cabinet). Mayors and councillors of cities and towns, as well as headmen and councillors of villages, are also elected by public votes.

(4) Economy and Industry

Table 2.1.3 shows the changes in the gross domestic product (GDP) in the past several years, and Table 2.1.4 shows the structure of GDP by economic activities.

Table 2.1.3 Gross Domestic Product (GDP)

	1994	1995	1996	1997	1998	1999	2000
GDP (million lei, current prices)		6,480	7,798	8,917	9,122	12,322	15,980
GDP growth (annual%)			-5.9		-6.5	-3.4	1.9
GDP per capita							
- Current prices (Lei)	1,313	1,798	2,167	2,441	2,498	3,379	4,391
- Purchasing power parity (USD)	2,975	2105	2128	2,207	2,087	2,033	
- Ratio to the previous year by comparable price				100.1	93.5	96.8	102.1
GNP per capita							
- Current prices (USD)			650.0		470.0	410.0	400.0

Sources: Refs. 24, 25, 26, 31.

Table 2.1.4 Structure of Gross Domestic Product by Economic Activities (%)

Categories	1997	1998	1999	2000
Total gross value added	86.0	84.6	89.3	87.6
- Agriculture/forestry/fishery	26.0	25.8	24.9	24.5
- Industry	20.2	16.7	17.0	17.5
- Construction	4.7	3.2	3.3	2.6
- Commerce	8.2	10.3	15.3	13.4
- Transportation/communication	6.5	7.4	8.2	9.0
- Others	24.2	26.0	26.2	26.6
- Indirect financial service	-3.8	-4.8	-5.6	-6.0
Net products and import taxes	14.0	15.4	10.7	12.4
Gross domestic product	100	100	100	100

Source: Ref. 26.

The GDP per capita at purchasing power parity (PPP) decreased in 1995 to 71% of the previous year. Since then, it remains at similar levels.

The shares of industry and construction in the GDP have been decreasing in the latest 3 years, while that of commerce, transportation/communication, and "others" have been increasing.

(5) Income Level

Average monthly income in the country and the counties in 1999 and 2000 are shown in Table 2.1.5. The differences in income levels between Chisinau City and all other regions are remarkable.

Table 2.1.5 Average Monthly Family Income (Lei)

	1999	2000
National average	304.6	407.0
Chisinau City	481.3	614.7
Balti County	266.6	358.9
Cahul County	222.4	307.0
Chisinau County	242.2	315.3
Edinet County	204.2	281.0
Lapusna County	198.0	275.7
Orhei County	217.3	317.9
Soroca County	228.4	305.6
Taraclia County	227.7	274.6
Tighina County	195.0	251.1
Ungeheni County	225.1	293.1
UTA Gagauzia	236.2	299.1

Source: Ref. 26

(6) Energy

Moldova is a net energy importer with only 3% of demand for primary energy covered by domestic sources. In 1995 primary energy supply was dominated by natural gas (48%). The main energy suppliers are in Russia (100% of gas imports), Ukraine (with Russia it accounts for 100% of country's coal imports), and several European countries (oil products). The Republic annually spends about 25 - 30% of GNP for energy import.

Some 60% of final energy consumption is in the form of electricity and heat, of which industry is the main consumer (41% and 47%, respectively). Until 1998, electricity was supplied by only one enterprise "Moldenergo," a State Company. The largest plant is the Moldovan Thermal Power Plant (MTPP) located on the left bank of Nistru. MTPP produces 85% of the electricity produced in the country. At the end of 1997 this Company was divided into 14 smaller enterprises under the privatization programme.

Installed capacities and operating capacities of Moldovan power plants are shown in Table 2.1.6.

Operating capacity amounts to only 54% of installed capacity. The energy supply level per capita in Moldova is below the average of Europe and lower than in all neighboring countries. The consumption of primary energy dropped by more than 50% from 10.3 million toe in 1990 to 4.8 million toe in 1995. Electricity consumption also decreased from 12,700 GWh to 5,400 GWh. There was a significant decrease in heat consumption, from 4,283,000 toe (ton oil equivalent) in 1991 to 1,630,000 toe in 1995.

Energy consumption in the residential sector fell between 1991 and 1995, from 2.02 million toe to about 1.18 million toe. Heat represents 30% of residential energy consumption. Energy consumption in the transport sector decreased considerably, from 1.25 millions toe in 1990 to 0.35 million toe in 1995. Industrial manufacturing is the main energy consumer among the economic sector. Energy consumption in industry decreased from 2.09 million toe in 1990 to 0.7 million toe in 1995, and that of agriculture from 0.98 million toe to 0.35 million toe. (Source: Ref. 9 with minor modifications)

Table 2.1.6 Installed and Operating Capacities of Moldovan Power Plants, 1996

Plant	Installed capacity, MW	Operating capacity, MW
MTPP-Dniestrovsk	2,520.0	1,629.4
TPP-1 Chisinau	54.0	40.0
TPP-2 Chisinau	240.0	215.0
TPP-Balti	20.4	20.4
District heating power plant Chisinau	98.0	92.0
HPS-Dubasari	48.0	48.0
HPS-Costesti	16.0	14.0

Source: Ref. 8.

Electricity lines connection with Western European countries are limited (3 lines 110 kV with Romania), but very extensive with Eastern European countries (7 lines 330 and 14 lines 110 kV with Ukraine).

The former State Company "Moldenergo" has been decentralized, privatized and corporatized in last years. Three categories of enterprises with investment capitals are existing (Ref. 30):

- Power generation companies: MTPP-Dniestrovsk, TPP-1, TPP-2, TPP-Balti
- Transmission company: Moldtranselectro
- Distribution companies: RED Chisinau, RED Central, RED South (all privatized by UNION Fenosa), and RED North, RED Noth-West (state owned companies).

2.1.2 Population

Details of population data for the study area are available for the year of 1998. Table 2.1.7 shows the population data for the 4 cities/towns (Balti, Soroca, Falesti, Riscani) and other principal nearby towns (Floresti, Drochia, Singerei).

Table 2.1.7 Population of Principal Cities/Towns (1998)

City/Town	Soroca	Balti	Riscani	Falesti	Floresti	Drochia	Singerei	Total
Population	46,000	162,550	16,367	18,963	20,100	22,000	15,969	301,949

Source: Data from Municipalities

The population data (1998) of rural communities along the roads between above cities/towns are given in Table 2.1.8

Table 2.1.8 Population of Communities Between the Principal Cities/Towns (1998)

Line	Population (1998)	Number of Communities
Soroca - Barti	25,886	18
Balti - Riscani	12,150	4
Balti - Falesti	8,116	4
Balti - Singerei	4,252	2
Soroca - Drochia	14,486	5
Riscani - Prut River	21,117	14
Falesti - Prut River	11,517	11

Source: Data from Municipalities

2.1.3 Economic Conditions

(1) Industries

During the Soviet era, industrial developments of the 4 cities/towns in the Study were characterized as follows:

- Balti Important industrial, commercial, trade and administrative center in the northern Moldova
- Soroca Important industrial center in the northern Moldova
- Falesti Agricultural products processing and machinery assembling town
- Riscani Agricultural products processing town

Principal industrial enterprises established during the Soviet era and number of people employed in these industries are shown below.

Table 2.1.9 Industries in the Study Area - During the Soviet Era and Present

City/Town	Major industrial enterprises established during the Soviet era	Current state
<p>Balti</p> <p>70,700 people were employed during the Soviet era in the industrial enterprises</p>	<p>More than 70 production enterprises were established. Largest factories:</p> <ul style="list-style-type: none"> - vegetable oils and fats processing, - bakery - sugar refinery - wine and brandy production - street lights towers and equipment production - beer production - table water production - agricultural machinery production - biochemical factory 	<p>Much less number of enterprises are operated stably. Some are adopted for small-scale private production. On the other hand, a large number of small individual shops, production and processing enterprises, service enterprises have been created.</p>
<p>Soroca</p> <p>20,000 people were employed during the Soviet era in the industrial enterprises</p>	<p>Around 20 production enterprises such as the following were established:</p> <ul style="list-style-type: none"> - technological equipment production - hydromotors experimental plant (Hydroprivod) - metal goods production - light industries such as sewing factory, knitted wear factory - milk, canning, table water, and bakery factories - regional complex for seeds and agricultural products processing 	<p>The following enterprises are in working conditions and have certain potential to maintain operational capacities:</p> <ol style="list-style-type: none"> 1) technological equipment, 2) Hydroprivod, 3) dairy, canning, and bakery, 4) sewing and knitted wear factories, 5) local mining areas, carriers, construction materials companies, 6) agricultural processing
<p>Falesti</p> <p>12,000 people were employed during the Soviet era in the industrial enterprises</p>	<p>Relatively large 12 production enterprises were constructed including:</p> <ul style="list-style-type: none"> - sugar refinery - factory for assembling pavement cleaning machines - machinery plant - canning factory - dairy production and bakery facilities - wine factory - others including sewing factory, agricultural machines repair center, fish farming enterprises 	<p>Enterprises having potential to continue production are: 1) sugar refinery, 2) dairy factory, 3) factory for assembling pavement cleaning machines (changing production profile), 4) machinery plant (modified technology), 5) agricultural machines repair center</p>
<p>Riscani</p> <p>6,500 people were employed during the Soviet era in the industrial enterprises</p>	<p>13 production enterprises including the following were established:</p> <ul style="list-style-type: none"> - dairy factory - pig breeding farm - construction materials factory - canning factory - fish farming enterprises 	<p>Enterprises having development potentials are: 1) agricultural products processing and dairy factory, 2) some construction and repair organization, 3) incubator for domestic birds growing, 4) private agricultural processing complex AVISNORD, 5) sewing factory</p>

(2) Employment and Income

According to the questionnaire survey conducted in the current Study for randomly selected households in the four cities/towns, sectoral distribution of jobs of the respondents are as shown in Table 2.1.10, which also shows average monthly household income.

Table 2.1.10 Working Sectors and Income of Households in 4 Cities/Towns

	Balti	Soroca	Falesti	Riscani
Number of samples (households)	255	114	60	76
Working sectors (%)				
Agriculture	2.7	0.9	15.8	16.4
Industry	14.1	9.6	14.0	11.0
Construction	4.3	1.8	7.0	4.1
Transport and communications	9.0	6.1	3.5	4.1
Trade and public food	15.7	19.3	26.3	13.7
Education, culture, research	9.4	11.4	10.5	2.7
Health	3.5	11.4	5.3	8.2
Others	31.4	30.7	17.5	39.7
Average monthly income/household (Lei)	602	616	414	411
Average number of persons/household	3.1	3.3	3.2	3.4

Source: Sociological Survey (5 - 16 June 2001) entrusted to Acvaproiect.

(3) Electric Power Supply

Electricity supplies in the Study Area are made by two power distribution companies. In Balti City, Falesti Town and Riscani Town, electricity is supplied by RED North Company, and in Soroca by RED North-West Company. Both are state owned company, while remaining 3 power distribution companies in Moldova have been privatised.

2.1.4 Land Use

Land use situations in the 4 municipalities are shown in Table 2.1.11.

Residential areas dominate in the cities of Balti and Soroca, and agricultural areas dominate in the town of Riscani. In the town of Falesti, the land use is relatively mixed being shared by agriculture, residence, natural reserves, forests/green, and industry/transport, in that order. The total area of Riscani is the largest among 4 municipalities, followed by Balti, Falesti and Soroca. The industry/transport areas are largest in Balti, followed by Falesti, Riscani and Soroca.

Table 2.1.11 Land Use in Four Municipalities

Type of Use	Balti		Soroca		Falesti		Riscani	
	ha	%	ha	%	ha	%	ha	%
Agricultural	27	0.7	21	1.6	991	37.9	3,341	64.0
Residential	2,614	63.1	951	72.1	537	20.5	792	15.2
Industry, transport, etc.	839	20.3	92	7.0	280	10.7	150	2.9
Nature protection	0	0.0	0	0.0	1	0.04	0	0.0
Forests/green areas	497	12.0	95	7.2	296	11.3	13	0.3
Water	81	2.0	45	3.4	0	0.0	1	0.02
Natural reserves	84	2.0	115	8.7	509	19.5	920	17.6
Total	4,142	100.0	1,319	100.0	2,614	100.0	5,217	100.0

2.2 Natural Conditions

2.2.1 Topography and Geology

Moldova is bordered to the north, east and south by Ukraine, and to the west by Romania. Prut and Nistru Rivers flow from north to south along the western and eastern borderlines. The national land area is approximately 33,800 km², with 300 km from north to south, and 60 - 150 km from east to west. The most part of the national land is gently undulating hills, and agricultural areas account for about 67 percent (Ref. 1-1) of the whole national land. Consequently, the landscape tends to be of bare rolling cultivated hills, with little natural woodland. The maximum height is approximately 430 m in the central zone of the country, while the minimum elevation is approximately 2 m at the downstream basin of Nistru River.

The Study area has the similar topographic conditions. The cities/towns of Balti, Soroca, Falesti and Riscani lie on the gently undulating hills of the following elevations:

City/Town	Elevation (m above sea-level)
Balti	90 m - 160 m
Soroca	45 m -170 m
Falesti	70 m - 150 m
Riscani	120 m - 185 m

The maximum and minimum elevations in the Study Area are approximately 350 m at the point near Soroca and 45 m at the bank of Nistru River in Soroca City, respectively. (refer to Figure 2.2.1)

The most part of the Study Area is covered by the Miocene geological formation (clay, limestone, sands, and sandstone). Balti city, Riscani and Falesti towns are situated at the Miocene geological

formation. While, Soroca City is located at the border of two geomorphological regions, namely Middle Nistru Subregion of Nisterian Terraces Plain (presented by Late Pliocene deep and narrow canyons) and Soroca Subregion of Nisterian Swell Height (to the west from the town, presented by Late Miocene accumulation deposits with canyons and valleys). (refer to Figure 2.2.2)

2.2.2 Meteorology

The climate throughout Moldova is created by continental air masses, influenced by the Carpathian Mountains in the northwest and the Black Sea in the southeast. Compared to other countries of Eastern Europe, the climate of Moldova is moderate throughout the year.

The solar balance in the Study Area is 45 - 52 kcal/cm² during a year: 40 - 41 kcal/cm² during the warm season and 5 - 8 kcal/cm² during the cold season. The annual total solar radiation is 100 - 114 kcal/cm²: summer period at 82 - 86 kcal/cm², and winter period at 25 - 28 kcal/cm². The sunshine hour is about 2,000 - 2,200 hours per year.

The annual air temperature is averaged at 8 - 9°C with registered maximum at 39°C in Falesti and minimum at -35°C in Soroca. The average temperature in July is about 20°C, while that in January is -4°C. The temperature of the topsoil layer in July is estimated at 25 - 28°C and that in January between -5°C and -7°C.

The annual average precipitation in the Study Area is approximately 560 mm, of which about 50% concentrates in the four warmer months of May through August (refer to Table 2.2.1 and Figure 2.2.3). The annual evaporation is approximately 740 mm in the northern part of Moldova and 870 mm in the central part. The excess of the potential evaporation over the precipitation in the Study area is estimated at 310 mm/year. It can be said that this deficit of the precipitation has significant influences on both surface and groundwater resources in the Study area.

2.2.3 Hydrology

There are three major river basins in the Study area, namely Nistru River, Prut River and Raut River. The river networks are shown in Figure 2.2.4.

Nistru River rises in the Carpathian Mountains in Western Ukraine, where it passes for over 50% of its total length. It finally discharges into the Black Sea, west of the city of Odessa. Prut River also rises in the Carpathian Mountains in Ukraine, and forms Moldova's western border with Romania, until the river merges into the Danube. Raut River runs between Nistru River and Prut River, and merges into Nistru River at the north of Chisinau.

The catchment area of Nistru River covers about 35% of the national total land area, and Prut River and Raut River account for a little over 20%, respectively.

River	Length (km)		Catchment area (km ²)	
	Total	in Moldova	Total	in Moldova
Nistru River	1,352	630	64,340*	11,310*
Prut River	976	695	27,500	7,990
Raut River	286	286	7,760	7,760

Note: * Excluding the catchment area of Raut River.

Water Discharge

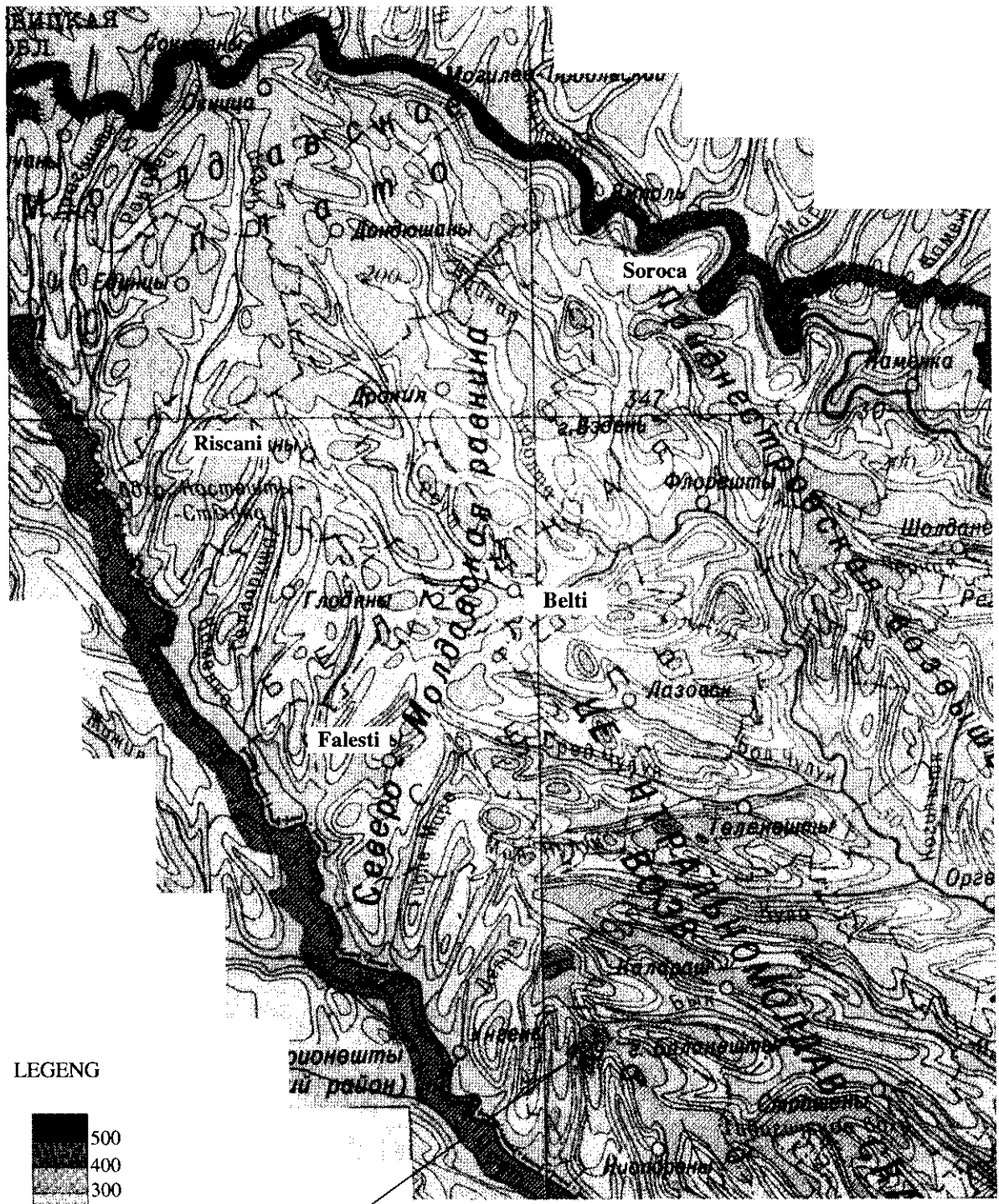
The daily water discharges of Nistru River and Prut River from 1991 to 1995 and their maintenance flow rates are shown below.

The two major international rivers, Nistru River and Prut River have a large water discharge throughout the year. However, some of their tributaries are drying up due to the large excess of potential evaporation over precipitation during the summer months.

River	Daily Flow Rate During 1991 - 2001 (m ³ /sec)			
	Average	Maximum	Minimum	Maintenance flow
Nistru River	300	1,645	107	80
Prut River	97	636	22	17

Note: The observed point is Soroca for Nistru river and Taxobeni for Prut river.

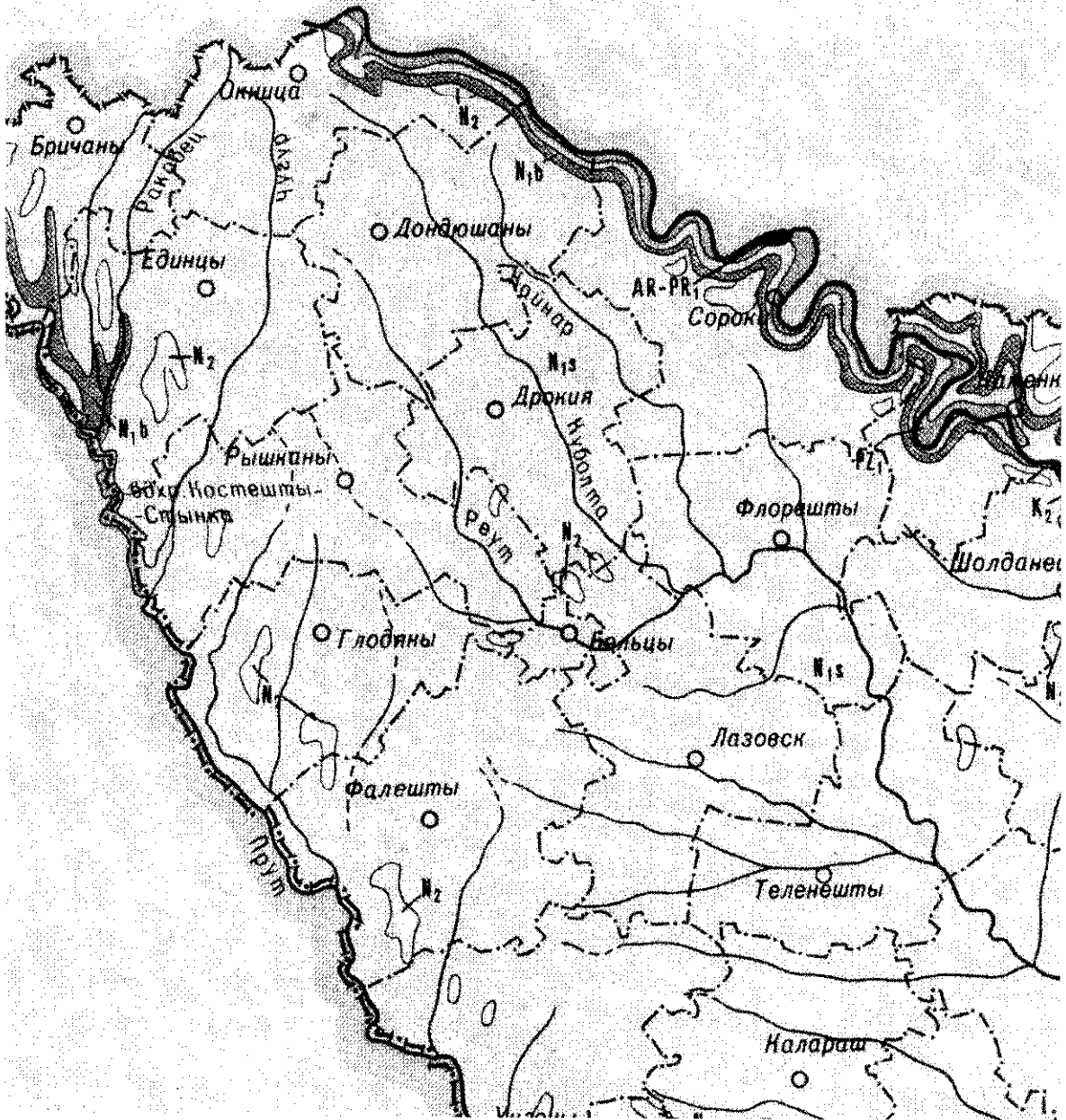
Source: Apele Moldovei



The maximum elevation in Moldova: 429 m

Source: "Atlas of the Moldovan SSR" 1990, Main Direction of Geodesy and Cartography of the Council of Ministers of USSR.

Figure 2.2.1 Topographical Map in the Study Area



Source: "Atlas of the Moldovan SSR" 1990, Main Direction of Geodesy and Cartography of the Council of Ministers of USSR.

LEGEND

- N₂ The pliocene (Pont)
- N_{1s} The miocene (Middle Sarmat)
- N_{1b} The miocene (Lower Baden-Sarmat)
- PZ₁ First Paleozoic
- AR+PR₁ Archaeo-first Paleozoic

Figure 2.2.2 Geological Map in the Study Area

Table 2.2.1 Precipitation in the Study Area (Monthly Average)

unit: mm

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Soroca	26	25	25	49	57	68	97	52	62	40	45	37	581
Balti	18	22	26	39	48	75	71	59	63	36	33	33	520
Falesti	34	27	25	47	61	110	60	51	48	27	44	39	574
Riscani	30	33	30	48	68	108	62	52	29	26	48	43	578
Average	27	27	26	46	58	90	72	53	50	32	42	38	563

Soroca, Balti: the average is calculated monthly data from 1990 to 1999.

Falesti: from 1980 to 1990.

Riscani: from 1980 to 1992.

Precipitation in the Study Area (Monthly Average)

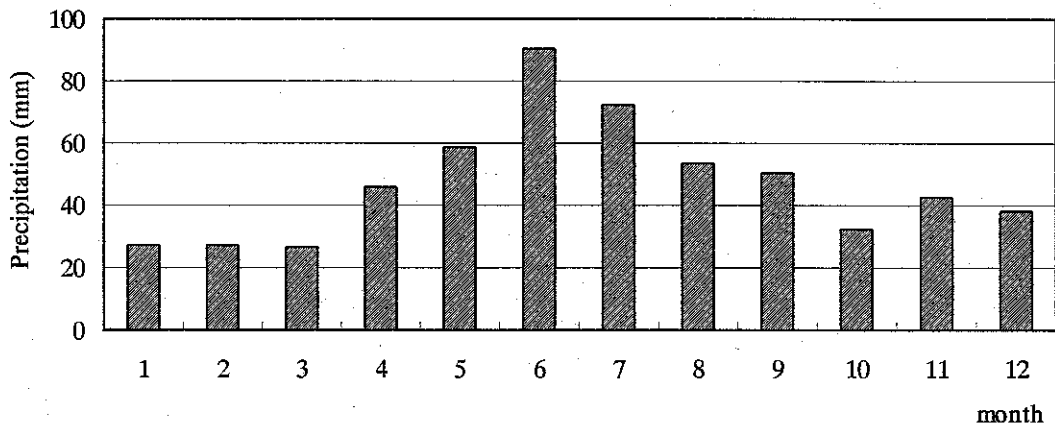


Figure 2.2.3 Precipitation in the Study Area (Monthly Average)

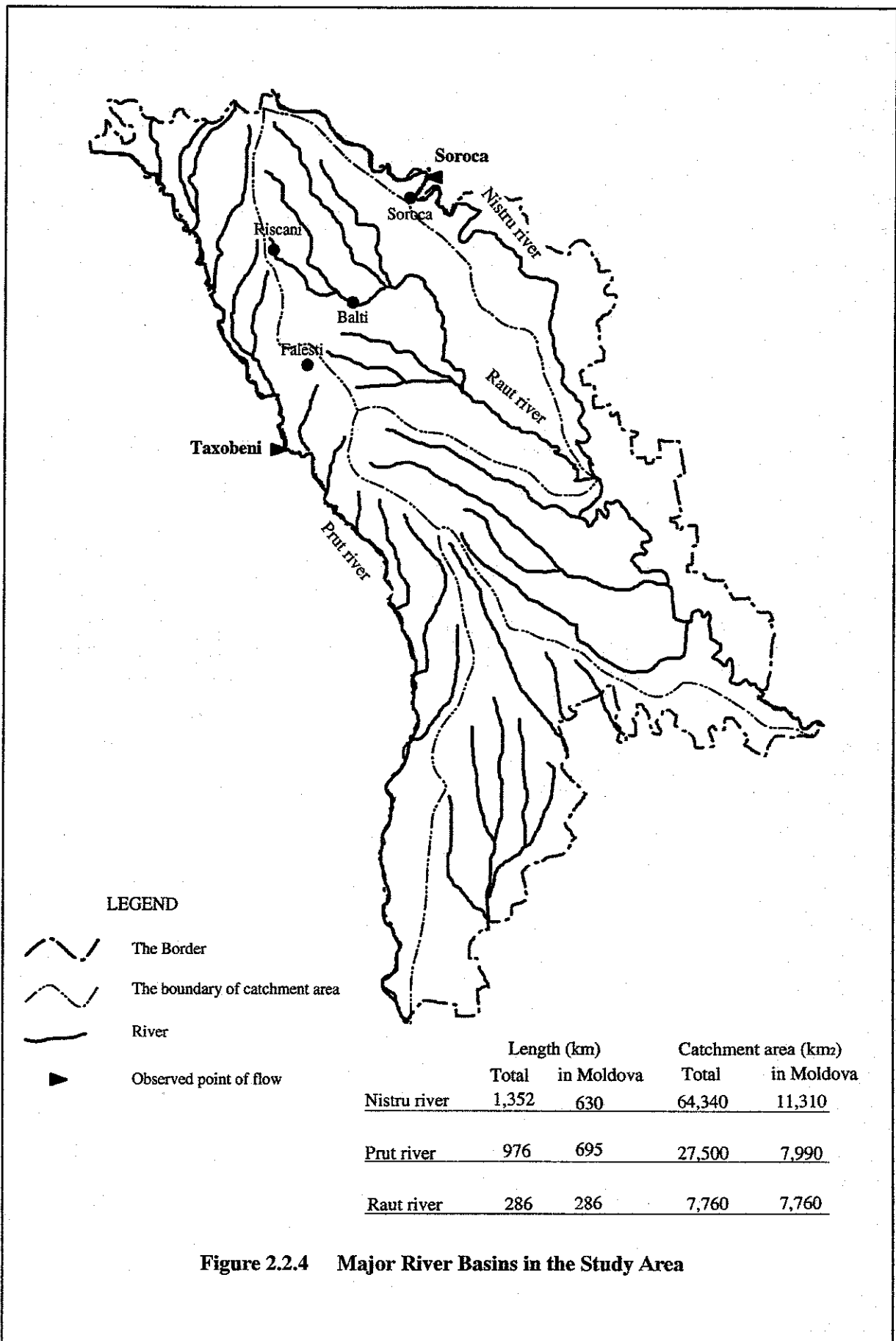


Figure 2.2.4 Major River Basins in the Study Area