CHAPTER 2 DETAILS OF THE STUDY

2.1 Status of the Study

2.1.1 Relationship with Existing Laws

(1) Relationship with Forest Code

A forest management plan in Romania is formulated for national forests among those forests (national forest assets) referred to in Article 1 of the Forest Code (Law No. 26/24, April, 1996) for each forest range office (Ibid. Article 17) every ten years (Ibid. Article 18). The subject forests of the said plan are subject to control under technical standards regarding forest development, reforestation and protection, etc. (Ibid. Article 9).

A forest restoration plan (the Plan) is similarly formulated for national forests among those forests (national forest assets) referred to in Article 1 of the Forest Code. The Plan also conforms to various technical standards set forth by Article 9 of the Forest Code.

(2) Relationship with Environmental Protection Law

According to Article 8 and Appendix No. II of the Environmental Protection Law (Law No. 137/29, December, 1995), activities requiring environmental impacts assessment are such forest/forestry-related activities as the construction of pulp plants, particle board plants and sawmills, etc. and forest development in forests other than national forests. Consequently, all of the planning items of the Plan are in conformity with the Environmental Protection Law.

(3) Relationship with Land Law

The privatisation of part of the national land (forests and farmland) is currently in progress pursuant to the Land Law (Law No. 18/1991). This Law initially stipulated the return of forest land of upto 1 ha per household to the original owner. The revised Land Law (Law No. 169/1997) changed the maximum area to be returned to 30 ha in the case of forest. This is stipulated in Article 45 of the re-promulgated Land Law (Law No. 18/1991) in June, 1998

(4) Items Related to Grazing

Article 37 of the Forest Code prohibits grazing in national forests, plantation sites on devastated land and protected forest belts. As an exception, central government agencies (MWFEP, GMOF) sometimes permitted grazing in these areas at the request of a local public body. However, Article 23 (c) of the Law on Hunting Fund and Protection of Game (Law No. 103/23.09.1996) withdraws such exceptions and introduces the blanket prohibition of grazing in all forests.

2.1.2 Relationship with Forest Planning System

(1) Relationship with Forest Planning System

As stipulated in Article 18 of the Forest Code, a forest management plan is formulated every 10 years for each forest range office of the forest branch office in accordance with the technical standards for forest management. The planning period may be changed to between five and 10 years for forests of such fast growing species as *Populus* spp. and *Salix* spp. All forest range offices in the Study Area have formulated their respective forest management plans within the last five years except for five stations (former Draganesti-Olt, Caracal, Vultresti, former Apele Vii and Segarcea) and have been conducting forest management according to these plans. With the completion of the Plan, new data will be added to the subject forests of the Plan. In view of this prospect and for forest management in the entire area, a revised plan incorporating new data to the existing management plan will be formulated.

(2) Relationship with Forestry Development Strategy

The MWFEP formulated the Forestry Development Strategy for forests nationwide in 1995. The following action plans are listed in this Strategy for forests on the Romanian Plain. Here, the target figures are national figures.

1) Forests on the Romanian Plain will be expanded to ensure water and land conservation in view of the low forest coverage ratio and the existence of devastated land. The short-term targets upto the year 2000 are (i) the creation of 1,000 km long water conservation forests and windbreak forests, (ii) the reforestation of 10,000 ha of devastated land and (iii) the reforestation of 2,000 ha of land which is not currently forest land. Similarly, 10,000 km, 200,000 ha and 25,000 ha respectively are set as the medium-term targets for the period from 2001 to 2025.

2) A survey on the economic importance of water conservation forests and windbreak forests will be conducted over an area of 600,000 ha every year.

3) Tending and thinning will be conducted without fail to improve the quality of existing standing trees and also to improve existing forests to achieve a stand structure which is appropriate for protection forests.

4) The regeneration of forests damaged by drought and pollution, etc. will be attempted. The short-term and medium-term targets for areas of regeneration are 6,000 ha and 65,000 ha respectively.

5) Research will be conducted to identify those species which have a strong resistance to drought.

6) New species suitable for the local conditions will be introduced for planting purposes. The short-term and medium-term targets for this type of reforestation are 15,000 ha and 50,000 ha respectively.

7) New biotechnologies will be developed to facilitate production of the seedlings of *Quercus* spp.

8) Measures for pest control will be promoted.

Other items included in the Strategy are the increased production of forest by-products, the new construction and repair of forest roads and the mechanisation of various aspects of forestry activities although no specific numerical targets are adopted.

In short, the Strategy aims at enhancing the wood production function of forests as well as promoting forest functions for public benefit, including mitigation of the negative impacts of drought and other climatic conditions in the subject area.

(3) Relationship with Budget System

The subject forests of the Plan are national forests which are controlled and managed by the ROMSILVA R.A. which was established in 1991 (and which was then reorganized as the RNP in 1996). The RNP operates on a self-financing basis and relies on income from the production and sale of wood to conduct the management of all national forests, including regeneration and tending. In the case of forest road construction and the reforestation of devastated areas, the RNP receives public funding from the government. The forest branch offices which are directly responsible for the control and management of actual forests control their operational expenses within the income arising from their operation in their respective areas of jurisdiction.

2.1.3 Relationship with Various Organizations

(1) Relationship with RNP and ICAS

As stipulated in Article 18 of the Forest Code, forest management plans are formulated by the ICAS under the supervision and with the approval of the MWFEP and GMOF, i.e. the central administrative bodies for forestry. Felling, regeneration, tending and the protection of forests are conducted by the RNP based on the forest management plans and the results of ICAS research (Article 21 of the Forest Code).

(2) Relationship with Local Administrative Bodies

As stipulated in Article 34 and Article 70 of the Forest Code, the county government and county council have the obligation to assist the forest monitoring work of both national and private forests within their authority afforded by the Forest Code. These bodies also have the obligation to assist fire prevention as well as fire-fighting work in both national and private forests (Article 36 and Article 70 of the Forest Code).

(3) Relationship with Forestry Enterprises

In the area of jurisdiction of the forest branch office in each of the two subject counties, state enterprises engaged in log production (felling, log production and hauling) and sawing used to purchase standing trees in national forests or were subcontracted to conduct such work upto a few years ago. At present, however, the forest range offices under the forest branch office conduct such work mainly by means of directly employing local people on a daily wage basis.

As private forestry enterprises have not developed in these counties, it is reasonable to assume that forestry work in national forests will be directly conducted by the RNP using the local workforce.

2.2 Natural Conditions

2.2.1 Climate

Romania belongs to the almost semi-arid but still semi-wet temperate zone combining a continental climate with substantial temperature fluctuations within a year and the

Mediterranean climate. The temperature in summer is very high with the maximum temperature of exceeding 30°C even though the mean temperture is 22 - 24°C. Winter is cold with a mean temperature of -3°C, but the minimum temperature can be as low as less than -20°C.

As precipitation is a climatic factor with direct implications vis-a-vis the Study, the analysis here mainly focuses on precipitation. Temperature, humidity, wind direction and wind velocity are also generally analysed using data collected by the Craiova, Bailesti, Caracal and Bechet Observatories located in the Study Area.

(1) Precipitation

The maximum, minimum and mean precipitation values at the Craiova and Bailesti Observatories for the period from 1962 to 1994 are shown in Table 2-2-1.

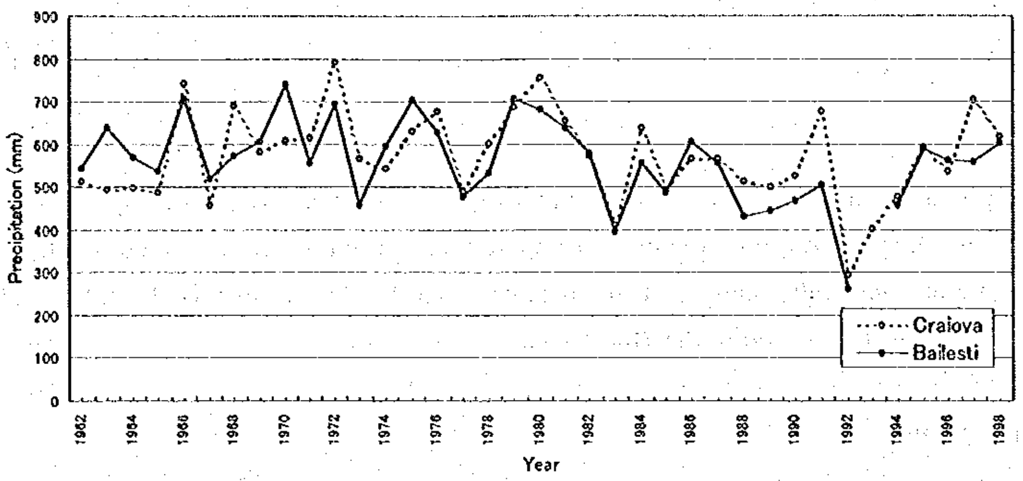
Table 2-2-1 Maximum, Minimum and Mean Annual Precipitation at Craiova and Bailesti Observatories (1962 - 1994)

(Unit: mm)

Observatory	Maximum	Minimum	Mean
Craiova	792.4 (1972)	293.5 (1992)	567.7
Bailesti	740.3 (1970)	262.7 (1992)	554.5

Source: *National Institute of Meteorology and Hydrology*

Observation data for these 33 years show mean annual precipitation of approximately 550 mm. Changes of the annual precipitation during this period are shown in Fig. 2-2-1. The annual precipitation showed a declining trend from 1980 to 1994. The general tendency was a fluctuation of some ±100 mm until 1982 with normal annual precipitation of around 600 mm. The tendency towards low annual precipitation started to become manifest in 1983 and the mean annual precipitation in the nine years from 1983 to 1991 at Craiova was 540 mm, a drop of some 60 mm from the previous level. At Bailesti to the south, the mean annual precipitation dropped by more than 100 mm to less than 500 mm in the same period. This decline of the precipitation further worsened in 1992 and thereafter, showing a low precipitation level which can be duly described as a drought. In fact, the low annual precipitation level continued for four successive years from 1992 (250 mm) and 1993 (400 mm) to 1995. The annual precipitation started to increase in 1996 upto the present.



Source: *National Institute of Meteorology and Hydrology*

Fig. 2-2-1 Changes of Annual Precipitation at Craiova and Bailesti Observatories

As shown in App. A-1, mean monthly precipitation is in the range of 30 - 70 mm, with high precipitation in the May through July and November periods and low precipitation in September, October, January and February.

(2) Temperature

The mean annual temperature in Olt County and Dolj County based on observation data for a period of 33 years from 1962 to 1994 is approximately 11°C as shown in Table 2-2-2.

Table 2-2-2 Mean Annual Temperature and Other Temperature Data at Craiova, Bailesti and Caracal Observatories

(Unit:°C)

Observation Station	Mean Annual Temperature	Temperature in Hottest Month		Temperature in Coldest Month	
		Maximum	Mean	Minimum	Mean
Craiova	10.6	39.4	21.5	-22.6	-2.0
Bailesti	11.1	-	21.9	-	-1.7
Caracal	-	41.6	-	-22.7	-

Note: The mean annual temperature is based on data observed from 1962 to 1994 while others are based on data observed from 1987 to 1997.

Source: *National Institute of Meteorology and Hydrology*

As indicated in App. A-2, the mean annual temperature began to show an increasing trend in the second half of the 1980's. Extreme values recorded at the Craiova Station during the period from 1987 to 1997 were a maximum temperature of 39.4°C and a minimum temperature of -22.6°C. At the Caracal Station, a maximum temperature of

41.6°C and a minimum temperature of -22.7°C were recorded, suggesting considerable temperature fluctuation in the Study Area between the summer and winter.

(3) Humidity

The mean monthly humidity for the period from 1967 to 1997 is shown in Table 2-2-3. The mean monthly humidity based on observation data for these 30 years is 79%. The humidity is high in spring and summer, i.e. from April to September, and low in winter, i.e. from November to February.

Table 2-2-3 Mean Monthly Humidity at Craiova and Caracal Observatories

(Unit: %)

Observatory	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Craiova	90	86	80	74	74	74	74	72	74	79	87	91	79
Caracal	90	87	80	73	72	71	69	71	73	80	88	91	79

Source: *National Institute of Meteorology and Hydrology*

(4) Wind Direction and Wind Velocity

The Study Area is also known as areas prone to strong wind. The distribution of sand dunes indicates the effect of strong wind and these areas are lowland along the Danube River in the southwestern part of Dolj County, areas between the lowland along the Danube River to the middle terraces in the southeastern part of Dolj County and lowland along the Danube River in Olt County.

The wind direction frequency for the 30 year period in the Study Area is shown in Table 2-2-4.

Table 2-2-4 Wind Direction Frequency at Craiova, Caracal and Bechet Observatories

(Unit: %)

Observatory	N	NE	E	SE	S	SW	W	NW	Calm
Craiova	2.6	12.3	21.0	3.7	3.1	5.2	21.7	4.3	26.1
Caracal	5.0	6.4	16.5	2.4	2.1	2.4	23.4	5.6	36.2
Bechet	0.8	1.6	14.0	1.1	0.4	0.8	15.2	2.2	63.9

Source: *National Institute of Meteorology and Hydrology*

In the Study Area, the number of calm days increases from northernmost Craiova southwards to Caracal and Bechet. In terms of the eight wind directions, the east and west winds are the most frequent wind directions. The mean wind velocity for the 30 year period in the Study Area is shown in Table 2-2-5.

Table 2-2-5 Mean Wind Velocity at Craiova, Caracal and Bechet Observatories

(Unit: m/s)

Observatory	N	NE	E	SE	S	SW	W	NW
Craiova	2.8	4.4	5.1	3.1	2.4	3.0	4.9	3.5
Caracal	2.5	3.4	4.7	3.3	2.6	2.8	4.7	3.5
Bechet	2.8	3.2	3.3	2.6	2.4	2.4	3.7	3.0

Source: *National Institute of Meteorology and Hydrology*

The mean wind velocity decreases towards the southern part of the Study Area. The mean maximum wind velocity is observed in spring (March and April) and the corresponding figures are 6.1 m/s at Craiova, 5.6 m/s at Caracal and 4.1 m/s at Bechet.

2.2.2 Topography

The Carpathian Mountains (South Transylvanian Mountain Range) runs in the east-west direction, dividing Romania's national land in the north - south direction. Occupied areas by elevation category to the south of the Mountains are 1% for an elevation of 2,000 m or more, 11% for an elevation of 1,000 m - 2,000 m, 18% for an elevation of 800 m - 1,000 m, 37% for an elevation of 200 m - 800 m and 33% for an elevation of 200 m or less. The Romanian Plain where the subject counties of the Study, i.e. Olt and Dolj, are located forms terraced areas from the southern piedmont of the Mountains to lowland along the Danube River.

The Danube River is a major river which originates in Germany and reaches the Romanian Plain via Austria and Hungary. As it caused repeated flooding during the diluvial epoch, a thick alluvial fan was created in the western part (mid-to-northwestern part) of Dolj County at the site where the Danube River leaves the valley forming the pivot of the fan. Towards the end of the diluvial epoch, the Danube River continued to erode the ground, moving its main course to the south (Bulgarian side) and forming a larger fan. At present, the ground surface of the fan is tilted towards the southwest and the course of the main channel has approached the mountain land on the right bank (Bulgarian side).

The water level of the Danube River is approximately 35 m in the southern part of Dolj County while it is as high as more than 170 m in high places of the fan (north side). Considering the fact that a sedimentation layer is distributed under the current channel, this represents a very thick sedimentation layer. The Danube River transported old glaciation products which formed a slightly fine-grained sediment layer in the catchment area and created a thick alluvial fan. This fan has intercalated fine soil layers which have become clayey layers due to weathering during the Mindel-Riss and Riss-Wurm inter-glacial periods during the late diluvial epoch.

The surface section of middle and high terraces in particular shows the thick accumulation of clayey fine soil due to weathering during the inter-glacial periods. The lowland along the main channel of the Danube River is known as a strong windy area where many sand dunes of more than 10 m in height are distributed. This type of sand dune is also observed on the left bank of Jiu River and at the southern part of the mid-terraces on the right bank of Olt River, both of which are located near the Danube River.

App. A-3 shows the river system in the Study Area. Tributaries of the Danube River flow northwest by west to southeast by east in the slope direction of when the fan was originally created. Larger rivers which gather the flow of minor tributaries change their direction from north to south. Jiu River, Bals River and Olt River which run north to south in the eastern part of Dolj County and the western central part of Olt County are such rivers, forming flood plains, low terraces and middle and high terraces along their routes. The surfaces of these terraces are characterised by their north-south direction which is almost at a right angle to the flow direction, i.e. northwest by west to southeast by east or west to east, of the main channel of the Danube River in the alluvial fan.

The elevation of middle and high terraces is similar to that of the middle and high terraces of the Danube fan despite their having been formed in the alluvial fan of tributaries. On this basis, it is inferred that the gravel layer of the base formation often originates from the Danube fan. Tributaries originating from the Carpathian Mountains created their own terraced topography by cutting through the alluvial fan created by the main channel of the Danube River. The layers constituting these terraces are characterised by alternating layers of consolidated silt deposits and relatively loose sand. It is not unusual, however, for a consolidated sand layer mixed with some silt to be found.

The effects of the Danube fan are not observed in the northern part of Dolj and Olt Counties and hilly highland is seen with terraces with minor undulations being formed at relative lowland between highland.

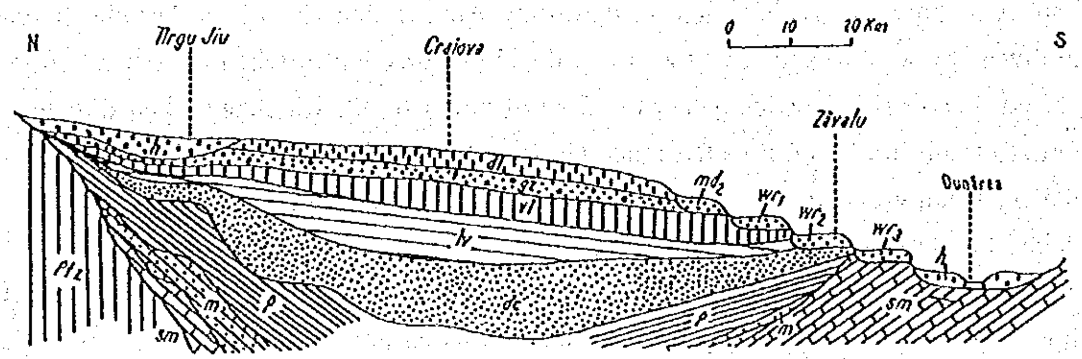
2.2.3 Geology and Soil

(1) Geology

The geological structure of this southern plain consists of a deep-seated crystal basement with subsequent deposits formed on it. These deposits fall into three classes, the (i) Triassic, (ii) Jurassic-Paleogene, and (iii) Neogene-Quaternary. The surface deposits have considerable thickness, with the exact thickness of levels varying by region.

Fig. 2-2-2 shows a summary view of the Quaternary deposit found in the western region of the Romanian southern plain in Dolj County.

The bedrock of the Romanian Plain is seldom exposed and is covered by deposits carried by water and wind. Accordingly, the matrix, a base of soils, consists of plutonic, igneous aqueous, and other rocks.



Ptz : crystal basement (prior to Quaternary)
sm : Neogene/Miocene
m, p, ac, lv : Neogene/Pliocene
Inferior Pleistocene : vl : vifranchian stage; qz : Gunz glacial stage
Middle/Later Pleistocene : dl : loess deposit, md_2 : Mindel glacial stage (old deposittional terrace)
Wurm glacial stage : wr_3 : W III (upper deposittional terrace)
wr_2 : W II (lower deposittional terrace)
wr_1 : W I (lowermost deposittional terrace)
h : Holocene (alluvial flood plain of the Danube River)

Fig. 2-2-2 Summary Cross-Sectional View of a Quaternary Deposit Found in the Western Region (Dolj County) of the Romanian Southern Plain (Liteanu, N. and Ghenea, C.)

Within the Romanian Southern Plain little bedrock is exposed; and since the surface is covered with deposits carried by water and wind, the matrix, a base of soils, consists of plutonic, igneous, aqueous, and other rocks. The western part of the southern Romania plain from north to south is characterized in terms of topography and surface geology by the following:

1) Clayey and fluviatile deposit in the highland
2) Loess-like deposits in the interior of the plain
3) Loess and loess-like deposits in the river terrace
4) Fluviatile and aeolian sandy deposits in the bottomland along the Danube River

(2) Soil

According to the soil map prepared in Romania, many soil units (based on the FAO/UNESCO soil classification, 1988) are distributed on the Romanian Plain (Olt and Dolj Counties).

- Chernozems (CHh, CHk, CHg); Phaeozems (PHh, PHl); Luvisols (LVh, LVa, LVj, LVv, LVx); Planosols (PLe); Podzoluvisols (PDd, PDj); Vertisols (VRe); Cambisols (CMe, CMv); Solonetz (SNh); Regosols (RGd, RGe); Fluvisols (FLe, FLg, FLc); Gleysols (GLd, GLm); Arenosols (ARb, ARh, ARc)

The soil profile survey conducted in the summer of 1998 found the following correspondence between the soil types mainly found in forest areas and the topography/vegetation.

1) Hilly mountain foot: Luvisols, Cambisols
   Q. petraea , *Q. frainetto* , *Q. cerris*

2) Tableland (central part of plain): Luvisols, Phaeozems, Podzoluvisols
   Q. frainetto , *Q. cerris*

3) Middle terrace (central part of plain): Chernozems, Phaeozems
   Q. frainetto , *Q. cerris* , *Q. pedunculiflora* , *Q. pubscens*

4) Low terrace/riverside lowland: Cambisols, Fluvisols, Gleysols
   Q. robur , *Q. pedunculiflora* , *Fraxinus excelsior* , *Populus alba* , *P. nigra*

5) Riverside lowland (sand dunes): Arenosols
Robinia pseudoacacia , *Populus* spp. , *Pinus nigra* , *Q. robur*

The soil profile survey points (latitude and longitude) are shown in App. B-1 while the soil profile survey results are summarised in App. B-2. The soil classification results using the FAO/UNESCO units for Olt and Dolj Counties are summarised in Fig. 2-2-3. The soil classification codes and symbols used in Romania and their translation to FAO/UNESCO soil classification units are shown in App. B-3 and App. B-4 respectively. This translation was conducted by the Study Team.

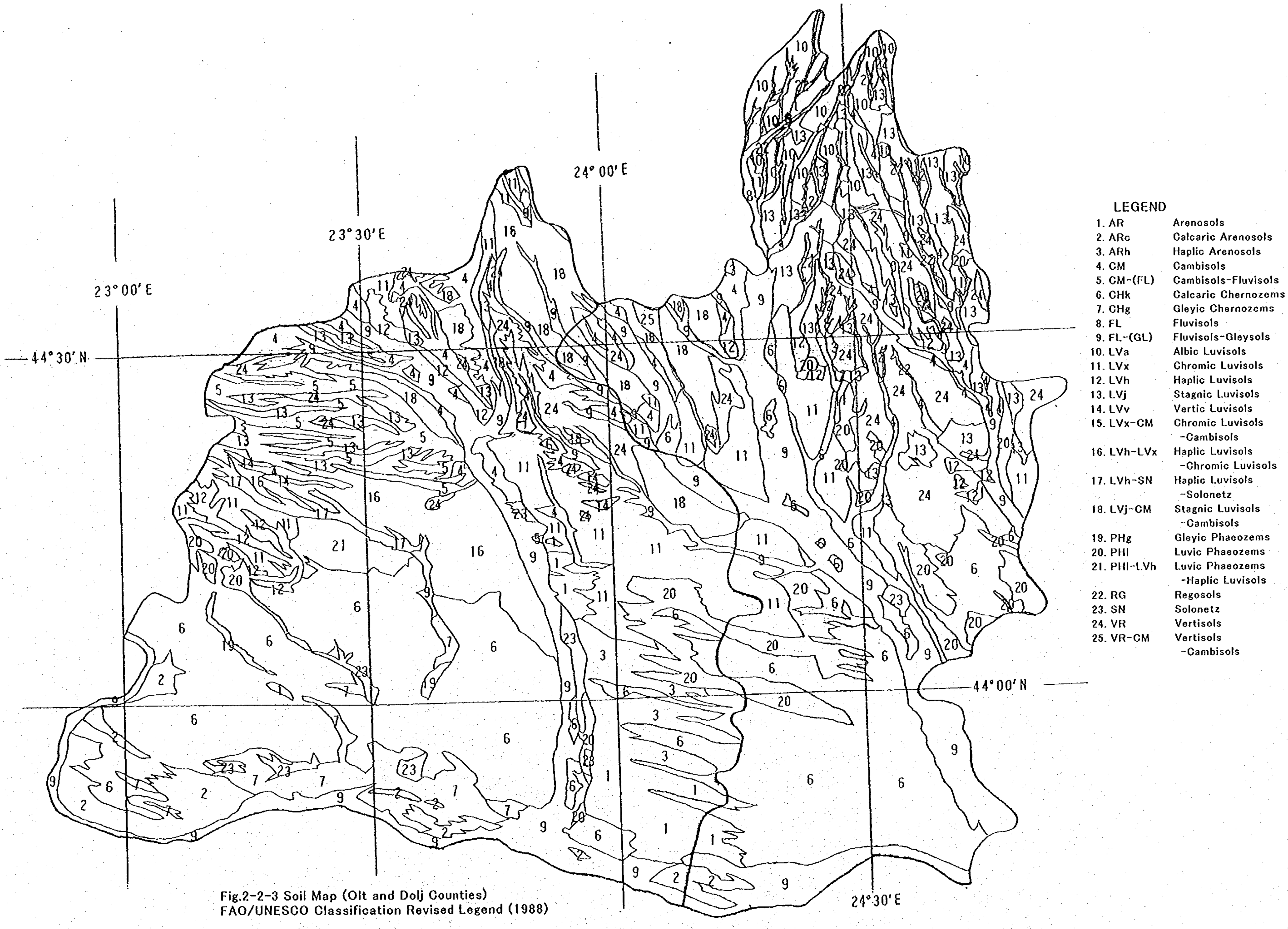


Fig.2-2-3 Soil Map (Olt and Dolj Counties)
FAO/UNESCO Classification Revised Legend (1988)

2.2.4 Hydrology

(1) General

When riverside terraces are composed of gravel or sand possessing high permeability, the groundwater level around rivers is usually linked to the river water level and is actually higher than the river level. As the sedimentation layer in middle and high terraces which mainly compose the Study Area is composed of fine soils, its permeability is low and it is thought that there is a small link with the surrounding water level. From this point of view, the merits of a compact layer as a water environment element are low. However, since the compact layer of fine particles is extremely thick, presenting a strong possibility of the unbroken continuity of fine pores, it is estimated that the storage capacity of these pores is large. Due to high capillary tension, it is usually difficult for trees to utilize water stored in fine pores, however, for tree types whose root systems reach the compact layer and have high absorption capacity, this is an effective source of water.

Thanks to capillary tension, water stored in fine pores hardly runs off through gravity at all and is not consumed except for evapotranspiration. Accordingly, once water is stored in this manner, it is held for an extremely long time and serves as a stable store of water. It is estimated that this store of water is subject to repeated fluctuations, falling slightly in dry seasons and filling up again in rainy seasons.

Specifically speaking, there was an ample store of water in fine pores up until 1981, when the drought started in this area, and there is a strong possibility that this was maintained in the ensuing years of drought and supported the forest trees. Following the abnormally low rainfall of 1992 and 1993, however, areas where even this water dried up appeared and dramatic decline occurred.

In this way, on low terraces (including some middle terraces) of the gravel layer connected to the flood plains of major rivers, the water environment is supported by groundwater that is linked to the level of rivers and lakes, whereas on medium and high terraces, the water environment is characterized by water stored in fine pores within compact layers of fine particles.

Since the absorption capacity (equivalent to capillary tension) of pores in the soil layer is strong, water that percolates from the surface is first stored in medium, small and fine pores, after which water in medium and small pores is thought to gradually flow out according to the gravity of the stored water. Since fine pore capillaries have strong absorption capacity, the water stored in the fine pores doesn't flow out immediately but only after an excess of water builds up with respect to the pore capacity. Accordingly, in cases where fine pores in the soil layer are dry and areas in contact with percolating water are large, almost all water is stored in the fine pores and there is little chance of vertical percolation to the aquifer. Having said that, in reality percolation to the groundwater level and runoff to the water system have been observed even in dry years when the soil is supposed to be dry. Although this could not be confirmed in the soil section survey, a small degree of medium and large pores exist in the firm layer and there is smooth vertical percolation of some water via these. In cases where fine pores are laterally situated some distance from the vertical conducting system, percolation into these fine pores takes time and it is believed that vertical percolation takes place. In such cases, vertical percolation occurs even if the fine pores are generally dry.

Within the Study Area, the hilly highland in the north is characterised by comparatively high precipitation and no instances of very dry weather. Because small and medium rivers originating in upstream mountain areas form shallow valleys between hills in this region, the groundwater level is shallow here and in surrounding hill areas. This also prevents extreme drying of the surface layer. Since the relative altitude of middle terraces is also low, the disparity between the ground surface altitude and groundwater level is small and soil is kept relatively moist.

In the case of sloping topography such as hilly land, it is usually the case for the soil layer to be thin compared to terraces and water storage to be low, however, on the hilly plain, since the eroded layer is thick (gravel layer in places), there are numerous points where the storage capacity of soil is large. Blessed with relatively abundant rainfall, it is thought that much water is stored between soil layers. For this reason, forest decline has not taken place.

From the central to the southern part of the Study Area, rivers such as the Jiu, Bals and Olt, etc. flow southwards cutting large swathes through the middle and high terraces. Land around these rivers is made up of valley-bottom plains consisting of riverside flood plains and low terraces. Because of the small difference in the relative height vis-a-vis the river water level, these plains are believed to be comparatively moist. In contrast, middle and high terraces are usually dry because of the large disparity with the water level.

Since there are no rivers which cut through middle and high terraces on the western side, i.e. right bank side, of Jiu River, wide middle and high terraces spread out to the main stream of the Danube River. This area forms an old thick alluvial fan having the area around Droveda Turna Severin in the west as its head, and there are many parts which retain the original fan form. On the surface, shallow valleys run southwards or south-eastwards following the gradient of the alluvial fan. When these small valleys merge to form larger valleys, they run southwards into the main stream of the Danube. The main stream of the Danube River currently runs close to the border with Bulgaria from the western edge to the southern edge of the alluvial fan, and the valley plain here is sometimes more than 100 m below the terraces. In other words, since the western alluvial fan is located higher than the current water level of the Danube River, this area displays middle and high terrace features and the north-western parts of terraces in particular display plateau features. According to observations taken at the comparatively deep valley bottom dam (Desnatui River, Fintinele Dam) located in the southeast of the alluvial terrace, the flow of this tributary is far greater than the basin area would suggest, indicating the possibility of another water supply route. Concerning the origin of this, it is thought that water from the main stream of the Danube River enters the alluvial fan layer from near the fan head in the north-west and appears as spring water in the small river basins after infiltrating the sub-soil. The alluvial fan sedimentary layer is composed of alternating firm silt layers and sand layers, but it is thought that groundwater mainly flows in the sandy layers while percolating through the compact layers. Near the fan head, since the main stream is at high altitude, it appears that sub-soil infiltration occurs in the middle parts as well as the low parts. In rainy years and the rainy season, shallow groundwater is easily formed. Spring water from this shallow groundwater leads to the formation of small shallow valleys (small tributaries), and the shallow groundwater is thought to be stable because these valleys are relatively large.

If shallow layer groundwater and water in small rivers is stable, it follows that the state of surface water on terraces should also be stable. However, since this shallow layer groundwater probably possesses perched water features, it tends to disappear in dry years. Accordingly, small valley flows are also disappearing. As was mentioned above, the sedimentary layer which forms the middle and high terraces is composed of alternating layers of compact silt and sand and it is thought that the shallow layer groundwater is often found at the bottom of sand layers in between the compact silt layers. When the sand layers are thick, the water linked to the firm layers is cut off and water stored in porous gaps in the firm layers supports the water environment, but when the sand layers are thin compared to the amount of groundwater, the groundwater is connected to the upper firm layers thus making the water environment near the surface stable. When the groundwater disappears in dry years, since the connection with the upper layers is cut off, surface areas dry out. In any case, water stored in fine pores in the surface soil layer is lost when a certain amount of time elapses after rainfall, so the water environment for root systems is largely determined by the amount of water that is stored in fine pores in compact layers.

In the case of the middle and high terraces distributed between Jiu River and Olt River and also to the east of Olt River, the groundwater level is assumed to be linked to the water level of these rivers. Moreover, it can be seen that percolating water from upstream areas has an effect on middle and shallow groundwater. However, because the relative height difference between these terraces and the river water level is large at 50 - 100 m and sand strata can often be found between sedimentary layers, the direct link between surface dryness and the groundwater level is thought to be very weak. Even in cases where shallow groundwater can be found at the bottom of silt layers, water reserves in capillary gaps are stable.

It is not unusual for sand dunes to be distributed along the main stream of the Danube River to have a thickness of 10 m or more. The bottom of the sand layer is far deeper than the present river level, and a groundwater aquifer linking the level of river water to that of lake water can be found in the sand layer. The groundwater level becomes higher the further one moves away from the river, sometimes varying by a few meters over one kilometer. Even in dry years, this water level only falls by 2-3 m and never falls below the river level. Under these circumstances, the water environment on low terraces and sand dunes is considered to be extremely stable. Regarding tree growth, there is low water stress and small danger of a decline of forests.

These sand dunes were higher in the past and the base of some middle terraces is formed from the sand layer. In the case of sand layer middle terraces, the surface layer of 2 m or so is often covered in silt originating from loess and, since sand layers containing shallow groundwater can be found below this, a relatively beneficial environment for deep root trees is formed.

Sand dunes and sand layers can be widely found on middle terraces that are based on the firm silt layer. This is frequently so to the south. In this case, since the groundwater aquifer formed inside the sand layer lies on top of the firm layer beneath the sand, it is not very thick. Accordingly, the groundwater level rises to near the surface and the surface water environment is moist during the rainy season when there is much water percolation, however, in dry years the groundwater disappears and the water environment is dry. These extreme fluctuations in the water environment place great stress on trees and lead to forest depletion.

(2) Rainfall

Precipitation in the Study Area has already been described in 2.2.1 - Climate. Rainfall observation was conducted at Varvoru (of the Craiova Forest Branch Office UP I) to establish the actual rainfall situation and to provide reference data on the relationship between rainfall and the water content in soil and between rainfall and the groundwater level. The observation period was from June, 1998 to May, 1999. The hourly maximum rainfall, daily maximum rainfall and monthly maximum rainfall during the observation period were 15.0 mm (between 09:00 and 10:00 on 6th August, 1998), 42.5 mm (on 16th July, 1998) and 91.0 mm (September, 1998) respectively. App. A-4 shows the observation data in the form of hourly rainfall.

The number of rainless days and other information were established based on data collected in Romania. Table 2-2-6 shows the maximum number of rainless days, the duration of daily rainfall of less than 5 mm and the duration of daily rainfall of less than 10 mm at Craiova and Caracal in a wet year, normal year and dry year.

Table 2-2-6 Rainfall Situation at Craiova and Caracal for Wet, Normal and Dry Years

Observatory	Type of Data	Wet Year (1991)	Normal Year (1997)	Dry Year (1993)
Craiova	Longest Duration of Rainless Days (days)	19 (2 Sept.-20 Sept.)	26 (14 Jan.-8 Feb.)	25 (4 Jan.-28 Jan.)
	Duration of Daily Rainfall of Less than 5 mm (days)	64 (18 Aug.-20 Oct.)	43 (15 Feb.-29 Mar.)	43 (1 Oct.-12 Nov.)
	Duration of Daily Rainfall of Less than 10 mm (days)	65 (17 Aug.-20 Oct.)	88 (1 Jan.-29 Mar.)	74 (30 June-11 Sept.)
Caracal	Longest Duration of Rainless Days (days)	17 (4 Sept.-20 Sept.)	14 (17 Sept.-30 Sept.)	20 (11 Oct.-30 Oct.)
	Duration of Daily Rainfall of Less than 5 mm (days)	49 (17 Feb.-6 Apr.)	88 (1 Jan.-29 Mar.)	50 (30 Jun.-18 Aug.)
	Duration of Daily Rainfall of Less than 10 mm (days)	81 (16 Feb.-7 May)	88 (1 Jan.-29 Mar.)	117 (9 Jun.-3 Oct.)

Note: The dates in brackets show the corresponding periods.
Source: *National Institute of Meteorology and Hydrology*

The average duration of a specific rainfall situation is established by focusing on the dry year for Craiova and Caracal. The average longest duration of rainless days, average duration of daily rainfall of less than 5 mm and average duration of daily rainfall of less than 10 mm are approximately 20 days, 45 days and 95 days respectively. In particular, the duration of daily rainfall of less than 10 mm at Caracal is as long as 117 days (almost four months).

(3) Quality of Rainwater

Rain traps were installed in the premises of the Slatina Forest Branch Office to conduct a water quality survey in order to check whether or not the rainwater quality affects forest decline. The survey items were pH, EC and NO_3 and the survey took place in warm months in the period from June, 1998 to May, 1999. The survey results are shown in Table 2-2-7.

Table 2-2-7 Analysis Results of Rainwater Quality

Date of Test	pH	EC (μs/cm)	NO_3 (mg/l)	Water Temperature (°C)	Accumulated Rainfall[*1] (mm)
14th June, 1998	6.15	33.8	1.2	28.4	–
27th June, 1998	5.80	15.9	0.9	29.2	5.9
13th July, 1998	7.32	129.7	2.8	25.8	0.6
27th July, 1998	5.31	30.4	0.9	29.1	3.6
11th August, 1998	6.70	56.7	1.7	26.2	1.9
–	–	–	–	–	0.0
8th September, 1998	5.47	28.9	1.2	17.7	9.1
22nd September, 1998	5.23	22.0	0.8	17.2	8.0
7th October, 1998	5.55	25.6	1.1	16.4	2.7
21st October, 1998	6.26	47.0	0.8	17.5	2.9
Snow	–	–	–	–	–
29th March, 1999	7.21	153.3	3.4	16.0	14.3
19th April, 1999	5.49	31.5	1.4	16.7	2.1
7th May, 1999	5.54	31.9	1.5	16.8	4.1
14th May, 1999	6.07	73.3	2.5	16.2	0.9
27th May, 1999	5.68	24.0	1.0	20.2	4.6

Note: [*1] Each figure under accumulated rainfall indicates the accumulated rainfall in the period from one test date to the next (approximately two weeks)

Source: *National Institute of Meteorology and Hydrology*

While the data for 13th June, 1998 and 14th May, 1999 is inferred to be abnormal in view of an extremely small number of samples, the data for 29th March, 1999 is inferred to be equally abnormal because of the mixture of melted snow which fell in the preceding winter period. The pH values do not show any seasonal fluctuations and the average value of 5.74 indicates weak acidity. As the criterion for acid rain is a pH value of 5.6 or lower, the local rain cannot be described as acid rain because of the proximity of the pH value to neutral. The NO_3 analysis results indicate a mean density of 1.1 mg/l which is similar to that of rainwater in Japan. Given the facts that there has been no forest damage caused by an excessive level of NO_3 in rainwater in Japan so far and that the level of the NO_3 load on local forests is much smaller than that in Japan because the quantity of rainfall in the Study Area is only one-third or one-quarter of that in Japan, the quality of rainwater in the Study Area cannot be a direct cause of forest decline.

(4) River Flow Regime and Hydrologic Cycle

A survey was conducted to establish the river flow regime and hydrologic cycle and to infer the mechanism of the water source conservation function in the Study Area. The observation data used was discharge observation data gathered at the Fintinele Dam on Desnatui River by the Apare Romania.

1) River Flow Regime

Various indices indicating the flow regime characteristics were calculated for a wet year (1991), normal year (1997) and dry year (1993) to establish the flow regime in the catchment area of the Fintinele Dam on Desnatui River and are shown in Table 2-2-8. The flow-duration curve for each year based on daily run-off data is shown in Fig. 2-2-4.

Table 2-2-8 Flow Characteristics of Wet, Normal and Dry Years

Item	Wet Year (1991)	Normal Year (1997)	Dry Year (1993)
Maximum Discharge ($x10^3m^3$)	1,088.0	549.0	34.2
35 Day Discharge ($x10^3m^3$)	82.3	37.3	19.1
Plentiful Discharge ($x10^3m^3$)	22.8	19.4	13.3
Normal Discharge ($x10^3m^3$)	15.6	14.2	8.6
Low Discharge ($x10^3m^3$)	13.0	10.7	5.8
Scanty Water Discharge ($x10^3m^3$)	10.0	7.4	4.6
Minimum Discharge ($x10^3m^3$)	6.9	6.5	4.6
Specific Discharge ($x10^3m^3/km^2$)	22.9	20.1	8.7
River Regime Coefficient	157.7	84.5	7.4
Flow Regime Coefficient	2.3	2.6	2.9

Source: *National Institute of Meteorology and Hydrology*

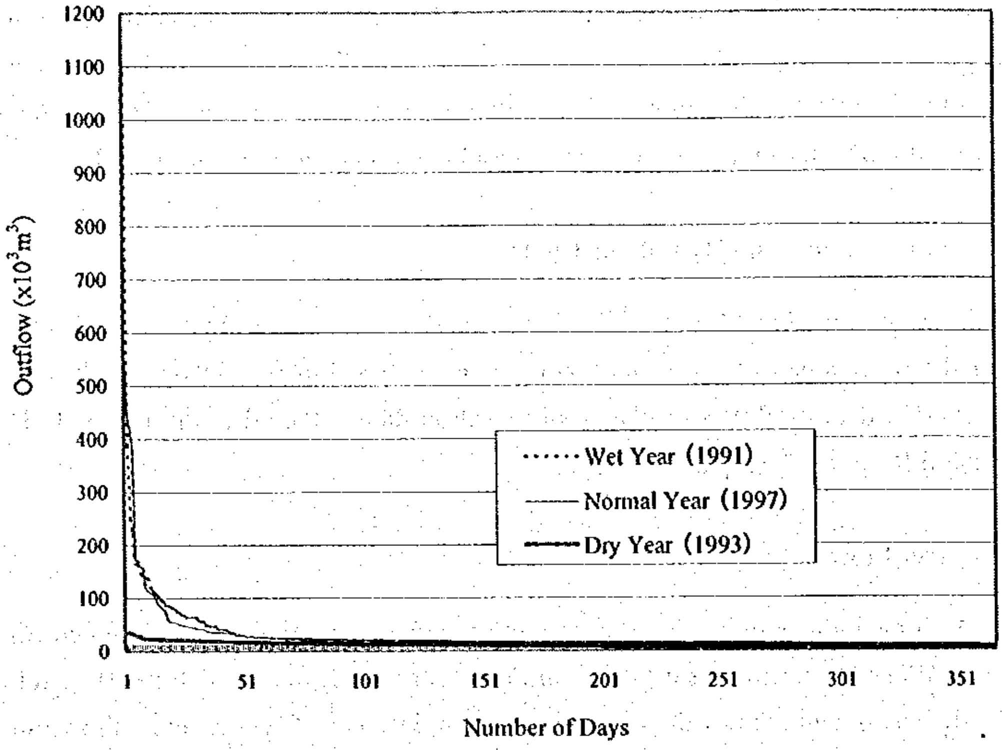


Fig. 2-2-4 Flow-Duration Curve

The maximum runoff rate in the dry year (1993) is only some 6% of that in the normal year (1997) or a mere 3% of that in the wet year (1991), indicating a very low outflow due to the extremely low precipitation in 1993.

The river regime coefficient represents the relative ratio between the maximum discharge and minimum discharge. While it is mainly between 100 and 600 for forest areas in Japan, the corresponding values for the Study Area are much lower except for the wet year, suggesting little fluctuation of the outflow compared to torrents in Japan.

The flow regime coefficient represents the relative ratio between plentiful discharge and scanty water discharge, indicating the outflow characteristics of a normal or low water level. The calculated values are small between 2 and 3. As the flow-duration curves clearly show, the discharge is fairly uniform with little fluctuation. Fig. 2-2-4 shows a sharp curve for the wet and normal years. This indicates the low levelling function of the outflow and the catchment area is characterised by the low level of the water source conservation function which can be attributed to the geology of the Study Area where the infiltration capacity of the parent materials is poor.

2) Hydrologic Cycle

The annual inflow, outflow, loss and outflow rate for wet, normal and dry years at the Fintinele Dam are shown in Table 2-2-9.

Table 2-2-9 Annual Inflow, Outflow, Evapotranspiration and Outflow Rate for Wet, Normal and Dry Years at Fintinele Dam

Category		Annual Inflow ($x10^3m^3$)	Annual Outflow ($x10^3m^3$)	Annual Evapo-transpiration ($x10^3m^3$)	Annual Outflow Rate (%)	Remarks
Wet Year	1980	25,281.8	–	–	–	Outflow data is missing for1980
	1991	10,142.7	26,550.5	-16,407.8	262	
Normal Year	1987	10,626.5	–	–	–	Outflow data is missing for 1987
	1997	8,927.3	18,814.0	-9,886.7	211	
Dry Year	1992	3,818.0	4,298.2	-480.2	113	
	1993	3,833.9	5,908.4	-2,074.5	154	

Source: *National Institute of Meteorology and Hydrology*

It was initially attempted to estimate the volume of evaporation in the Study Area based on the difference between the annual inflow and annual outflow at the Fintinele Dam. As shown in Table 2-2-9, however, the annual evapo-transpiration shows a negative value at this dam reservoir and the annual outflow rate exceeds 100%, resulting in an imbalance between the inflow and outflow. Interviews with local people led to the discovery that there are several springs at the bottom of the reservoir. This suggests that the catchment area of the Fintinele Dam on Desnatui River is located within an old fan of Danube River, of which the pivot area lies in the western part of Mehedinti County, a neighbouring county of Dolj County, and that underflow water emerges as spring water into the dam reservoir.

The water balance in this catchment area was then analysed to establish the hydrologic cycle in the Study Area. The annual precipitation at the nearest Craiova Observatory was considered to indicate the inflow to the catchment area. Having considered the annual inflow to the Fintinele Dam to be the annual outflow in the catchment area, the annual evapo transpiration and annual outflow rate were calculated as shown in table 2-2-10.

Table 2-2-10 Annual Precipitation, Outflow, Evapotranspiration and Outflow Rate in Catchment Area of Fintincle Dam on Desnatui River

Category		Annual Precipitation (mm)	Annual Outflow (mm)	Annual Evapo-transpiration (mm)	Annual Outflow Rate (%)
Wet Year	1980	754.7	57.1	697.6	7.6
	1991	677.7	22.9	654.8	3.4
Normal Year	1987	566.0	24.0	542.0	4.2
	1997	706.9	20.2	686.7	2.9
Dry Year	1992	293.5	8.6	284.9	2.9
	1993	403.0	8.7	394.3	2.2

Note: Size of catchment area = 443 km^2
Source: *National Institute of Meteorology and Hydrology*

Given the annual precipitation level of 100%, the annual evapo-transpiration of 95% is extremely high regardless of it being a wet, normal or dry year. The water balance of this area is marked by an extremely low level of direct outflow (5%). In short, the water environment of the Study Area where the annual precipitation is as low as one-third to one-quarter of that in Japan shows the typical characteristic of a semi-arid area where once infiltrated into the soil, rainwater evapotranspirates in the atmosphere.

(5) Soil Moisture Survey

A soil moisture (water tension) survey was conducted to establish the relationship between forest decline and soil moisture stress. The survey sites were seven representative forests in Dolj County as listed in Table 2-2-11.

Table 2-2-11 Soil Moisture (Water Tension) Survey Sites

No.	Survey Point	Forest Cover Type				Soil Type
1	O.S. Craiova UP I ua.80 (Criva)	Degraded	*Q. frainetto* *Q. cerris*	90% 10%	80y	LVx
2	O.S. Craiova UP III ua. 46A (Seaca)	Degraded	*Q. frainetto*	100%	60y	LVv
3	O.S. Craiova UP III ua. 95A (Seaca)	Healthy	*Q. frainetto* *Q. cerris*	98% 2%	60y	PHI
4	O.S. Craiova UP IV ua. 81B (Bratovoesti)	Healthy	*Q. robur* *F. excelsior* Others	50% 20% 30%	90y	FLc-s
5	O.S. Perisor UP I ua.64A (Verbicioara)	Degraded	*Q. frainetto*	100%	70y	LVx-v
6	O.S. Perisor UP III ua. 57A (Tirnava)	Degraded	*Q. frainetto* *Q. cerris* Others	40% 50% 10%	55y	CHk
7	O.S. Poiana Mare UP II ua. 92B (Tunari)	Healthy	*R. pseudoacacia*	100%	16y	ARc

The survey involved the insertion of moisture sensors at 0.25 m, 0.5 m, 1.0 m and 1.5 m below the ground at each site and data was collected approximately once a week. The precipitation and time series changes of the water tension of the soil in the period from June to October, 1998 are shown in App. A-5.

The general picture of the Study Area is that the moisture level is relatively stable as the permanent wilting point was not exceeded during the survey period at the low terrace and site with a shallow groundwater level (at Craiova Forest Branch Office UP IV ua. 81B and former Poiana Mare Forest Branch Office UP II ua. 92B) which have a good water environment. In contrast, at Perisor Forest Branch Office UP III ua. 57A and Craiova Forest Branch Office UP I ua. 80 which represent middle to high terraces, the permanent wilting point was exceeded upto 25 cm below the ground, mainly because of evaporation from the ground surface. However, sizable rain (daily rainfall of 30 mm or more) solves this problem. In regard to other survey sites, the permanent wilting point was exceeded upto a soil depth of 1.0 m at Perisor Forest Branch Office UP I ua. 64B and upto 1.5 m at both Craiova Forest Branch Office UP III ua. 95A and ua. 46A, resulting in very dry soil conditions due to evaporation from the ground surface and water absorption by the root system. While the degree of rainwater infiltration in the ground varies depending on the soil type, infiltration only takes place upto 50 cm below the surface. Soil which is 1.5 m below the ground was found to be still dry, suggesting the lingering effect of drought.

As described earlier, the data used here was collected between June and October, 1998. According to the available meteorological data, annual precipitation of approximately 600 mm was recorded in 1998 which was higher than the mean annual precipitation of 550 mm for the previous 33 years. Consequently, it can be inferred that water tension above that in 1998 occurred in the low rainfall period from 1983 to 1994, particularly in the dry years of 1992 and 1993, presumably constituting the largest cause of forest decline.

(6) Groundwater Level Survey

This survey was conducted to establish the conditions of groundwater in the plain catchment area, the reality of the water source conservation function and the relationship between the groundwater level and forest decline. The survey was generally conducted in two ways, i.e. direct measurement of the groundwater level at existing wells in the Study Area and analysis of the link between the groundwater level observation data at specific sites provided by the Romanian side and the actual rainfall observation data.

The groundwater level at some 100 wells in Olt and Dolj Counties was surveyed and the results are shown in App. A-6 - Groundwater Distribution Map. In general, the groundwater level is linked to the water level of a nearby river. In terms of the topographical connection, the groundwater level is deeper at higher terraces. Typical areas of a deep groundwater level are Seaca de Padure, Criva and Leu in Dolj County at 30 - 40 m below the ground. In contrast, areas with a shallow groundwater level are dominated by low terraces along such major rivers as the Danube, Jiu and Olt. In addition, a very shallow groundwater level of 1.0 m below the ground is observed at Topana located in the northernmost part of Olt County. These findings suggest that the distinctive relationship between topography and declined forests at higher terraces, i.e. a deeper groundwater level, is associated with more declined forests. In other words, declined forests are less observed in areas with a shallow groundwater level, such as low terraces.

Meanwhile, Table 2-2-12 shows data provided by the Romanian side on the groundwater level 3 km southeast of Varvoru Forest for the period from June to December, 1998. In order to analyse the relationship between rainfall and the groundwater level, rainfall data for the period from June to December, 1998 at Varvoru Forest observed under the Study and the above groundwater level data are shown in Fig. 2-2-5 in a time series manner.

Table 2-2-12 Groundwater Level 3 km Southeast of Varvoru Forest (cm)

Date	June	July	August	September	October	November	December
3	2,595	2,594	2,594	2,592	2,593	2,588	2,596
6	2,596	2,593	2,596	2,593	2,571	2,591	2,597
9	2,597	2,594	2,594	2,594	2,589	2,593	2,596
12	2,597	2,595	2,595	2,595	2,587	2,596	2,596
15	2,596	2,597	2,593	2,593	2,585	2,594	2,594
18	2,595	2,596	2,594	2,593	2,583	2,576	2,595
21	2,597	2,597	2,596	2,594	2,583	2,595	2,596
24	2,596	2,598	2,597	2,592	2,584	2,593	2,597
27	2,595	2,597	2,595	2,594	2,585	2,594	2,598
30	2,596	2,575	2,593	2,595	2,586	2,596	2,577

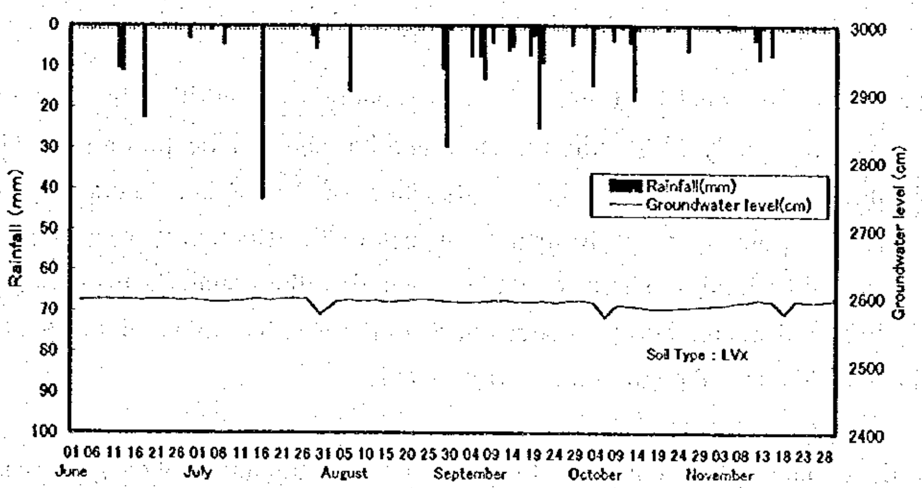


Fig. 2-2-5 Relationship Between Rainfall and Groundwater Level (Varvoru Forest)

These findings indicate a tendency that the higher terraces are (meaning a deeper groundwater level), the more declined forests are.

The groundwater level fluctuated by 23 cm between 2,575 cm and 2,598 cm. Rainfall does not appear to immediately affect the groundwater level, showing no correlation between the two. This suggests a low level of the water source conservation function of forests in the Study Area.

However, when wells are located in a fan created by the main channel, the fluctuation of the groundwater level at these wells may well be small because of the presence of stable groundwater channels filled by underflow water originating from the upperstream.

The observed values at least indicate that water supply from stored water in the soil to the groundwater belt is not smoothly conducted, presumably because of the following reasons.

- The low infiltration capacity of the soil means a low level of water supply to the stored water in the soil.
- The stored water in the soil is constantly in a state of water shortage (shortage of soil moisture) due to evapotranspiration.

2.3 Socioeconomic Conditions

2.3.1 General

(1) General Socioeconomic Conditions of Romania

Romania has a national land area of approximately 23.84 million ha. The population totalled approximately 22.6 million in 1996 and has shown a declining trend since 1990 (23.2 million) (see App. C-1-1-1 - Statistics of Romanian Economy). From an administrative point of view, Romania consists of the Bucharest Special District (the capital) and 40 counties. The Carpathian Mountains, the country's backbone mountain range, divides Romania into three areas of a similar size, i.e. mountainous Transylvania, highland Moldavia and plain-dominated Walachia.

Since the collapse of the communist regime in 1989, Romania has been proceeding with its shift to a market economy, implementing such measures as the elimination of price controls, liberalisation of inward foreign investment, reform of the banking system (privatisation of state banks and establishment of commercial and saving banks, etc.), entry to the Western European trade market due to the collapse of COMECON trade and the privatisation of state enterprises.

Substantial fiscal spending was conducted in 1996 to compensate for the operating deficits of state enterprises together with large increases of the energy prices and to provide subsidies for the agricultural sector. Because of these measures, the economic indices have rapidly worsened since 1996 with rising inflation, an increase of the fiscal deficit and deterioration of the current balance, etc.

Looking at the economic production trends, the productivity of agricultural production has recovered since 1993 due to the development of the irrigation system, input of chemical fertilisers and other reasons. As of 1996, the agricultural sector has a total farming area of 14.79 million ha, accounting for 62% of the total national land. Privately owned farmland accounts for 72% of the farming area. Farmland is divided into 9.34 million ha of cultivated land (63.2% of the total farming area), 3.39 million ha of pasture (22.9%), 1.5 million ha of hay producing land (10.1%), 0.29 million ha of vineyards (2.0%) and 0.27 million ha of orchards (1.8%) (App. C-1-1-2). The production volume of such grain as maize and barley is particularly large (App. C-1-1-3). In the industrial sector, the extreme import control measures introduced to repay foreign debts have resulted in a decline of the industrial output due to the deterioration of equipment. The commencement of technical as well as financial assistance by international organizations has facilitated the smooth supply of raw materials and energy in the industrial sector which began to show steady growth in 1993 and thereafter. In 1996, the manufacturing sector accounted for 81.9% of the total production value of the industrial sector while the electricity, thermal energy, gas and hot water production sector and the mining sector accounted for 10.3% and 6.8% respectively (App. C-1-1-4). Within the manufacturing sector, the food and beverage industry was the largest contributor with 17.1%, followed by the metallurgy industry (10.4%) and the synthetic fibre industry (7.8%).

The GDP in 1997 was 249,750.2 billion Lei with a GDP per capita of 11.077 million Lei (US$ 1,545). The real GDP growth rate was -6.6% in 1996, indicating the sluggish state of the Romanian economy. The industrial sector accounted for the largest share of the GDP with 34.2%, followed by the agricultural sector with 18.7%. Meanwhile, the GDP share of the forest and forestry sector had been around 0.4 - 0.5% for some time (App. C-1-1-5).

The consumer price inflation (year-on-year basis) of 256.1% in 1993, 136.7% in 1994, 32.3% in 1995, 38.8% in 1996 and 154.8% in 1997 has been very high (App. C-1-1-6). The foreign exchange rate against the dollar has changed from 76.4 Lei to the dollar in 1991 to 8,383 Lei to the dollar in April, 1998 (App. C-1-1-7).

In the first quarter of 1998, Romania's export value table by importing country was topped by Italy (21.5%), followed by Germany (19.3%), France and the UK. In terms of export items, textiles (25.5%) and base metals (22.5%) were the two main categories. Several forest/forestry related items were also exported, ranging from wooden furniture (5.4%), wooden/cork/woven willow products (4.3%) and logs/timber/particle boards (4.2%) to pulp/old paper/paper/paper products (0.6%). The two leading exporting countries in the same period were Italy (16.4%) and Germany (16.0%), followed by

Russia and France. The main import items were automobiles/machinery (22.1%), crude oil (17.8%), pulp/paper/paper sheets (2.7%), furniture (0.7%) and cork/branches for weaving (0.5%).

The agricultural sector has the largest workforce, accounting for 34.6% of all, followed by the manufacturing sector with 24.5%. Forestry workers account for 0.8% of the entire workforce (App. C-1-1-8). Among forestry workers, some 78% are men and 63% live in local areas. The average monthly wage (April, 1998) is 1,045,498 Lei (US$ 125) for all industries or 721,181 Lei (US$ 86) for the agricultural sector, 3,414,473 Lei (US$ 407) for the financial sector, 1,163,170 Lei (US$ 139) for the government sector, 725,170 Lei (US$ 87) for the timber industry and 1,021,699 Lei (US$ 122) for the pulp and paper manufacturing industry (App. C-1-1-9).

The unemployment rate changed from 3.0% in 1991 to 8.2% in 1992, 10.4% in 1993, 10.9% in 1994, 9.5% in 1995, 6.6% in 1996 and 6.4% in 1997. The unemployment rate stood at 9.3% in April, 1998. ILO statistics for 1997 put the unemployment rate for urban dwellers (69.4%) higher than that for rural dwellers (30.6%). By age group, the unemployment rate for the 15 - 24 year old group of 46.1% was the highest. By sex, the unemployment rate for men was 53.7% while that for women was 46.3%.

In 1996, higher education students accounted for 7.6% of the total population compared to 4.5% in 1991. The number of female students enrolled in higher education showed a sharp increase from 46% in 1991 to some 50.3% in 1996.

(2) General Socioeconomic Conditions of Olt County

The total area of Olt County is approximately 0.55 million ha, accounting for 2.3% of the total national land area. Data for 1996 puts the population at 0.52 million which has been continually declining since 1990 when the population stood at 0.53 million (App. C-1-2-1). The county office is located in Slatina and there are two cities, five towns and 94 villages in Olt County. Slatina has a population of 90,000, accounting for some 17% of the county's total population. Caracal, which has a population of some 40,000 (7.6%), is the county's second city and is located approximately 50 km south of Slatina.

Olt County has a workforce of some 210,000, of which 110,000 (51.8%) are engaged in agriculture, 40,000 (19.9%) in industries and 500 (0.2%) in forestry (App. C-1-2-2). The local unemployment rate of 8.6% in 1998 is lower than the national average of 9.3%. The average monthly wage in 1996 for all sectors was US$ 102 (313,561 Lei). The highest paid were those in the insurance and finance sector at US$ 203 (626,552 Lei) while the lowest paid were hotel and restaurant workers at US$ 63 (193,937 Lei). Forest workers received an average of US$ 97 (299,122 Lei) (App. C-1-2-3).

Agriculture is the county's main industry and farming areas occupy 80.5% (0.44 million ha) of the county's total land area (App. C-1-2-4 and C-1-2-5). The most popular agricultural products are such grain as wheat, rye and maize. In fact, maize is the dominant product, accounting for 82% of the total grain production. Other popular products are sunflowers to produce cooking oil and beets (App. C-1-2-6). In the industrial sector, data for 1995 puts the share of the manufacturing sector in terms of the production value at an overwhelming 97.6%. The metallurgy, food and tobacco industries were particularly important (App. C-1-2-7). Exports from Olt County were dominated by metals, particularly steel and iron, accounting for 87.9% of the total export value (US$ 131.84 million) which far exceeded the import value of similar products (US$ 8,085,000). Chemicals were the top import item, accounting for 32.7% (US$ 21.163 million) of the total import value. In all, the external trade of Olt County recorded a deficit of US$ 275.000.

(3) General Socioeconomic Conditions of Dolj County

The total area of Dolj County is approximately 0.74 million ha, accounting for 3.1% of the total national land area. The population in 1997 was approximately 0.75 million which reflected the declining trend since 1990 when the population was more than 0.78 million (App. C-1-3-1). There are two cities, five towns and 484 villages in Dolj County and the county office is located in the city of Craiova which has a population of 310,000, accounting for 41% of the county's total population. Such industries as machine manufacturing, aviation, electronics, chemicals, food, textiles, construction and furniture manufacturing industries are located in Craiova. Bailesti, the other city with a population of 20,000, has such industries as agricultural product processing, electronics and metallurgy industries.

Dolj County has a workforce of some 300,000 (employment ratio of 40.3%), of which some 150,000 (49%) are engaged in agriculture. The manufacturing industry has the second largest workforce (21.7%) while forestry employs the smallest workforce of some 1,400 (approximately 0.5%). The local unemployment rate of 9.3% (as of 30th April, 1998) is the same as the national average unemployment rate. The unemployment rate of 8.4% for women is lower than the national average (App. C-1-3-2).

Comparison of the average monthly wage between 1995 and 1996 when converted to US dollars shows a decline from US$ 105 (213,659 Lei) in 1995 to US$ 104 (319,341 Lei).

The average wage of those engaged in fish culture or fisheries was US$ 79 (161,299 Lei) in 1995 which dropped by 21% to US$ 63 (192,970 Lei) in 1996. Those sectors which saw a real wage increase were forestry (a 17% increase to US$ 85 or 260,874 Lei) and foreign trade (a 5.3% increase to US$ 92 or 283,382 Lei) (App. C-1-3-3).

Dolj County is endowed with fertile land and constitutes the central area for Romanian agriculture in terms of the production value and workforce. Agricultural land accounts for 79% of the total area (App. C-1-3-4) and cultivated land accounts for 83% of the agricultural land, followed by pasture (12%), vineyards (3.2%) and orchards (1.6%) (App. C-1-3-5).

While the production of grain is the predominant farming activity, maize in particular accounts for 85% of the total production value. The production of vegetables and fruit is also popular (App. C-1-3-6). In regard to industrial activities, automobile manufacturing accounts for 25.6% of the total industrial production value, followed by electricity generation/gas/water/hot water production and transportation with 20.8% respectively and food and beverage production with 19.2%. Minor industrial activities include recycling with 0.2% and timber (including furniture manufacturing) with 0.6% (App. C-1-3-7). The products produced in Dolj County and exported abroad include transportation machinery, including cars, aeroplanes and ships, accounting for 63% of total export value in Dolj County and producing a trade surplus of US$ 217.05 million. Other goods producing a trade surplus are chemical products (US$ 585,000), vegetables (US$ 483,000) and timber/charcoal/wooden boats (US$ 232,000). Machinery and equipment lie at the top of the import list, accounting for 65% of the total import value and producing a trade deficit of some US$ 404.92 million. In total, external trade registered a deficit of US$ 473.08 million in 1997.

2.3.2 Requirements of Forests Among Local People

(1) Area Categories

Dolj and Olt Counties are classified into three categories, i.e. northern hilly mountain foot areas, middle "tableland plains" and southern "riverside plains", based on three indices, i.e. topography, forest soil and forest utilisation. In addition, the opinions of local people were obtained in regard to "their use of forests", "public benefit functions of forests" and "role of forests to contribute to local development" and the expectations of local people vis-a-vis forests and the characteristics of local forests were clarified (Table 2-3-1).

Table 2-3-1 Evaluation of Expectations of Forest Use and Public Benefit Function of Forests

Area Category	Forest Use			Public Benefit Function of Forests			Forest Contribution to Local Development		
	Interview		Repeated Interview & Discussion	Interview		Repeated Interview & Discussion	Interview		Repeated Interview & Discussion
	Upto Present	Future	Future	Upto Present	Future	Future	Upto Present	Future	Future
Survey Sites	Type of Use (%)	Importance of Use (% /Score)	Use Score	Type of Function (%)	Importance of Function (% /Score)	Function Score	Type of Contribution (%)	Importance of Contribution (%/Score)	Contribution Score
North Part	Con: 43	Con: 57/8.0	Con: 9.4*	Con: 43	Con: 71/7.8	Con: 9.3*	Con: 43	Con: 100/9.3	Con: 9.4*
(Hilly Mountain Foot	Pro: 100	Pro: 100/7.1	Pro: 8.9*	Pro: 100	Pro: 100/8.3	Pro: 6.8	Pro: 100	Pro: 100/9.0	Pro: 6.1*
Areas)		Api: 14/8.0*	Api: 7.3		Api: 14/8.0*	Api: 5.5		Api: 14/10.0*	Api: 7.8
		Tou: 28/5.0	Tou: 6.3		Tou: 28/8.5*	Tou: 5.3		Tou: 43/9.3*	Tou: 3.4
Seaca (Olt)		Rec: 15/5.0	Rec: 6.3		Rec: 14/5.0	Rec: 6.1		Rec: 14/6.0	Rec: 5.3
Melinesti (Dolj)			Hun: 2.3						
			Fru: 2.3						
Middle Part	Con: 32	Con: 94/8.4	Con: 9.0*	Con: 42	Con: 94/8.9	Con: 9.5*	Con: 32	Con: 94/9.3	Con: 9.5*
(Tableland Plains)	Pro: 100	Pro: 100/8.1	Pro: 8.7*	Pro: 100	Pro: 100/8.1	Pro: 6.7	Pro: 53	Pro: 94/8.5	Pro: 8.5*
	Api: 11	Api: 17/6.0	Api: 8.3	Api: 11	Api: 22/7.5	Api: 5.7	Api: 11	Api: 22/8.3*	Api: 7.4
Falcoiu, Bals	Fru: 5	Fru: 6/7.0	Fru: 7.4				Eco: 5	Eco: 6/10.0*	Eco: 7.0
Scornicesti (Olt)	Med: 5	Med: 6/7.0	Med: 7.3				Dev: 5		
Seaca de Padure	Mus: 5	Cra: 6/9.0	Cra: 9.0*				Soc: 5		
Radovan	Pas: 26			Pas: 73	Tou: 5/7.0	Tou: 6.4	Pas: 11	Tou: 5/7.0	Tou: 6.0
Malu Mare (Dolj)	Hun: 11	Hun: 2/7.0	Hun: 8.6*	Hun: 11	Hun: 11/9.0*	Hun: 7.0	Hun: 11	Hun: 22/7.3	Hun: 8.5*
	Rec: 5			Rec: 11	Rec: 11/10.0	Rec: 8.4*		Rec: 17/9.7	Rec: 9.2*
South Part	Con: 67	Con: 100/6.2	Con: 8.6*	Con: 73	Con: 100/7.1	Con: 8.5*	Con: 73	Con: 87/8.2	Con: 8.6*
(Riverside Plains)	Pro: 100	Pro: 100/5.5	Pro: 8.9*	Pro: 93	Pro: 93/7.2	Pro: 6.1	Pro: 93	Pro: 93/7.1	Pro: 9.0*
	Api: 20	Api: 47/6.4	Api: 8.4*	Api: 20	Api: 40/6.5	Api: 6.6	Api: 20	Api: 47/7.4	Api: 8.5*
Vladila (Olt)	Fru: 7			Fru: 7			Agr: 7	Agr: 13/6.0	Agr: 6.5
Poiana Mare	Hun: 33	Hun: 13/5.5	Hun: 5.4	Hun: 20	Hun: 13/8.0*	Hun: 4.3	Hun: 20	Hun: 13/8.0	Hun: 4.0
Rast, Apele Vii		Tou: 7/1.0	Tou: 4.8		Tou: 7/10.0*	Tou: 3.3	Tou: 7	Tou: 13/6.5	Tou: 3.5
Ostroveni				Rec: 7	Rec: 13/5.5	Rec: 4.4	Rec: 7	Rec: 7/7.0	Rec: 5.4
Sadova (Dolj)				Hay: 7			Hea: 7	Hea: 7/2.0	Hea: 2.4

Notes 1. This table compiles the field survey findings using the Delphi technique.
2. Con: conservation, Pro: production, Api: apiculture, Fru: small fruit, Med: medicinal herbs, Mus: mushrooms, Pas: pasture, Hun: hunting, Rec: recreation, Cra: willow crafts, Eco: economy, Soc: social, Dev: development, Agr: agriculture, Hea: health, Tou: tourism, Hay: hay production

[North Part: Hilly Mountain Foot Areas]

County	Forest Range Office	
Olt	Vulturesti	–
Dolj	Amaradia	Filiasi

The forest vegetation of the hilly mountain foot areas located in the northern parts of Olt and Dolj counties mainly consists of *Q. petraea* , *Q. frainetto* and *Q. cerris*. The forests are relatively healthy and their main function is timber production.

[Middle Part: Tableland Plains]

County	Forest Range Office		
Olt	Bals	Slatina	(Draganesti-Olt)
Dolj	Craiova	Perisor	–

The vegetation of the middle tableland plains shows *Q. frainetto* , *Q. cerris* , *F. excelsior* and *Populus alba* , etc. Forests on the tableland indicate signs of decline and the area of declining forests shows a high percentage. Many forests enjoy good site conditions because of their proximity to such cities as Craiova and Slatina and perform the function of recreational forests.

[South Part: Riverside Plains]

County	Forest Range Office				
Olt	Caracal	(Corabia)	–	–	–
Dolj	Calafat	(Poiana Mare)	Sadova	(Apele Vii)	Segarcea

Riverside plains with sandy soil spread from the Danube River to the low tableland and many forests are affected by drought and strong wind. Forests are created to act as windbreak forests or to serve such protection functions as soil conservation and mitigation of extreme climate. The main species of these forests are *Robinia pseudoacacia* , *Populus* spp. and *Q. robur*. Groups of large areas of farmland are spread on the riverside plains, creating a unique forest landscape through their combination with the windbreak forests.

(2) Interview Results

An interview survey was conducted to clarify the expectations of forest functions and the intentions of forest-related persons in local communities and also to establish the state of forest use. The subject persons were the chiefs of forest range offices, foresters, municipal heads and representatives of farmers. A total of 41 people were interviewed, i.e. seven in hilly mountain food areas, 19 in tableland plain areas and 15 in riverside plain areas. As a result, the conventional roles and future expectations of forests were clarified in terms of forest use, public benefit functions and contribution to local development.

1) Forest Use

Conventional forest use in the hilly mountain foot area entirely consists of wood production and forest use to produce timber is expected to continue. Hunting, apiculture and fruit picking are conducted in forests in the tableland plain area in addition to wood production. Future expectations include the further development of apiculture and hunting and the use of forests to produce willow crafts. In the riverside plain area, wood production has the highest expectations, followed by environmental protection and apiculture.

2) Public Benefit Functions

The environmental conservation of forests is noted in all areas as a public benefit function. The expected forest functions in the future in the tableland plain area are tourism and recreation.

3) Role of Forests to Contribute to Local Development

In all areas, the timber production and environmental conservation functions of forests are strongly recognised by local people who are also aware of the contribution of forests to apiculture and hunting, etc. The contribution of forests to socioeconomic development and the windbreak function of forsts to protect agriculture are also pointed out in the tableland plain and riverside plain areas respectively. The expected forest functions in the future are apiculture in the hilly mountain foot areas, tourism in the tableland plain areas and the further performance of the windbreak function and apiculture in the riverside plain areas.

2.4 State of Forest Management

2.4.1 Organizations Related to Forests and Forestry

(1) Administrative Organizations Related to Forestry and National Forest Management Organizations

Forestry administration in Romania is under the jurisdiction of the MWFEP which underwent reorganization in March, 1999 as shown in App. E-1. The Forestry Regime Office of the Forestry Bureau, MWFEP is responsible for general forestry administration and has 23 staff members.

National forests are managed by the RNP which is directly controlled by the MWFEP. Its head office is located in Bucharest and the number of staff members has been reduced to the present 84 due to rationalisation.

The budget size of the MWFEP regarding forestry administration has been slightly increasing in recent years and stands at some nine million dollars in 1999. The budget size of the RNP for national forest management has also been increasing, from some 5.6 million dollars in 1998 to some 6.7 million dollars in 1999.

In the Study Area, the Slatina Forest Branch Office and Craiova Forest Branch Office used to be located in Olt and Dolj Counties respectively as branch offices of the RNP to manage local national forests. Following the reorganization at the end of December, 1998, however, both were integrated to their northern counterparts, i.e. the Rimnicu Vilcea Forest Branch Office in Vilcea County in the case of the Slatina Forest Branch Office and the Tirgu Jiu Forest Branch Office in Gorj County in the case of the Craiova Forest Branch Office. This reorganization also reduced the number of forest range offices under each forest branch office from six to four in the case of the former Slatina Forest Branch Office and from nine to seven in the case of the former Craiova Forest Branch Office. Accordingly, the number of staff members has been declining in the last few years. The Rimnicu Vilcea Forest Branch Office currently has some 320 staff members, including those of the forest range offices in Olt County, while the Tirgu Jiu Forest Branch Office has some 190 staff members, including those of the forest range offices in Dolj County. Fig. 2-4-1 and Fig. 2-4-2 show the present organizational structure of the Tirgu Jiu Forest Branch Office and the Craiova Forest Range Office in June, 1999 respectively.

The most recent reorganization was characterised by the assignment of graduate forest engineers to positions nearer field work than was previously the case.

The operational expenditure as of 1998 was some two million dollars for the former Slatina Forest Branch Office and some three million dollars for the former Craiova Forest Branch Office and these figures were relatively low among the forest branch offices in Romania. At both offices, operation related to wood production and the tending/management of forests accounted for more than 75% of the total expenditure.

(2) Division of Forest Management

The national forests in each forest range office area are divided into production forest units (UP: Unitatea de Productie) based on the natural topography and/or permanent structures. In Olt County, there are 31 UPs controlled by four forest range offices, while in Dolj County there are 38 UPs controlled by seven forest range offices. The national forests in each UP are further divided into compartments. In principle, the maximum area of a compartment is 20 - 30 ha for a plain or hilly land. If there are stands requiring different types of forestry work in a single compartment, these are classified as sub-compartments. Although the minimum area of a sub-compartment is set at 0.5 ha, 0.1 ha is used as the minimum sub-compartment area in practice. The average forest management area per ranger is 250 ha in the case of a plain and 550 ha in the case of a hilly area.

The Romanian Forests Planning is conducted every 10 years for each forest range office in accordance with the technical standards for forest management and a plan is prepared for each UP. In other words, the two counties discussed here have a total of 69 UP forest plans. In addition, a general forest plan is prepared for each forest range office. These forest plans are prepared using the survey results of ICAS researchers and the planned work is implemented by the RNP.

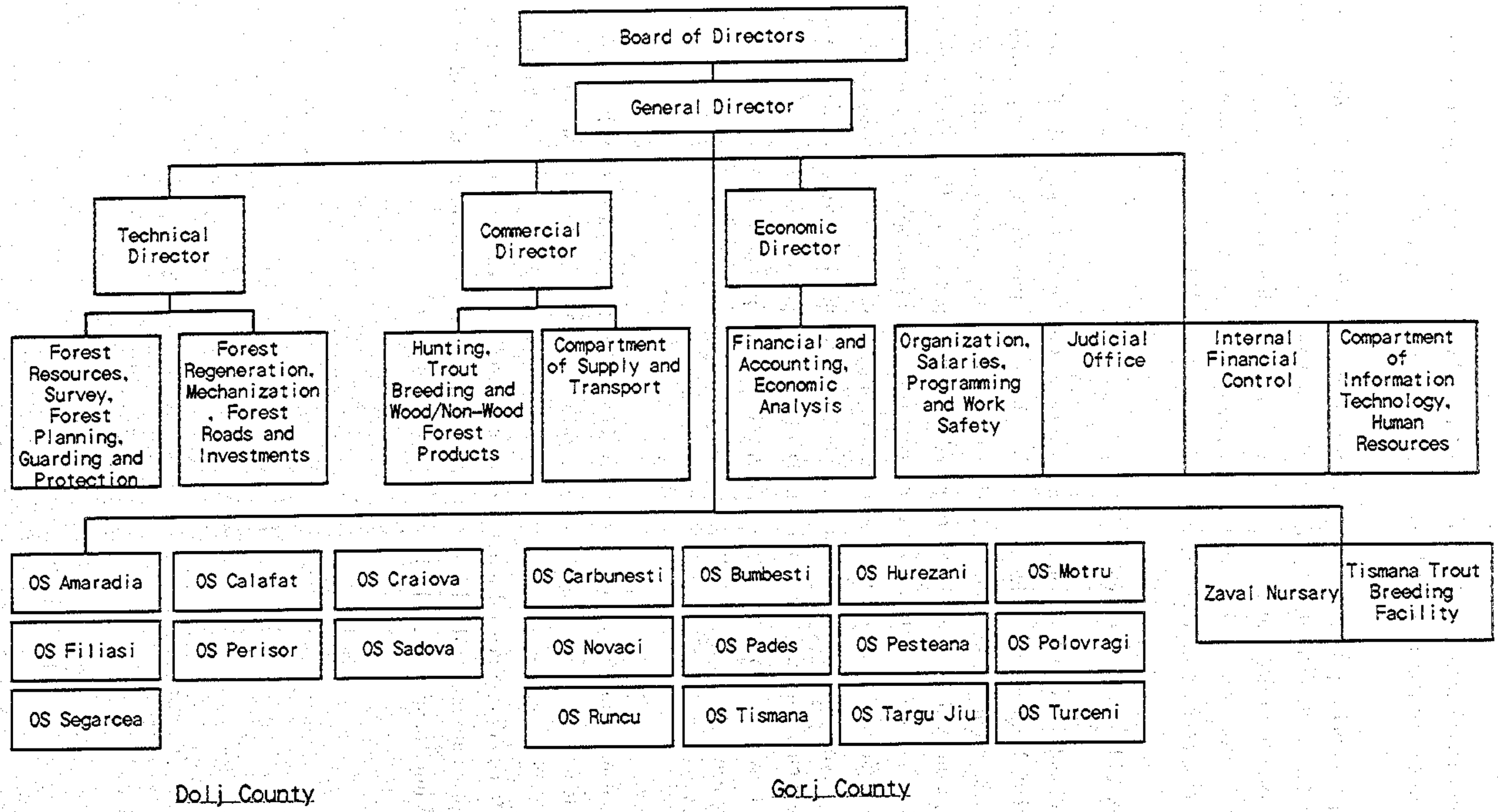
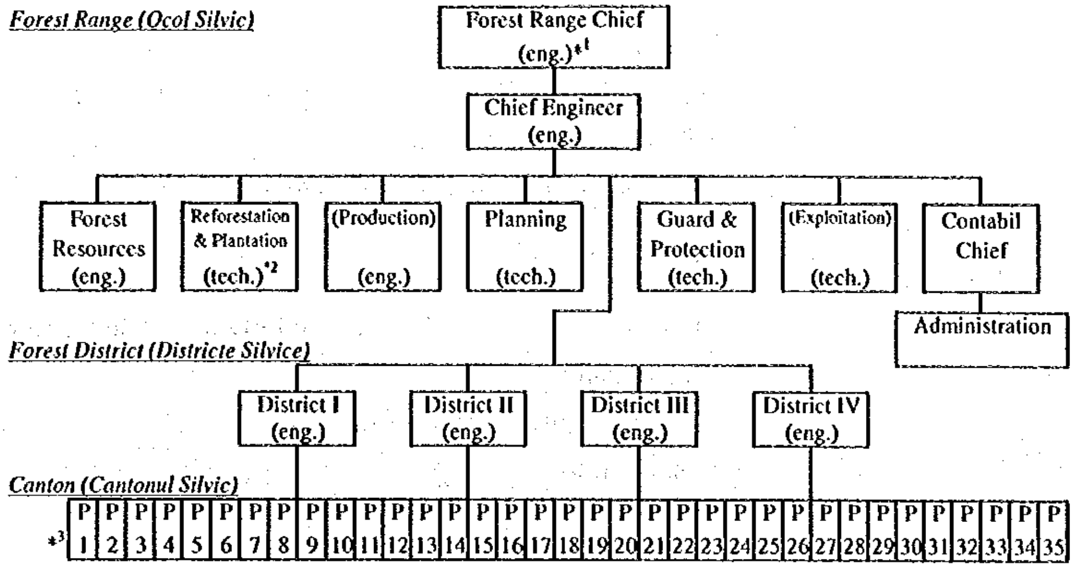


Fig.2-4-1 Organizational Structure of Tirgu Jiu Forest Branch Office (June, 1999)



Note: *1. eng.: Forest engineer, *2. tech.: Forest technician, *3. P: Padurar (Ranger)

Fig. 2-4-2 Organizational Structure of Craiova Forest Range Office of Tirgu Jiu Forest Branch Office (June, 1999)

2.4.2 Forest Distribution

(1) Forest Area in the Study Area

The total forest area in Romania is 6,371,000 ha, of which 115,806 ha of national forests (1.8%) are located in the Study Area. Forests in Romania are largely classified as mountain forests (elevation of 1,000 m or more), hill forests (elevation of 251 - 999 m) and plain forests (elevation of 250 m or less).

National forests in the Study Area consist of hill forests and plain forests. These local forests are distributed in areas at the top, sloping, foot and riverside areas of hilly mountain foot areas and at the tableland, sloping and riverside areas of plains.

Table 2-4-1 shows the area and stand volume of these forests. National forests in the Study Area are managed by 15 forest branch offices (as of December 1998: as of June 1999, the number of offices was 11) and are divided into three areas based on the geographical classification categories described in 2.3.2-(1), i.e. North Part, Middle Part and South Part.

The main species of national forests in the Study Area are *Quercus* spp., *Robinia pseudoacacia*, *Populus* spp., and *Fraxinus* spp. The relationship between the topographical features/areas and these species is described below.

– *Quercus* spp. : < North Part >
top, sloping and foot areas of hilly mountain foot areas
< Middle and South Parts >
tableland, sloping and riverside areas of plains

– *Robinia pseudoacacia* : < North Part >
sloping, foot and riverside areas of hilly mountain foot areas
< Middle Part >
tableland and sloping areas of plains
< South Part >
tableland areas of plains

– *Populus* spp. : < North Part >
riverside areas of hilly mountain foot areas
< Middle and South Parts >
riverside areas of plains

– *Fraxinus* spp. : < North Part >
riverside areas of hilly mountain foot areas
< Middle and South Parts >
riverside areas of plains

Table 2-4-1 Area and Stand Volume of National Forests in the Study Area

Forest Range Office	National Forest Area (ha)	Stand Volume (m^3)	Mean Volume (m^3/ha)	Main Species	Planning Revision Year	Area
Bals	12,110	1,316,301	109	Qf, Qc, Qp, Qr, Fe	1996	Middle Part
Caracal	4,934	592,951	120	Rp, Qped, Qpub. Pn, Pa, Pe	1990	South Part
(Corabia)	4,235	389,458	92	Pe, Sa, Rp, Qped, Pn, Pe, Pa	1997	South Part
Slatina	9,825	1,034,777	105	Qr, Rp, Qp, Qc, Pe, Qr	1997	Middle Part
(Draganesti-Olt)	4,629	516,636	112	Qr, Rp, Pe, Qf, Qc, Fe	1989	Middle Part
Vulturesti	7,265	806,453	111	Qf, Qc, Qpet, Rp, Pa, Pn	1991	North Part
Sub-Total	42,999	4,656,576				
Amaradia	10,722	1,178,487	110	Qf, Qc, Qpet, Rp, Pa, Pn	1997	North Part
Calafat	6,942	487,348	70	Rp, Pe	1994	South Part
(Poiana Mare)	7,718	741,005	96	Rp, Pe, Sa	1996	South Part
Craiova	11,667	1,455,033	125	Qf, Qc, Rp, Pe, Fe, Qr, Qpet	1997	Middle Part
Filiasi	9,163	1,170,467	128	Qf, Qc, Rp, Pe, Qpet, Qr, Fs	1998	North Part
Perisor	9,461	889,588	94	Qc, Qf, Rp, Qpub, Qped	1989	Middle Part
Sadova	6,929	768,161	111	Pe, Qr, Rp, Fe, Sa, Fs	1996	South Part
(Apele Vii)	3,849	395,014	103	Rp, Pe	1991	South Part
Segarcea	6,356	689,350	108	Qc, Rp, Qf, Qr, Pe, Sa	1992	South Part
Sub-Total	72,807	7,774,453				
Total	115,806	12,431,029				

Source: *The Romanian Forests Planning*

Fe : *Fraxinus excelsior*
Fs : *Fagus sylvatica*
Qc : *Quercus cerris*
Qf : *Quercus frainetto*
Qped : *Quercus pedunculiflora*
Qpet : *Quercus petraea*
Qpub : *Quercus pubescens*
Qr : *Quercus robur*
Pa : *Populus alba*
Pn : *Populus nigra*
Pe : *Populus euroamericana*
Rp : *Robinia pseudoacacia*
Sa : *Salix alba*

The area and distribution of forests by geographical part are summarised below (Table 2-4-2).

- North Part

The hills in the North Part are often used for forests, orchards and grazing land. Many forests are classified in the category of wood production forest and *Quercus* spp. are the main species. In the Study Area, the North Part enjoys a comparatively high ratio of forest land. The number of species observed is the highest among the three geographical parts and mixed forests of *Fagus sylvestris* and *Quercus* spp. are also found.

- Middle Part

Natural forests of *Quercus* spp. constitute a high proportion of forests and many stands are designated in Romania's forest function category of 1.3C. The area also has many plain forests. In general, the forests are scattered and a large forest land consolidation covers an area of some 3,000 ha.

- South Part

Many forests are distributed along riversides. Forests mainly consisting of *R. pseudoacacia* are found at plains which are away from rivers and are classified in the category of low terrace.

Table 2-4-2 Area and Stand Volume by Geographical Area in the Study Area

Area	Forest Range Office	National Forest Area (ha)	Stand Volume (m^3)	Mean Volume (m^3/ha)	Main Species
North Part	Vulturesti	7,265	806,453	111	Qf, Qc, Qpet, Rp, Pa, Pn
	Amaradia	10,722	1,178,487	110	Qf, Qc, Qpet, Rp, Pa, Pn
	Filiasi	9,163	1,170,467	128	Qf, Qc, Rp, Pc, Qpet, Qr, Fs
Sub-Total		27,150	3,155,407		
Middle Part	Bals	12,110	1,316,301	109	Qf, Qc, Qp, Qr, Fe
	Slatina	9,825	1,034,777	105	Qf, Rp, Qp, Qc, Pe, Qr
	(Draganesti-Olt)	4,629	516,636	112	Qr, Rp, Pe, Qf, Qc, Fe
	Craiova	11,667	1,455,033	125	Qf, Qc, Rp, Pe, Fe, Qr, Qpet
	Perisor	9,461	889,588	94	Qc, Qf, Rp, Qpub, Qped
Sub-Total		47,692	5,212,335		
South Part	Caracal	4,934	592,951	120	Rp, Qpet, Qpub, Pn, Pa, Pc
	(Corabia)	4,235	389,458	92	Pc, Sa, Rp, Qped, Pn, Pe, Pa
	Calafat	6,942	487,348	70	Rp, Pe, Sa, Pa
	(Poiana Mare)	7,718	741,005	96	Rp, Pe, Sa
	Sadova	6,929	768,161	111	Pe, Qr, Rp, Fe, Sa, Pc
	(Apele Vii)	3,849	395,014	103	Rp, Pe
	Segarcea	6,356	689,,350	108	Qc, Rp, Qf, Qr, Pe, Sa
Sub-Total		40,963	4,063,287		
Total		115,806	12,431,029		

Source: *The Romanian Forests Planning*

(2) Distribution of Declined Forests

In general, the Study Area can be classified into the healthy forest area and declined forest area based on the topographical features.

At low terraces (some 3 m higher than the river water level) along river channels and high precipitation zone in the North Part, the groundwater level is near the ground surface even in a dry year, resulting in an environment of low water stress for *Quercus* spp. trees. In contrast, a middle and high terraces (more than 10 m higher than the river water level of the main river channel), the groundwater level is deep even if the groundwater in the shallow layers is taken into consideration, suggesting particularly severe dry conditions in a dry year. In general, declined forests are less distributed in the relatively high precipitation zone in the North Part and at low terraces along river channels compared to middle and high terraces in the Middle Part.

The distribution of declined stands at middle and high terraces is determined by the micro-topographical factors and stand composition factors rather than the general topographical categories described above.

The soil at middle and high terraces is hard and has poor permeability. Stagnant water appears on the soil surface layer at minor concave sites and parts where the surface is firmly consolidated, even if the ground appears to be flat. The phenomenon where water absorbing roots in a near state of rot due to stagnant water cannot absorb water contained in the fine pores of soil in the succeeding dry season is thought to be occurring at these sites. When the dry conditions are harsh, trees start to decline. Only the growth of herbal species is observed are clearly concave sites where the phenomenon of stagnant water occurs.

At some middle and high terraces, valley type slopes can be seen due to advanced dissection. Ditches have been dug in many forest edge areas to prevent the arbitrary entry of vehicles to forest land. At these sites and in surrounding areas, forest decline is less apparent, presumably because of the good drainage conditions provided by these ditches. Areas near the bottom of valley type slopes appear to provide a favourable environment for tree growth as few declined trees are observed.

At forest edges and stands where the continuity of the canopy has recently been broken, the stand conditions have undergone a drastic change due to blowing wind and sudden increase of sunlight, causing a decline of the trees.

(3) Types of Forest Vegetation

1) Forest Vegetation in Olt and Dolj Counties Based on Existing Reference Materials

The community types of forest vegetation in Olt and Dolj Counties are mainly deciduous broad-leaved forests of *Quercus* spp. and forest grassland. Six species of *Quercus* spp. are mainly observed locally. *Q. robur* and *Q. petraea* species are observed in the northern part of both counties species associated with wetter areas. *Q. frainetto* and *Q. cerris*, are distributed inland to the north away from the Danube River which runs along the southern edge of these counties and are intermediate zone species from the climatological point of view. *Q. pedunculiflora* and *Q. pubescens* are observed in small areas in the southern dry zone. The main broad-leaved species other than *Quercus* spp. are *Fraxinus* spp., *Acer* spp., *Ulmus* spp. and *Tilia* spp., all of which are seen mixed with *Quercus* spp. *Populus* spp. and *Robinia pseudoacacia* are two major species for large artificial stands. The former tends to be observed along the Danube River and on the flood plains of Jiu River and Olt River, and the latter tends to be observed in the sandy soil region in the southern part of the country.

2) Types of Forest Vegetation Based on Belt-Transect Survey

The physiognomy analysis has confirmed that the forest vegetation in the two counties is deciduous broad-leaved forests with a strong presence of *Quercus* spp. However, a forest vegetation survey was conducted using the belt-transect method to determine the forest vegetation types in the Study Area by means of judging the degree of dominance of the observed species.

A longitudinal survey heading north from the Danube River was conducted to establish the appearance of *Quercus* spp. by the belt-transect method. Assuming five longitudinal lines (I – V) in the Study Area, belt-transect survey plots were established along these lines.

The detailed results of the belt transect survey are described in 2.4.3-(1).

3) Forest Vegetation Types in Olt and Dolj Counties

The forest vegetation types observed in Olt and Dolj Counties are shown in Table 2-4-3 [this classification is based on the method employed by N. Donita *et. al.* (1997)]. In this table, hidrofilo forests prefer a wet environment while termofilo forests prefer dryish conditions. Meanwhile, mezofilo forests prefer intermediate conditions between the above two.

Table 2-4-3 Forest Vegetation Types

Forest Vegetation Types	Details of Forest Vegetation Types
1	Mezofilo forest of *Quercus petraea*
2	Mesofilo forest of *Quercus robur*
3	Mezofilo hill forest of *Fugus*
4	Termofilo forest of *Quercus petraea*
5	Termofilo forest of *Q. cerris* and *Q. frainetto*
6	Termofilo forest of *Q. pedunculiflora* and *Q. pubescens*
7	Hidrofilo forest of flood plain and marsh with *Alnus, Populus, Salix* and *Fraxinus*
8	Artificial forest of *Robinia pseudoacacia, Populus euroamericana* and others
9	Hidrofilo forest of *Q. robur, Fraxinus excelsior* and others
10	Termofilo forest of *Q. robur, F. excelsior* and others
11	Termofilo forest of *Q. robur, Q. frainetto* and *Q. petraea*

While the distribution of the established 11 forest vegetation types is shown on the forest vegetation map, it is outlined below (see Table 2-4-4 for more details).

- Type 1 : minor distribution in the northern part of Olt County
- Type 2 : distributed from the central part to the northern part of both counties
- Type 3 : minor distribution in the northern part of Dolj County
- Type 4 : minor distribution in the northern part of Olt County
- Type 5 : widely distributed in the central part and northern part of both counties
- Type 6 : scattered in the south of the central part of both countries
- Type 7 : widely distributed on the flood plains of Jiu, Olt and the Danube Rivers
- Type 8 : mainly distributed in Poiana Mare, a sandy area in the south, and areas around Apele Vii
- Type 9 : distributed near Bratovoesti and Resca in the central part and the Zaval area in the southern part
- Type 10 : distributed near Rebegi in Segarcea Forest Range Office
- Type 11 : distributed in parts of Amaradia, Vulturesti and Bals in the northern part

Table 2-4-4 Forest Vegetation Types of the Belt-transect

Vegetation types	Forest name	Dominant tree species	Indicator herbs	Belt-transect
1	Filiasi	*Q.petraea*	*Melica uniflora* *Brachypodium silvaticum*	32
2	Filiasi	*Q.robur*	*Arum maculatum* *Aegopodiium podagraria*	30
3	Filiasi	*Fagus silvatica*	*Poa nemoralis* *Dactylis glomerata*	31
4	Bucovat	*Q.petraea*	*Festica heterophylla* *Galium aparine*	1
5	Bucovat	*Q.frainetto, Q.cerris*	*Geum urbanum* *Lithospermum purpureocoeruleum*	2
	Seaca	*Q.frainetto*	*Helleborus* *Poa pratensis*	3
	Seaca	*Q.frainetto*	*Poa nemoralis* *Carex praecox*	4
	Verbicioara	*Q.frainetto, Q.cerris*	*Poa pratensis*	11
	Verbicioara	*Q.cerris*	*Urtica dioica*	12
	Tarnava	*Q.cerris, Q.frainetto*	*Urtica dioica* *Bromus sterilis*	13
	Seaca Optasani	*Q.frainetto*	*Poa nemoralis* *Carex praecox*	19
	Seaca Optasani	*Q.frainetto*	*Festica heterophylla* *Poa pratensis*	20
	Bals	*Q.cerris, Q.frainetto*	*Poa pratensis*	21
	Vulturesti	*Q.frainetto*	*Poa pratensis*	28
6	Vladila	*Q.pubescens* *Q.pedunculiflora*	*Poa pratensis* *Carex Precox*	25
	Vladila	*Q.pedunculiflora*	*Glechoma hederacea* *Geum urbanum*	26
7	Bratovoesti	*Alnus glutinosa*	*Lysimachia nummularia* *Dactylis glomerata*	29
8	Celaru	*Robinia pseudoacacia*	*Sambucus ebulus* *Ultica dioica*	14
	Madona	*Robinia pseudoacacia*	*Bromus sterilis* *Cynodon dactylon*	15
	Desa	*Populus euroamericana*	*Bromus sterilis*	17
	Desa	*Robinia pseudoacacia*	*Bromus sterilis*	18
9	Bratovoesti	*Fraxinus excelsior* *Q.robur*	*Glechoma hederacea* *Lamium galeobdolon*	5
	Bratovoesti	*Fraxinus excelsior* *Q.robur*	*Glechoma hederacea* *Lamium galeobdolon*	6
	Zaval	*Fraxinus excelsior* *Q.robur*	*Dactylis glomerata* *Urtica dioica*	9
	Zaval	*Fraxinus excelsior* *Q.robur*	*Urtica dioica* *Viola hirtus*	10
	Resca	*Q.robur* *F.excelsior*	*Festica heterophylla*	23
	Resca	*Q.robur*	*Glechoma hederacea* *Lamium galeobdolon*	24
10	Rebegi	*Fraxinus excelsior* *Q.robur, Q.pedunculiflora*	*Geum urbanum* *Lithospermum purpureocoeruleum*	16
11	Amaradia	*Q.frainetto* *Q.petraea*	*Sambcus ebulus* *Ultica dioica*	7
	Amaradia	*Q.frainetto* *Q.cerris*	*Poa nemoralis* *Brachypodium silvaticum*	8
	Bals	*Q.petraea* *Q.cerris*	*Carex pilosa* *Brachypodium silvaticum*	22
	Vulturesti	*Q.petraea* *Q.robur*	*Glechoma hederacea* *Geum urbanum*	27

(4) Analysis of satellite-delivered data

1) Introduction

A remote sensing analysis was conducted using LANDSAT satellite images to identify temporal and spatial changes of forest conditions. A land cover survey was carried out on site for three weeks in October 1997 to observe disparities between satellite images and actual field covers. Samples were collected as much as possible at various points using a GPS camera to compare the color tones on the images and the images corresponding to the actual land cover conditions, and at the same time, to acquire exact coordinates of sample sites. A supervised classification method was employed using the training samples acquired from the field. Extraction of data on vegetation stress and a temporal analysis were conducted, also.

2) Satellite Images

The Study Area can be covered by shifting the image (Path 184, Row 029) 20% southward. The data acquisition dates were selected during a summer period from June to September when reflectance from leaves was still active. Table 2-4-5 shows the data used in this analysis.

Table 2-4-5 Date of LANDSAT TM Data Acquisition

Type of Sensor	Path/Row	Date	Cloud Cover	Resolution
Landsat TM	184/029	May 29 1986	0%	30 m
Landsat TM	184/029	July 11 1990	0%	30 m
Landsat TM	184/029	June 28 1997	0%	30 m

Image processing, such as geometry correction, was performed onto the acquired data.

3) Land Use Classification and Extraction of Temporal Changes

Using the geo-rectified scenes prepared, an unsupervised classification procedure was performed on six multi-spectral data except for the data from the Band Six. 240 spectral classes were then created through the supervised classification, and by interpreting the false color images, seven land cover classes were reclassified.

From each land cover class, about 15 to 20 polygons of training data were extracted, and land cover types were classified by the maximum likelihood classifier method. The following land cover classes were identified and grouped in the Study.

Urban

This class includes small villages as well as large cities like Craiova. The class is characterized by a mixed land use pattern having different land use elements such as buildings, roads, and vegetation.

Agriculture/Pasture Land

This class includes herbaceous field crops that are presently growing or ready to be cultivated. Managed crop fields and pastureland are included.

Presently irrigated agriculture

Forest

The area distributed coniferous forest and broad-leaf forest was classified into one class as Forest in this analysis.

Water bodies

Mixed area

This class consists of various types of vegetation that could not be distinguished from satellite image interpretation. This class may include some logged areas, non-managed grasslands, wetlands, and shrubs.

Barren

This class includes the abandoned agricultural field, lands in fallow, bare soil, and other areas that could not be classified into above classes.

The temporal change analysis was performed on the land use using the reclassified three land-cover images. The forest area decreased considerably from 1986 to 1990. The reduction of the forest area, according to the area calculation, resulted in increase in agriculture/pasture land areas. From 1990 to 1997, on the other hand, the forest area was increase.

However, the forest area does not change much according to the results of RNP. The reasons of difference between the result from the analysis and RNP data can be considered as follows.

a) Logged area could be included in grasslands or grazing. If trees were planted after LANDSAT data has been taken, the data does not capture the increase. As a matter of fact, trees are planted after felling in the Study Area. Consequently, it seems to be difficult to analyze the change of forest area using LANDSAT data.

b) Canopy areas are larger than building areas because many garden trees are planted in towns and villages. The garden trees may be classified as Forest.

4) Detection of Vegetation Stress

"Vegetation Stress" is a generic term that explains effects caused by noxious insects, fungi, and some geological and soil factors. In the Study Area, damaged trees by noxious insects and the deterioration of forest in the past 10 years was reported. For this reason, this analysis on vegetation stress was conducted by using the multi-bands of LANDSAT/TM effectively. Vegetation stress exhibits several spectral characteristics as follows:

① Low reflectance in the NIR (TM band 4) ;

② High reflectance in the MIR (TM band 5) ;

③ A subsequent high 5/4 ratio value ;

④ High red reflectance (TM band 3) ; and

⑤ Low green reflectance (TM band 2).

Using these spectral characteristics, it is possible to detect unhealthy vegetation areas in low biomass and low chlorophyll. The detection of vegetation stress was investigated only in areas classified as forest in the LANDSAT/TM data.

Firstly the TM bands 5/4 ratios image was created for three TM scenes, and the vegetation stress was detected and evaluated from these images. Then, the color composite images were prepared by assigning the TM bands 5/4 ratio multiplied by 100 to red, TM band 5 to green, and TM band 2 to blue. The color assignment was designed to show healthy vegetation blue, and stressed vegetation red in the images.

A linear pattern of vegetation stress areas was identified from east to west along the Danube River as the result. These areas are narrow in the eastern side, getting gradually wider toward the western side. The linear patterns of vegetation stress areas are clearly visible especially in the May and June scenes in all the scenes over the 11-year period covered by the scenes.

Secondly, the classification of vegetation stress was performed in the whole the Study Area for the purpose of grasping the distribution stress conditions quantitatively. The bands 5/4 ratios were set as the vegetation stress indices, they were classified into five classes from each histogram of bands 5/4 ratios statistically.

From these vegetation stress classification maps and the area calculation, the high stressed areas can be seen widely in 1990. This is caused by the decrease of forest from 1986 to 1990. In other words, the fact closely relates to the land cover changes.

5) Change Analysis in Vegetation Stress

In order to clarify the temporal changes of vegetation stress, images showing vegetation stress changes were created by subtracting the earlier 5/4 ratio images from the later ones (1986-1990, 1990-1997). Theoretically, resultant values that were negative indicated a decrease in vegetation stress, and positive values indicated an increase.

Negative values (decreasing trend) ranged 20-30 percents in the classified forest areas. On the whole, vegetation stress was showing a tendency to increase.

Further, images of vegetation-stress change were reclassified into five classes (decrease, moderately decrease, stable, moderately increase, increase) in order to grasp the tendency and the fluctuation of vegetation stress.

As for tendency by county, Dolj County had more vegetation stress than Olt County. Especially the forest around the western end of Dolj County, the stress change increased during the years from 1986 to 1990. Further south the stress increased from 1986 to 1990. The increasing trend continued from 1990 to 1997. Also, around southwestern Craiova, vegetation stress increased from 1986 to 1990, on the decrease during 1990 to 1997.