*Appendix H*

*PCM Workshop*

# Appendix H PCM WORKSHOP

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# Appendix H PCM WORKSHOP

## H.1 PCM Workshops in Skopje, Radovish, and Krushevo

### H.1.1 General Description

The PCM[1] Workshops were held in Skopje, Radovish and Krushevo during the second field survey. The main purposes of the Workshops are as follows:

- To understand actual local problems and their cause-effects relationship through getting direct input from the people concerned in the water resource development and management and from the community members;
- To identify local needs, potentials and available resources, which are to be helpful information for formulation of a master plan and individual projects;
- To improve awareness of project ownership and importance of active participation through the participatory planning method.

The three places for the Workshops mentioned above were selected with considering the water-related problems and development needs identified during the first field study and through discussion with the related agencies including the Ministry of Development and from the Agency for Economically Underdeveloped Area. The following criteria were used for the selection:

(1) Facing serious water-related problems

(2) Representing a group of cities/towns/villages sharing a certain water-related problems

(3) Promising potentials for development

(4) Human resources and facilities available for organizing a PCM workshop

Selected places are shown in the above. Skopje represents the Metropolitan area having the largest, growing population as well as the biggest industrialized zone in the country. At the same time, Skopje includes the isolated mountain areas with poor accessibility to safe drinking water. Radovish is located in the center of the eastern part of Macedonia suffering from limited rain falls and water shortage in spite of their agricultural potentials. Krushevo is typical of the Pelagonija region, where highlands and hilly mountains are dominant and the communities face serious municipal and agricultural water shortage.

[1] The PCM (Project Cycle Management) method is a tool for managing the entire cycle of a development project by means of a project format termed the PDM (Project Design Matrix): which has been introduced for its project planning and monitoring and evaluation by JICA (Japanese International Cooperation Agency). A PCM workshop, which consists of five steps of planning: participation analysis, problem/ objective/alternative/analyses and PDM formulation, provides a place for discussing and analyzing existing problems and formulating projects through participatory approach.

H.1.2 Outcome from the Skopje Workshop

The Workshop was held on June 17 (Wed), 1998 in Skopje. 15 persons attended from the Ministry of Development, the Agency for Economically Underdeveloped Area, the Ministry of Urban Planning, the Institute of Agriculture, Municipal offices (mayors) in Grand Skopje[2], Water Management Organization (PWME at present), Public Water Supply Companies, local communities (teachers) etc. The urban area of Grand Skopje has the problems that are common to rapidly growing and overpopulated urban areas, while the rural area has the problems caused by lack of basic infrastructure.

The core problem of the urban group was water source protection is limited. The participants pointed out that there were no serious problems observed currently about the quality and quantity of drinking water in the urban area of Skopje. Through the problem analysis, the major direct causes clarified here were untreated waste water is discharged, industrial polluters are existing, poor enforcement system of laws, poor respect to laws and insufficient inspection services. The problem tree prepared in the Workshop is shown in Figure H.1.

The outskirts group selected insufficient water supply as a core problem. The direct causes for this core problem were irrigation water shortage and no safe drinking water in most of the settlements. They also analyzed deeper about these two direct causes that were shown in the problem tree. At the same time, various effects caused by the core problem were identified, which described the actual problems suffered by the community members.

Most of them were the problems related to health and sanitary conditions such as occurrence of a wide range of epidemic diseases, occurrence of communicable (water-born) diseases among primary school students, poor hygiene situation in individual houses and public places etc. This shows that the water shortage has caused various types of health problems in the communities, especially among infants and children. PDMs showing the project idea prepared during the workshop is shown in Figures H.2, H.3 and H.4.

H.1.3 Outcome from the Radovish Workshop

The Workshop was held in Radovish on June 19 (Fri), 1998. 13 persons attended from the Ministry of Development, the Agency for Economically Underdeveloped Area, Municipal offices (mayor and representatives) of Radovish and Podaresh, Water Management Organization, Public Water Supply Companies, agro-kombinats, individual farmers, NGO (environment protection) etc.

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[2] Grand Skopje is the metropolitan area consisting of 7 municipalities: Gazi Baba, Gjorce Petrov, Karpos, Kisela Voda, Centar, Cair and Suto Orizari. Each of the 7 municipalities has a mayor; and Grand Skopje has a mayor also. It has a population of 475,000 in 1997, which share 85% of the entire population of the former municipality of Skopje and 24% of the total population of Macedonia.

The core problem in Radovish was frequent occurrence of water-related problems. Seasonal shortage of drinking water in towns, bad water quality and lack of irrigation water were the direct causes in this case. Reflecting the problems and needs of the local communities, the problem analysis tree was well developed both of upwards and downwards, which is shown in Figure H.5. In this area, a solution for the problem of drinking and irrigation water shortage is greatly required in the communities as people are migrating to the urban areas because of it.

PDMs developed in the workshop in Figures H.6, H.7 and H.8 summarize the project ideas in order to solve the problems above mentioned. All the discussions and analysis during the workshop were active and serious; which shows their seriousness about the water-related problems in the communities.

### H.1.4 Outcome from the Krushevo Workshop

The Workshop was held in Krushevo on June 24 (Wed), 1998. 23 persons attended from the Ministry of Development, the Agency for Economically Underdeveloped Area, Municipal offices (mayors and representative) of Krushevo, Demir Hisar, and Staravina (belong to the former municipality of Bitola) and Vitolishte (Prilep), Water Management Organization, Public Water Supply Companies etc.

Selecting serious water supply problems are existing as core problem, no accessibility to safe drinking water in mountain villages, serious water shortage in urban areas and insufficient quantity of irrigation water were identified as direct causes. The local problems and needs especially about the irrigation water shortage, the potentials of agricultural development (tobacco, fruits etc.) with irrigation, serious shortage of drinking water during the dry season and increasing number of migrants to the urban areas were clearly shown in the problem tree in Figure H.9.

Figures H.10 to H.12 include the project concept to cope with the existing problems mentioned above. Discussions in the workshop revealed that the shortage of irrigation water had been serious constraint in agricultural development in the communities in spite of their natural resources. In addition, it was also pointed out that, besides limited rainfall in the dry season, ineffective usage of irrigation water and inadequate maintenance of water pipeline system had caused the shortage of drinking water.

## H.2 PCM Workshops in Kochani and Gevgelija

### H.2.1 General Description

The 4th and 5th PCM workshops were held in Kochani and Gevgelija respectively

during this field study period. Because the Study was on the stage of formulation of master plan and individual projects, these two workshops placed importance on the steps of development of the project design matrix (PDM); while the workshops during the previous field study had aimed at problem identification through structuring a problem tree.

The outline of the workshops is briefed as below:

(1) Purpose:

- To understand urgency and seriousness of the water-related problems in the towns/villages which have been most severely suffered from water shortage;
- To identify local needs, potentials, and available resources, which are helpful in formulation of master plan and individual projects;
- To identify general and specific important assumptions which need to be taken into consideration for improving effectiveness and sustainability of individual projects;
- To clarify institutional environment of the central and local water-related organizations about problem analysis and project formulation from both of the engineering and institutional aspects.

(2) Place:

The candidate places for the PCM workshops had been selected including Gevgelija, Kochani, Kumanovo, Strumica, Tetovo, Veles etc. based on the result of the water balance study and the problem identification done by the Study. Among these candidates, Kochani and Gevgelija were chosen in the end based on their urgency and seriousness of the water-related problems, the higher priority given by the Macedonian Government, and no participation in the previous three PCM workshops during the second field study.

1) Major reasons of selecting Kochani:

- Suffering from serious seasonal shortage of drinking water in the two municipalities of Kochani and Vinica; there live approximately 70,000 people;
- Suffering from irrigation water shortage and famous for its rice production, which requires much water;
- Situated in the centre of the eastern part of Macedonia, where many municipalities suffer from seasonal or all through the year water shortage based on the water balance study;
- Already have its own concrete project plan of construction of a dam, intakes, and pipelines; a formal request of financial cooperation for this project has been already submitted by the Macedonian Government to the Japanese Government.

2) Major reasons of selecting Gevgelija:

- Suffering from shortage of irrigation water and inefficiency of aged existing irrigation system;
- Already have its own concrete project plan of construction of a dam, intakes, and pipelines;

High potentials of agricultural production of early-grown vegetables and fruits (grapes and peaches) which are major export products of Macedonia.

3) Date and workshop place

| | |
|---|---|
| - Kochani: | October 13 (Tue), 1998<br>Hotel "Centro Biznis" in Kochani |
| - Gevgelija: | October 15 (Thu), 1998<br>Hotel "Jugo" in Gevgelija |

(3) Component of the Workshop

Each Workshop consists of the following components.

1) Introduction of the participants
2) Explanation about the PCM outline
3) Problem analysis
4) Objective analysis/Alternative analysis
5) PDM formulation

(4) Participants

1) Kochani

22 persons from Ministry of Development, Agency for Economically Underdeveloped Area, PWME headquarters, PWME "Bregalnica", communal enterprise "Vodovod", agro-kombinat, association of ecologists, Institute for Health Protection, representatives from Water User's Association in the pilot sections of World Bank's Irrigation Rehabilitation Project in Bregalnica etc.

2) Gevgelija

32 persons from Ministry of Development, Agency for Economically Underdeveloped Area, MAFWE branch office, PWME headquarters, PWME "Povardarje", "Anska Reka", agro-kombinat, local road funds, communal enterprise "Komunalno" etc.

H.2.2 General Outcome

(1) PCM Workshop in Kochani

1) Problem analysis

The core problem of the problem analysis was "many water related problems occur". In the beginning, four direct causes including "seasonal shortage of irrigation water", "drinking water shortage", "lack of water supply facilities", and "low water quality" had been selected. However, it was pointed out that "lack of water supply facilities" had been one of the causes of "seasonal shortage of irrigation water" and "drinking water shortage", and that "low water quality" had been one of the causes of "drinking water shortage". Eventually, "seasonal shortage of irrigation water" and "drinking water shortage" were selected as the direct causes. This process of selecting the direct causes showed that the concept of the problem analysis and the problem tree had been well understood by the participants.

As for the causes of "seasonal shortage of irrigation water", the problem with the groundwater temperature was mentioned. Because the temperature of the irrigation water is too low, it is not appropriate for promoting healthy agricultural production. Institutional problems including poor management of existing pumps and poor maintenance of irrigation system were pointed out as the causes of "great water loss" and "insufficient capacity of water supplying facilities".

It was also discussed about whether to place much importance on rice production had been one the causes of irrigation water shortage or not. This was because rice production requires larger amount of water comparing with the other agricultural products. As a result of the group discussion, the card mentioning about this issue was not put on the problem tree because it was concluded that rice production had not necessarily been the negative factor for improving agricultural production in this area. However, the card describing that the most of the existing irrigation system had been designed for rice production was selected as the cause of irrational utilization of irrigation water.

As for the problem of water quality, poor health and sanitary conditions among inhabitants were mentioned as the effects. Deteriorated water supply network, shortage of water treatment facilities, and insufficient hydrogeological research were listed up as the causes from the technical viewpoints. At the same time, institutional problems related to poorly organised regulation enforcement system were pointed out. Untreated wastewater discharge, inadequate use of agrochemical compounds, and

improper solid waste disposal were selected as the causes of "insufficient ecological protection of the water".

The problem tree formulated in the Kochani workshop is shown in Figure H.13.

2) PDM formulation

Farmers in Kochani have faced with the serious problem with lack of market for their agricultural production. Especially, the market for rice produced in Kochani has been drastically reduced. This was pointed out as the necessity of marketing promotion in the PDM of "irrigation water supply project". The participants have recognised the importance of marketing promotion; the cards saying "activation of the agricultural stock exchange", "protection of domestic production", and "increased export of agricultural products" were placed in the input section of the PDM. However, at the same time, the output of the PDM showed that they had no concrete idea about how they could proceed in order to improve the accessibility to the domestic and international market.

In addition, financial problem of the local PWME was pointed out and "provision of finance" was one of the major activities of "irrigation water supply project" in the PDM. Main financial source of the PWME is the irrigation water charge paid by the farmers. Currently, the payment rate of the irrigation water charge has decreased to approximately 10%. PWME plans to reduce the water charge in order to increase the payment rate.

The PDM for "drinking water supply project" was formulated for the project of facility construction including a dam, pipeline, and water treatment facilities. It focuses on the importance of institutional strengthening in laws and regulations enforcement in the section of the important assumptions.

The two PDMs developed in the Kochani workshop are shown in Figure H.14 and H.15.

(2) PCM Workshop in Gevgelija

1) Problem analysis

In the Gevgelija workshop, the core problem was "many water related problems occur", which was the same as in the Kochani workshop. The direct causes were "irrigation water shortage" and "lack of drinking water"; this is also the same. The participants in the Gevgelija workshop has more interest in the problem of irrigation water shortage than the one of drinking water shortage.

Therefore, the direct cause of irrigation water shortage was analysed by two groups, while that of drinking water shortage was done by one. The problem tree formulated in the Gevgelija workshop was divided into three components, which are shown in Figures H.16, H.17, and H.18. Figures H.16 and H.17 were structured by the two separate groups responsible for the irrigation water problem analysis. And Figure H.18 was done by the group for the drinking water.

The problem tree (1) (Figure H.16) showed that the major causes of the irrigation water shortage in Gevgelija were related to "insufficient equipment and facilities"; lack of hydrosystem, irrigation network, irrigation equipment, obsolete channel network and irrigation pump, and great distance between the joints in the network etc. In addition, it pointed out that the natural conditions including high temperature in summer and strong wind caused drought and other negative effects, which led to "lack of atmospheric water".

In contrast with the problem tree (1), the problem tree (2) (Figure H.17) selected the causes from the other aspect in addition to the problems of lack of facilities. It includes the causes of inefficient land division, improper cropping pattern, low level of farming technology, old irrigation method, low collection rate of water charge, poor facility maintenance, and limited protection of water quality in the rivers.

The tree (1) gives detailed information about the facility problems, and the tree (2) shows that the people in charge of water supply had recognized the importance of human resources development and enhancement of laws and institutions.

The discussion for developing the problem tree (3) (Figure H.18) about drinking water shortage clarified that the quantitative shortage of the drinking water had not been so serious in this area. Limited number of people like the ones living in high-rise buildings have suffered from seasonal water shortage.

However, poor maintenance of the distribution system and polluted water quality caused by untreated wastewater discharge have negatively affected to the quality of water supply services of the communal enterprise, which leads to the low collection rate of water charge. The idea about "the quality of water supply services" is very unique, which was talked about only by this group during all of the five workshops.

2) PDM formulation

Three PDMs were developed in the Gevgelija workshop, which are shown in Figures H.19, H.20, and H.21. Most of the activities included in the

two PDMs about "irrigation water supply project" are related to construction of dams and irrigation networks as well as betterment of existing channel network and pump stations. The importance of institutional strengthening and human resources development were mentioned in the sections of the input and/or the important assumptions.

The PDM about "drinking water supply project" talks about facility construction; however, it includes staff training and operation and maintenance in the activities, as well. Issues related to community participation such as "financial contribution from inhabitants" as well as "local inhabitant contribution by labor" are discussed as the input of the project.

### H.2.3 Input for Master Plan and Individual Project Formulation

The outputs of the workshops provided the following points, which need to be considered for formulating master plan and individual projects as well as preparing development strategies of each economic sector.

(1) Relatively good institutional capacity of local level organizations in the water-related sectors with having long history of working with inhabitants and experienced human resources, although financial problems are common

(2) High dependency on the external financial source and at the same time lack of the knowledge and/or information for getting the fund

(3) High technical level of designing and implementing individual projects as well as their great pride about it

(4) Tendency of giving less priority to institutional strengthening, which is essential for better management, operation, and maintenance of the related equipment and facilities

(5) Urgent needs about marketing improvement; the lack of market for agricultural production including vegetables, fruits, and rice has been serious and no effective countermeasures have been taken by the Government

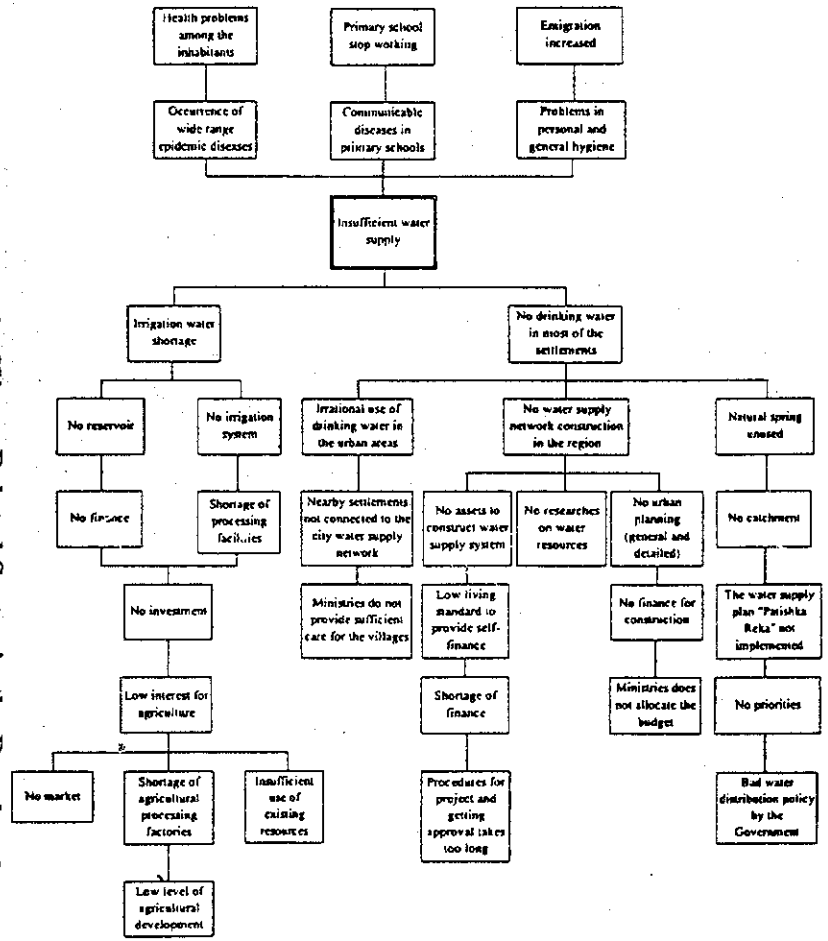
(6) Poor information provision about domestic and international markets to farmers

(7) Lack of concrete plans for increasing the collection rate of water charge

(8) Lack of inhabitants' willingness to pay due to low level of water supply services and/or facility maintenance services

(9) Farmers having limited interest or incentives in group activities, which is one of the constraints in establishing a water user's association in the irrigation rehabilitation project of World Bank

PROBLEM TREE IN THE RURAL AREA




PROBLEM TREE IN THE URBAN AREA

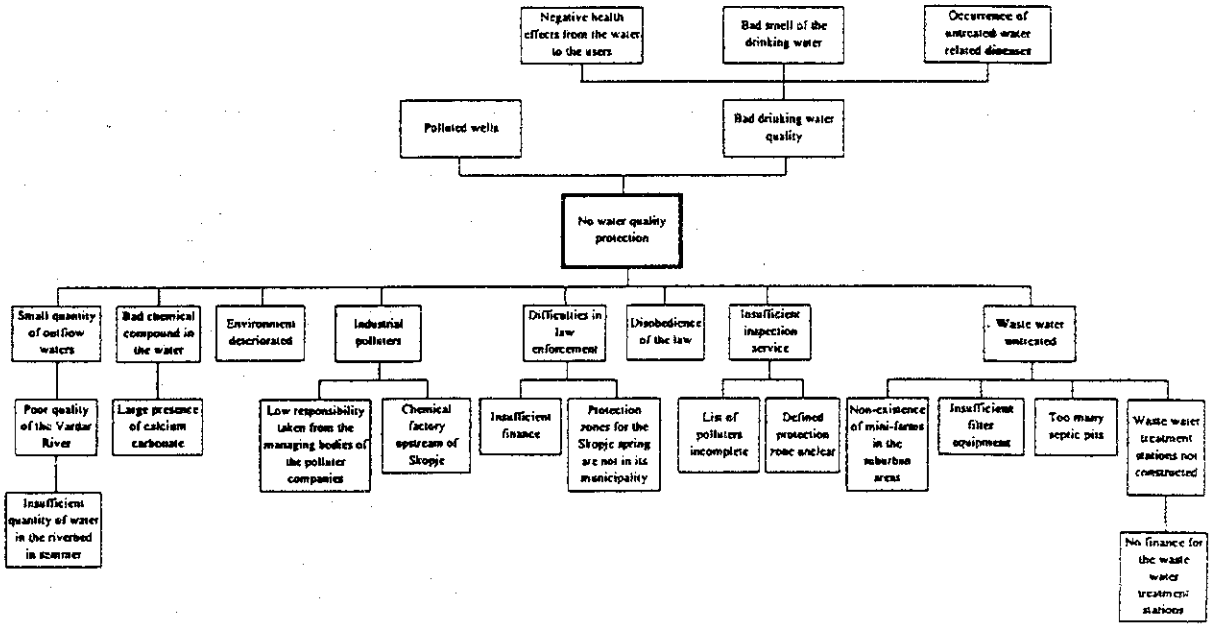



Figure H.1 Problem Tree About the Water-Related Sector in the Rural and the Urban Areas

| NARRATIVE SUMMARY | IMPORTANT ASSUMPTIONS |
|---|---|
| **OVERALL GOAL**<br>Improved water quality protection | |
| **PROJECT PURPOSE**<br>Waste water treated | |
| **EXPECTED OUTPUTS**<br>Relocation of small farms outside of the city springs<br>Treatment stations constructed<br>Upgrading of sewage system<br>Filter station constructed | |
| **ACTIVITIES**<br>Feasibility study making<br>Establishing existing facilities<br>List of existing condition<br>Analysis of waste water compound<br>Finance for construction provided<br>Choice of new locations<br>Defining project program<br>Choice of good quality filters<br>Findings good location for treatment station<br>Providing assets for relocation<br>Selection of sewage system & treatment station<br>Location of filters selected<br>Upgrading of collecting up to the station location<br>Legal support for relocation<br>Finance provision<br>Equipment for filters provided<br>Project formulation<br>Bidding<br>Selection of implementation agency<br>Establishing professional survey group<br>Technical acceptance<br>Construction work | **PRE-CONDITIONS** |

**Figure H.2 PDM-1 "Waste Water Treatment Project" in Skopje**

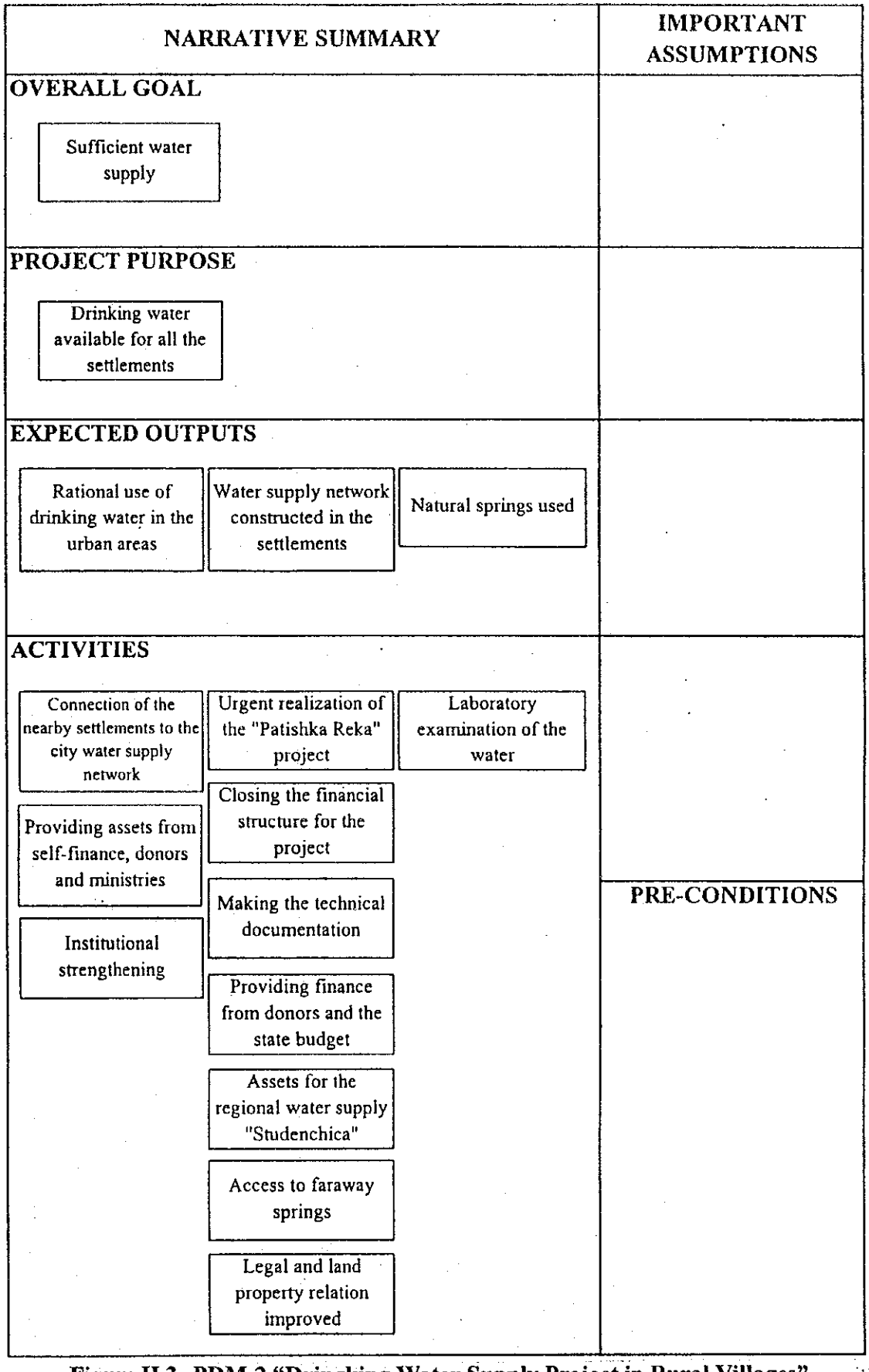



**Figure H.3 PDM-2 "Dringking Water Supply Project in Rural Villages" in Skopje**

| NARRATIVE SUMMARY | IMPORTANT ASSUMPTIONS |
|---|---|
| **OVERALL GOAL**<br>Sufficient water supply | |
| **PROJECT PURPOSE**<br>Sufficient quantity of irrigation water | |
| **EXPECTED OUTPUTS**<br>Reservoirs constructed<br>Irrigation system constructed | |
| **ACTIVITIES**<br>Providing finance for the reservoir<br>Making of study for reservoir construction<br>Providing international investment<br>Pressenting the study to an investor<br>Getting assets from MAPWE and MOD<br>Study for the economic benefits from the investment in the reservoir<br>Access to faraway springs<br>Legal and land property relation improved | **PRE-CONDITIONS** |

**Figure H.4 PDM-3 "Irrigation Water Supply Project in Rural Villages" in Skopje**

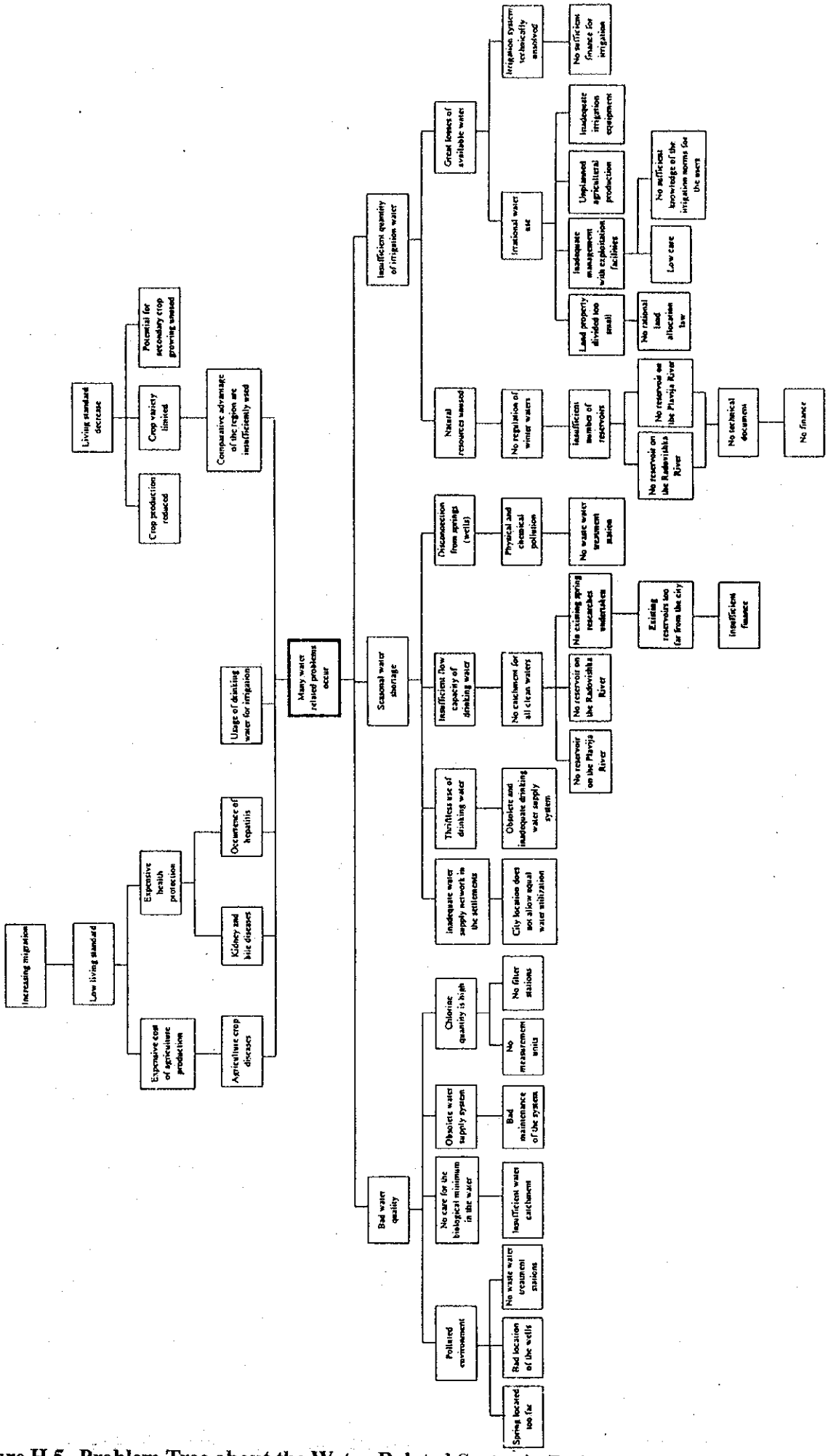



**Figure H.5 Problem Tree about the Water-Related Sector in Radovish**

| NARRATIVE SUMMARY | IMPORTANT ASSUMPTIONS |
|---|---|
| **OVERALL GOAL**<br>Water related problems reduced | Natural water resources existing<br>Increased water demand |
| **PROJECT PURPOSE**<br>Improved water quality | |
| **EXPECTED OUTPUTS**<br>Clean environment<br>Water supply system construction<br>Chlorinated water | |
| **ACTIVITIES**<br>Relocation of polluters<br>Technical documentation prepared<br>Water supply filter station construction<br>Waste water treatment station construction<br>Finance<br>Measurement units station<br>Making a project<br>Project implementation<br>Maintenance service provided<br>Equipment purchased<br>Project implementation | **PRE-CONDITIONS**<br>Active citizens<br>Finance provided |

**Figure H.6 PDM-1 "Water Quality Improvement Project" in Radovish**

| NARRATIVE SUMMARY | IMPORTANT ASSUMPTIONS |
|---|---|
| **OVERALL GOAL**<br>Water related problems reduced | |
| **PROJECT PURPOSE**<br>Stable drinking water supply | |
| **EXPECTED OUTPUTS**<br>Adequate water supply system for the settlements<br>Thrifty use of drinking water<br>Wells connected<br>Sufficient quantity of water for drinking and irrigation | Distance of water resources reduced<br>Legal- property relations improved |
| **ACTIVITIES**<br>Water supply network reconstruction<br>Mounting of adequate measurement units<br>Development programs for providing new quantity of water<br>Treatment station construction<br>New water supply network construction<br>Charge regulation and setting of market price<br>New spring researches from the aspect of its yield & quality<br>Legal regulation obedience & penalties measures<br>Staff training for facility maintenance<br>Construction of facilities for new quantity of water<br>Solution for access road | **PRE-CONDITIONS** |

**Figure H.7 PDM-2 "Drinking Water Supply Project" in Radovish**

| NARRATIVE SUMMARY | IMPORTANT ASSUMPTIONS |
|---|---|
| **OVERALL GOAL**<br>Water related problems reduced | |
| **PROJECT PURPOSE**<br>Sufficient quantity of irrigation water | |
| **EXPECTED OUTPUTS**<br>Natural resources utilization increased<br>Water losses reduced | Normal rain fall<br>Stable political situation |
| **ACTIVITIES**<br>Construction of reservoir on the Plavija River<br>Irrigation system upgrading<br>Preparation of technical documentation<br>Providing assets for purchase of adequate irrigation equipment<br>Providing of finance<br>Securing control over facilities management<br>Institutional connection among water users and user suppliers<br>Planned agricultural production<br>Law for rational land allocation<br>Staff training for irrigation system maintenance | **PRE-CONDITIONS**<br>No resistance from the inhabitants |

**Figure H.8 PDM-3 "Irrigation Water Supply Project" in Radovish**

**Figure H.9 Problem Tree About the Water-related Sector in Krushevo**

| NARRATIVE SUMMARY | IMPORTANT ASSUMPTIONS |
|---|---|
| **OVERALL GOAL**<br>Improved water supply | |
| **PROJECT PURPOSE**<br>Sufficient quantity of irrigation water | |
| **EXPECTED OUTPUTS**<br>More intensive utilization of arable areas<br>Rational water use<br>Treated water | Agreement from the water users<br>Normal functioning of the public water management enterprise |
| **ACTIVITIES**<br>Watcher service<br>Terrain research<br>Sewage system construction<br>Rational allocation of land property and crops<br>Good equipment provided<br>Treatment station construction<br>Association founded<br>Irrigation system construction<br>Technical documentation prepared<br>Reservoir construction | **PRE-CONDITIONS**<br>Construction permit<br>Water economy agreement<br>Condition for good location<br>Expropriation<br>Finance |

**Figure H.10 PDM-1 "Irrigation Water Supply Project" in Krushevo**

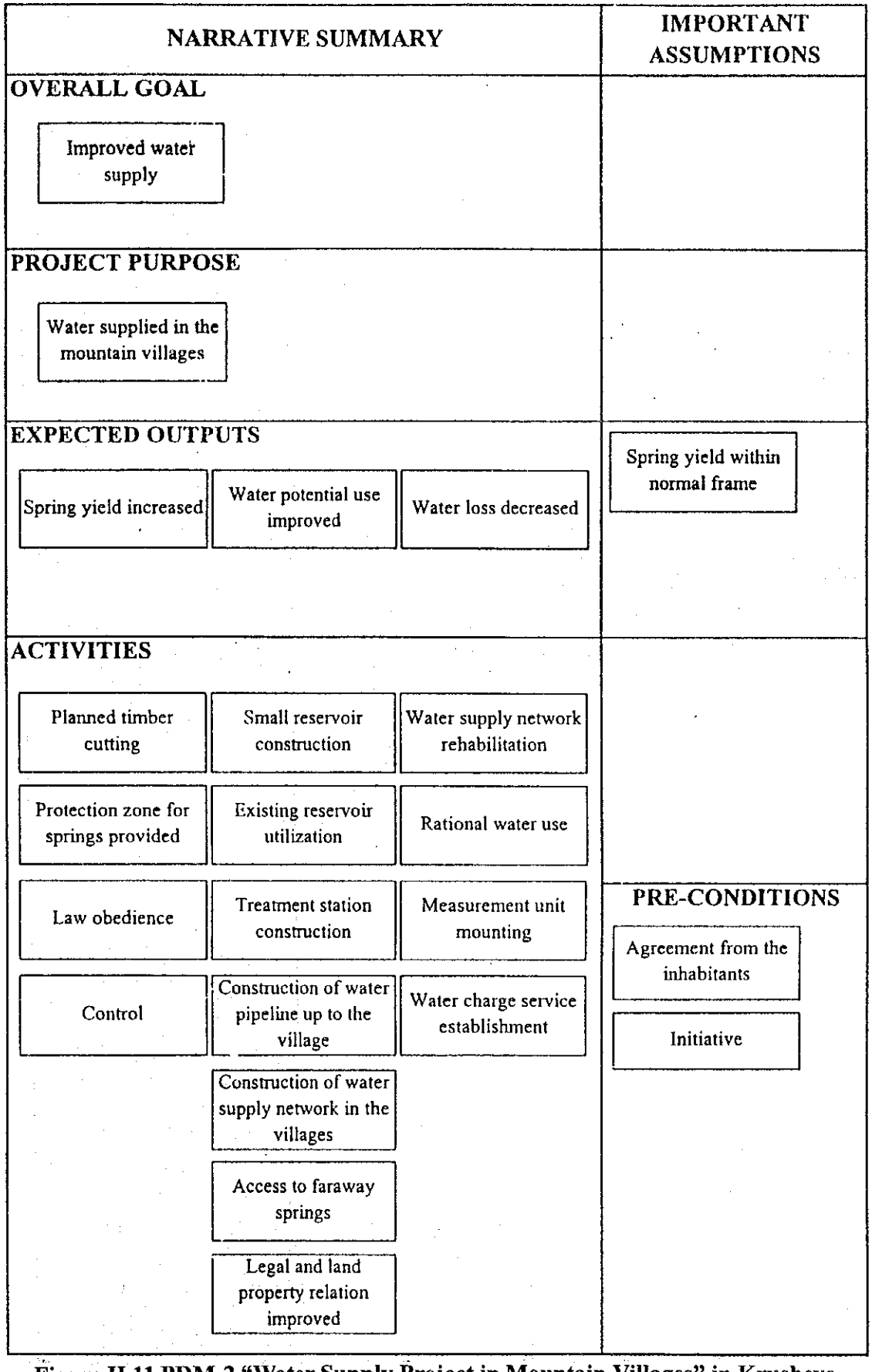
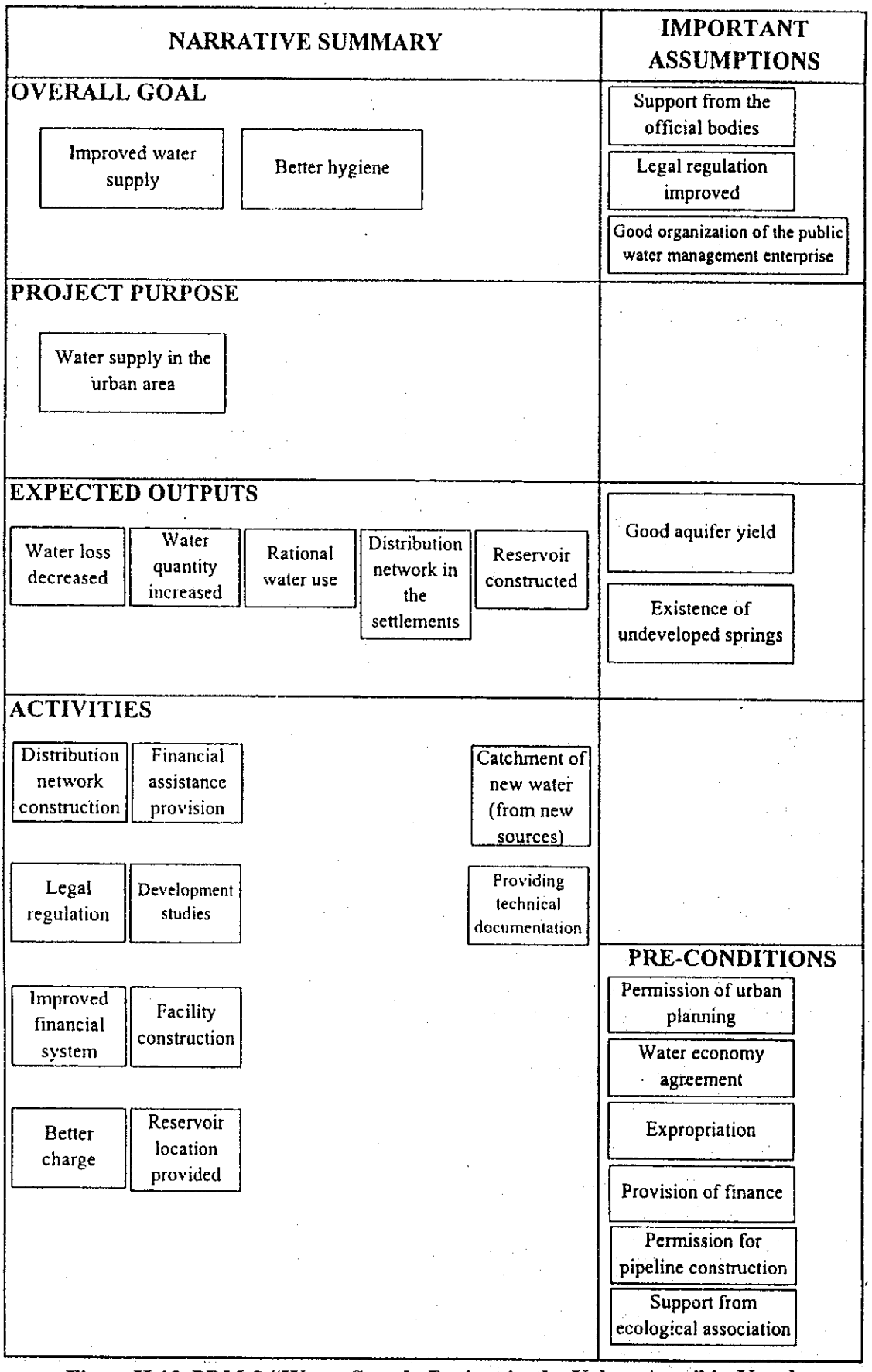



**Figure H.11 PDM-2 "Water Supply Project in Mountain Villages" in Krushevo**




**FigureH.12 PDM-3 "Water Supply Project in the Urban Area" in Krushevo**

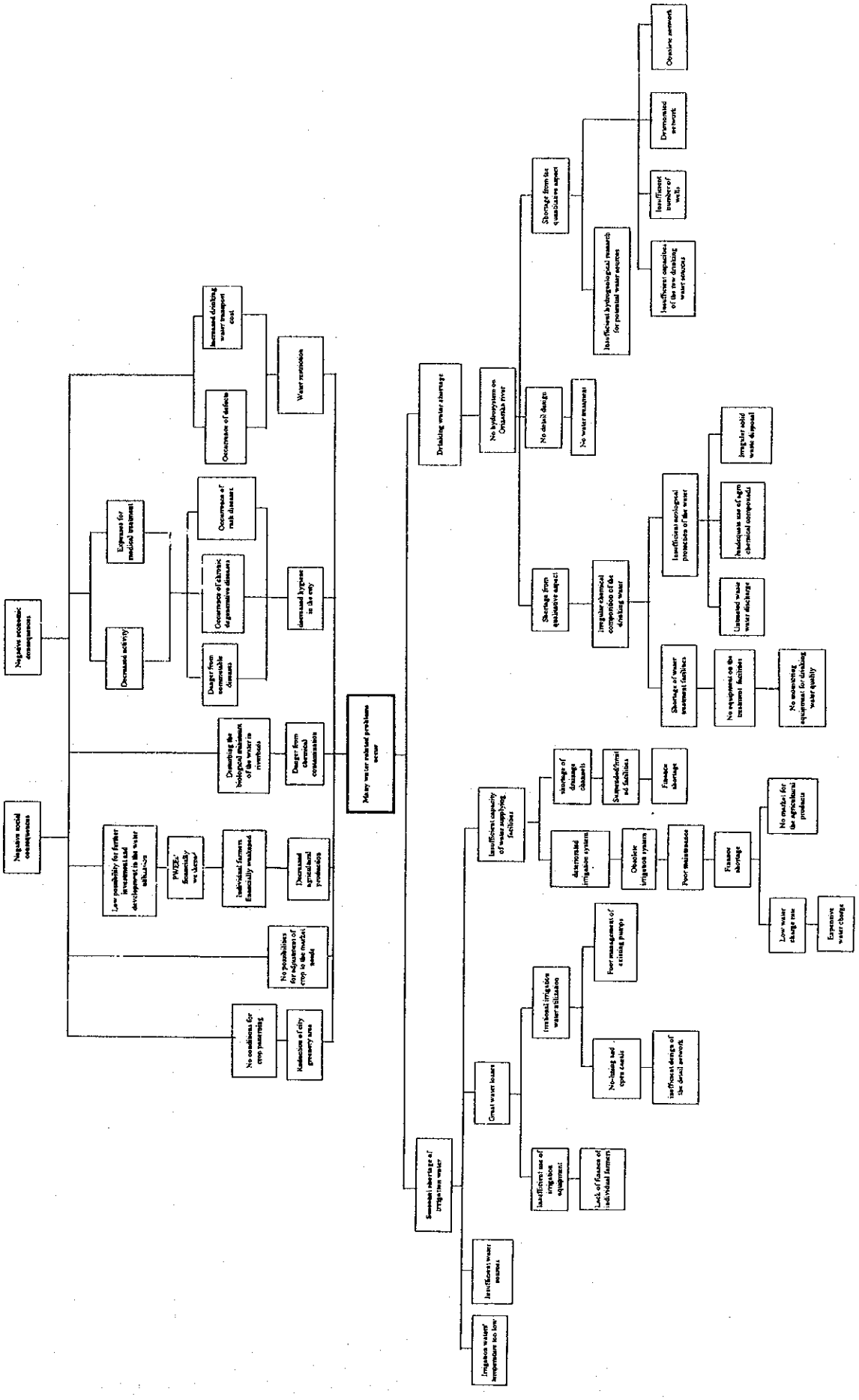



**Figure H.13 Problem Tree Formulated in the Kochani Workshop**

| SUMMARY | INDICATORS | IMPORTANT ASSUMPTIONS |
|---|---|---|
| **OVERALL GOAL**<br>Sufficient irrigation water quantity provided | | Stable hydrology<br>Farmers financial stability<br>Employment in the water-economy |
| **PROJECT PURPOSE**<br>Sufficient capacity for high irrigation water utilization rate provided | 80% utilized | Stable political situation in the country and the region |
| **OUTPUTS**<br>Completion of suspended hydrotechnical facilities construction<br>Rehabilitation of channel linings and irrigation system facilities | | |
| **ACTIVITIES**<br>Dam construction "Rechani" on Orizariska river<br>Reconstruction of the existing hydrotechnical facilities<br>Completion of technical documentation<br>Professional and regular maintenance<br>Provision of finance<br>Provision of finance<br>Systematic solution of the water charge problem<br>Provision of market for agricultural products<br>Promotion of modern irrigation techniques and equipment<br>Decreasing of water charge | **INPUT**<br>Loans on good terms<br>Foreign investment participation<br>Activation of the agricultural stock exchange<br>Protection of domestic production<br>Increased export of agricultural products | Provision of recipient country experts<br>Provision of recipients country executing construction agencies<br>**PRECONDITIONS** |

**Figure H.14 PDM-1 "Irrigation Water Supply Project" in Kochani**

| SUMMARY | INDICATORS | IMPORTANT ASSUMPTIONS |
|---|---|---|
| **OVERALL GOAL**<br>Sufficient quantity of good quality drinking water provided | Increase of ecological standards<br>Morbidity rate decrease | Sufficient quantity of untreated water<br>Responsible agencies' consent and opinion |
| **PROJECT PURPOSE**<br>Construction of the hydrosystem on Orizairska river | | Consent from all the related subjects<br>Finance for purpose realization<br>Regulated property rights<br>Provided hydrogeological research basis |
| **OUTPUTS**<br>Provision of good quality water<br>Provision of sufficient water quantity | | |
| **ACTIVITIES**<br>Water treatment facility construction<br>Research<br>Distribution system construction<br>Project designing<br>Dam construction<br>Water pipeline provision | **INPUT**<br>Expert human resources<br>Wider Infrastructural conditions<br>Equipment and executing agencies | **PRECONDITIONS** |

**Figure H.15 PDM-2 "Drinking Water Supply Project" in Kochani**

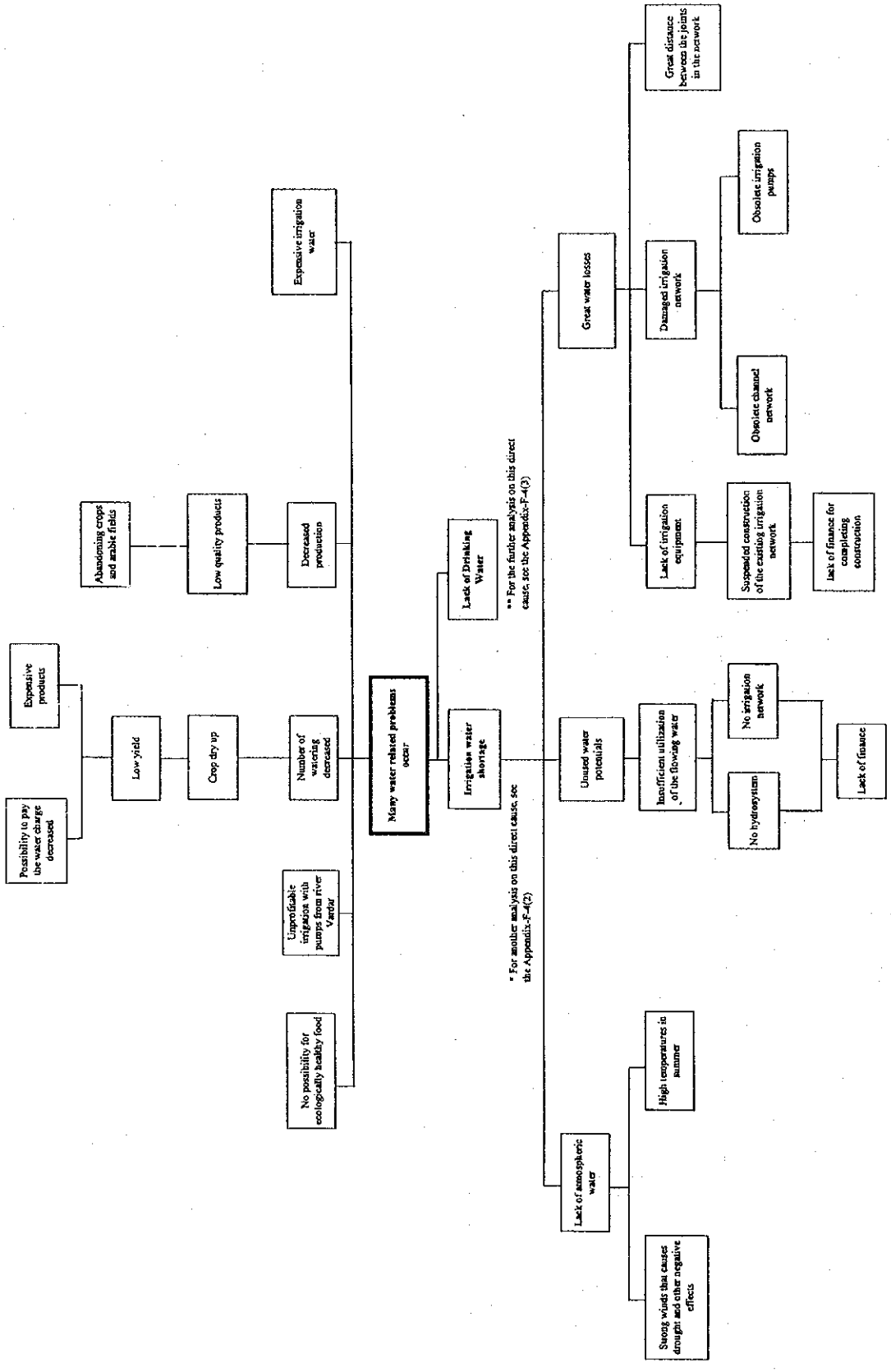



**Figure H.16 Problem Tree (1) Formulated in the Gevgelija Workshop**

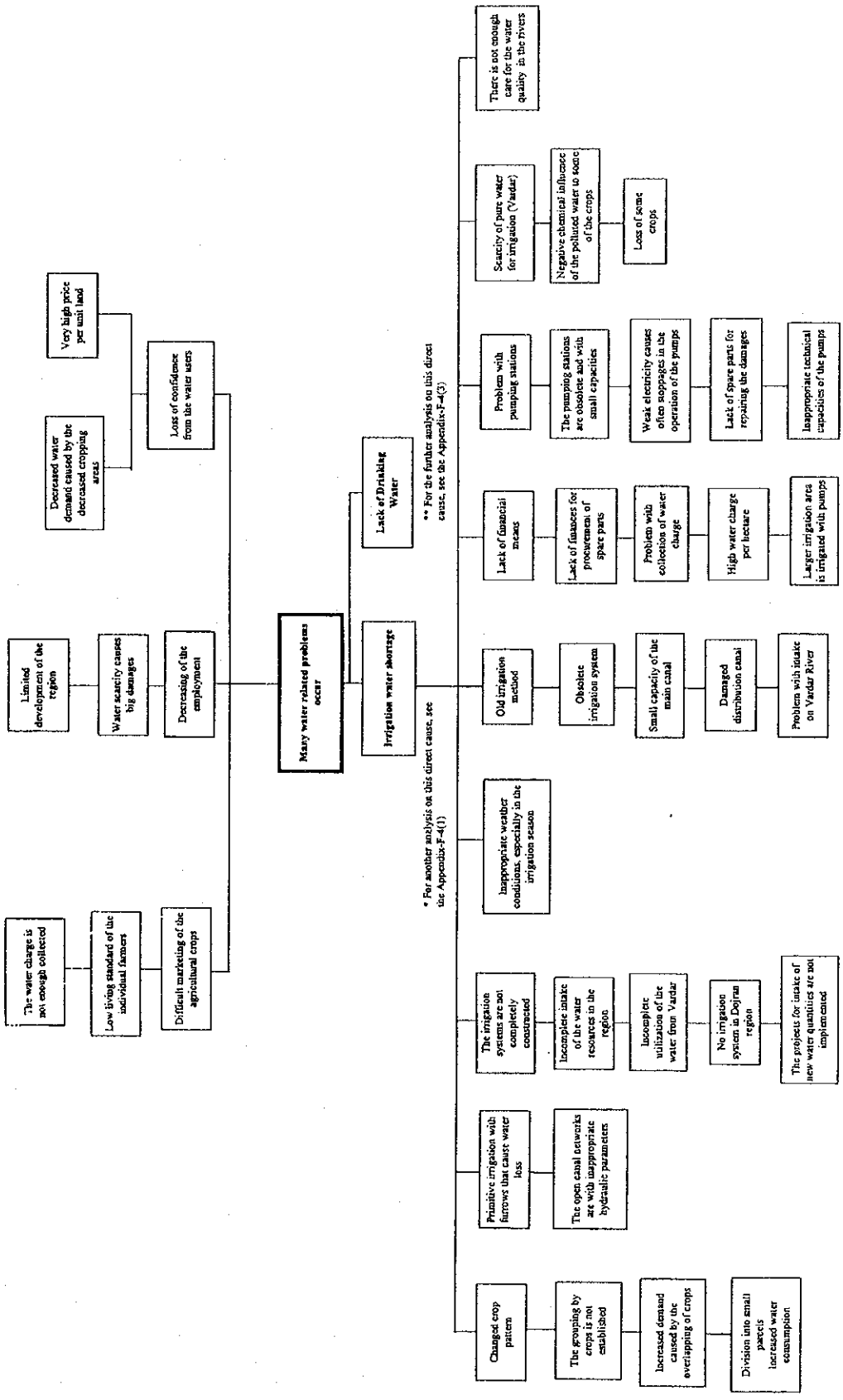



**Figure H.17 Problem Tree (2) Formulated in the Gevgelija Workshop**

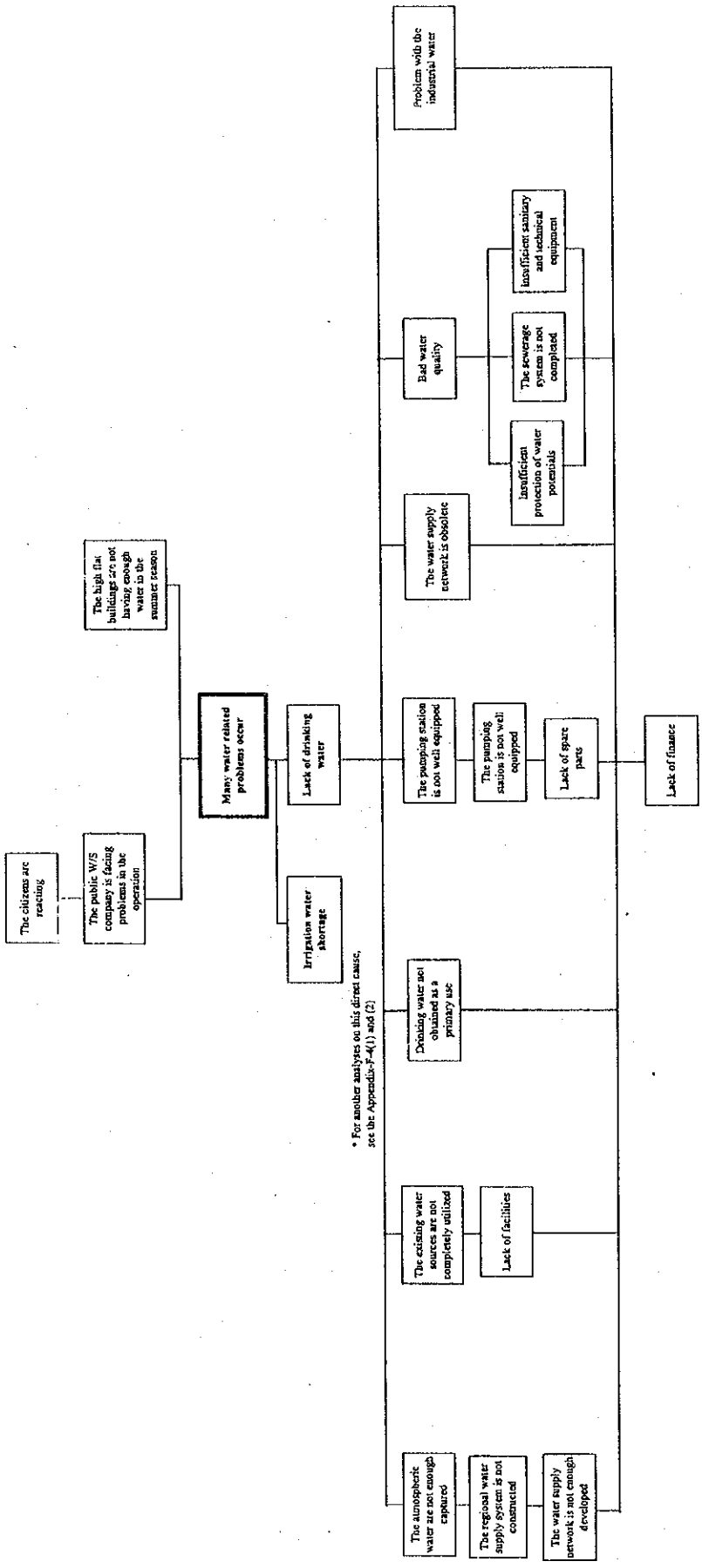



**Figure H.18 Problem Tree (3) Formulated in the Gevgelija Workshop**

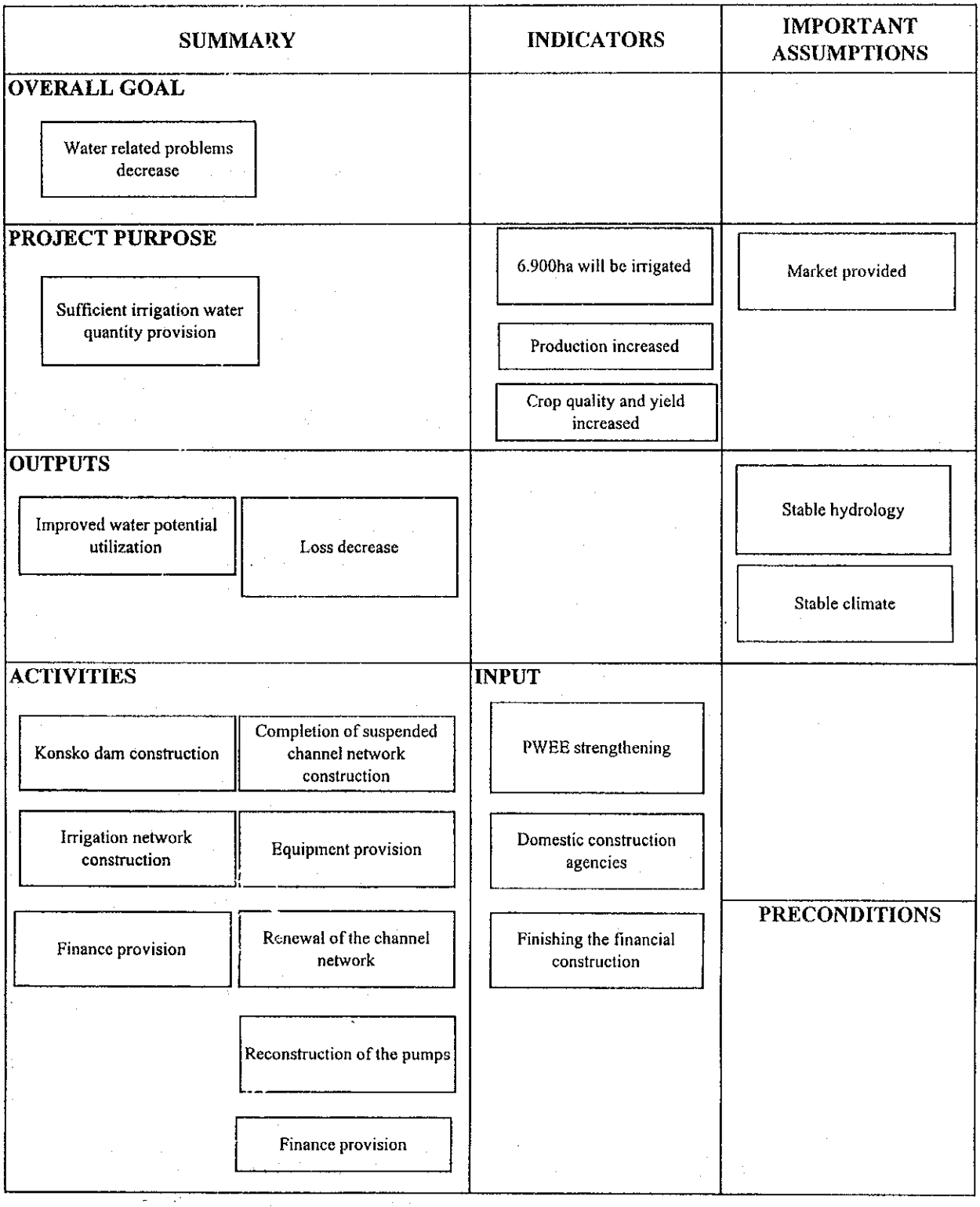



**Figure H.19 PDM-1 (1) "Irrigation Water Supply Project I" in Gevgelija**

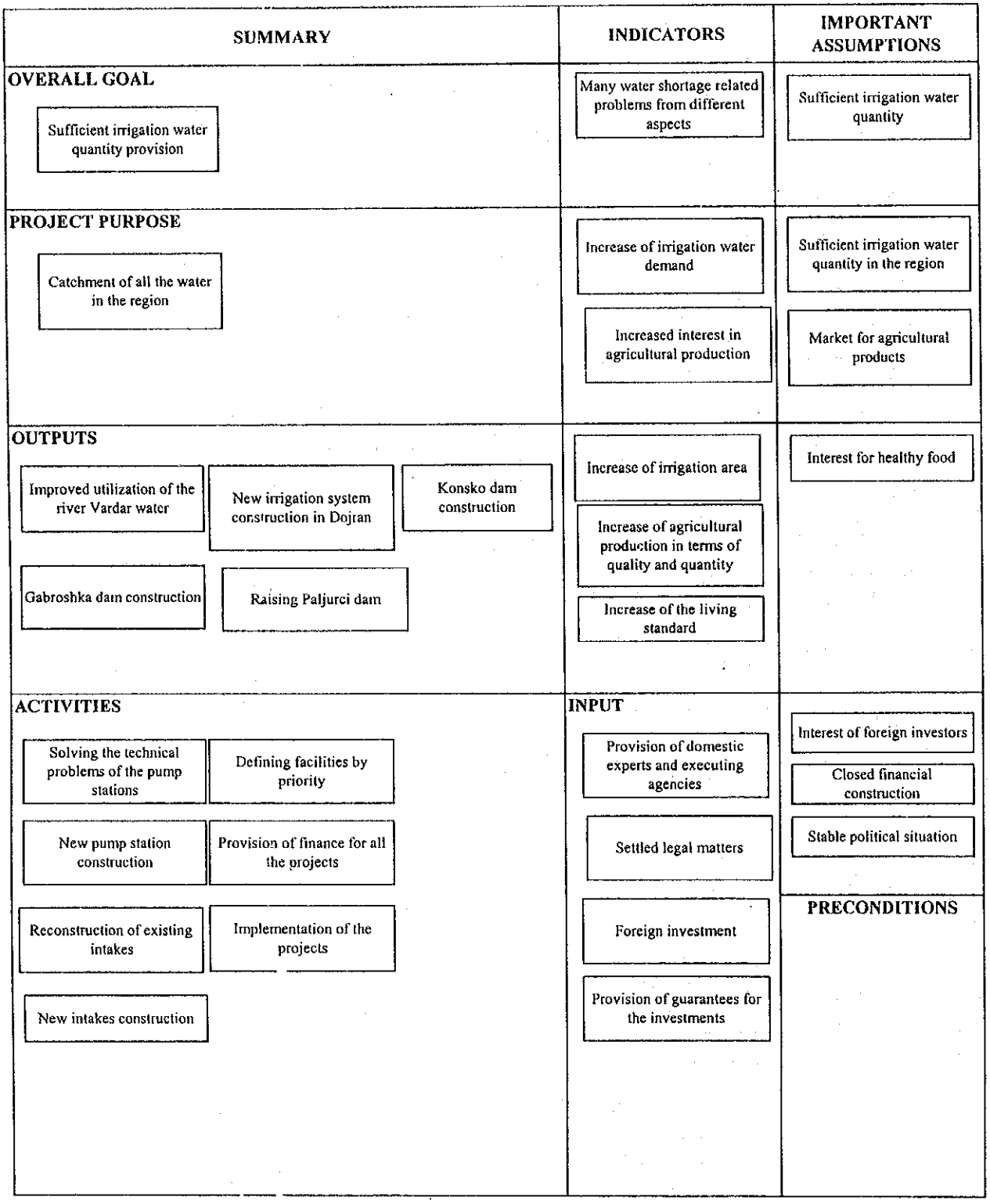



**Figure H.20 PDM-1 (2) "Irrigation Water Supply Project II" in Gevgelija**

| SUMMARY | INDICATORS | IMPORTANT ASSUMPTIONS |
|---|---|---|
| **OVERALL GOAL**<br>Sufficient drinking water quantity provided | Making decisions for the water utilization regime | Stable climate<br>Political stability |
| **PROJECT PURPOSE**<br>Provisin of good quality water | | |
| **OUTPUTS**<br>Catchment and reservoirs protection<br>Sewerage construction<br>Provision of good sanitary equipment | | |
| **ACTIVITIES**<br>Technical documentation making<br>Designing the project<br>To specify the sanitary-technical documentation<br>Catchment and reservoir fencing<br>Revision of the project<br>Staff training<br>Establishing keepers service<br>Project implementation<br>Equipment provision<br>Equipment built-in | **INPUT**<br>Local inhabitant contribution by labor<br>Financial contribution from the inhabitants<br>Financial contribution from the municipality | Local inhabitants' consent<br>**PRECONDITIONS** |

**Figure H.21 PDM-2 "Drinking Water Supply Project" in Gevgelija**

*Annex 1*

*Rashche Spring*

## Annex 1 RASHCHE SPRING

(1) Yield

Although annual fluctuation of the spring yield is recognized, the observed data are not available in general. The observed yields of Rashche spring, which is a main water source of Skopje, are collected and reviewed.

Rashche spring is located to the west from Skopje and originates from the bottom of thes south cliff of Zeden Mountain, where is composed of Paleozoic limestones and marbles and is protected as a secondary sanitary protection zone of the spring. Two spring water intakes, Rashche I and II, were constructed for spring water catchment. The spring water is introduced to Skopje through two pipelines with a diameter of 1600 mm.

According to the annual fluctuation during the past 10 years (1989 to 1998), the yields of Rashche I and II springs increase from March and are the maximum in May, and the yields decrease from June and are the minimum in November as shown in Table AN.1 and Figure AN.1.

The rainfall during the past 10 years was very small except for 1995 and the worst drought occurred in 1993. The maximum yield during the past 10 years occurred in May 1996. The fourth largest annual rainfall occurred in 1995 and delay of about one year from the maximum rainfall in 1995 to the maximum yield in 1996 was observed.

The annual averages are equivalent to approximately 85 % of the maximum. Rashche spring with an average of 4 $m^3$/sec is a macro-scale spring comparing with other springs. However, almost of other springs are extremely small and the yields are less than 1 *l/sec*. Therefore, the ratio of the average and maximum of other springs must be smaller than that of Rashche spring, but a pattern of annual fluctuations must be almost same.

(2) Water Quality

There is no indicator of chemical, physical, bacteriological, radiological pollution and pesticides according to the Republic Institute of Health Protection as shown in Table AN.2. However, various kinds of pesticides have been produced for agricultural and industrial uses and the pesticides might be utilized. Therefore, monitoring system for spring water quality should be required for safety utilization of the spring.

Table AN.1 Spring Yield of Rashche I & II (1/2)

| No | Year | No | Date | Rashche I m3/sec | Rashche II m3/sec | Total |
|---|---|---|---|---|---|---|
| 1 | 1989 | 1 | 20.01.89 | 2.42 | 0.78 | 3.20 |
| | | 2 | 23.02.89 | 2.52 | 0.80 | 3.32 |
| | | 3 | 21.03.89 | 2.80 | 0.89 | 3.69 |
| | | 4 | 26.04.89 | 2.88 | 0.88 | 3.76 |
| | | 5 | 26.05.89 | 2.99 | 0.97 | 3.96 |
| | | 6 | 27.06.89 | 3.18 | 1.03 | 4.21 |
| | | 7 | 25.07.89 | 2.89 | 0.79 | 3.68 |
| | | 8 | 30.08.89 | 3.05 | 0.85 | 3.90 |
| | | 9 | 04.10.89 | 2.87 | 0.78 | 3.65 |
| | | 10 | 09.11.89 | 2.64 | 0.75 | 3.39 |
| | | 11 | 04.12.89 | 2.52 | 0.85 | 3.37 |
| | | 12 | 28.12.89 | 2.78 | 0.82 | 3.60 |
| 2 | 1990 | 1 | 24.01.90 | 2.64 | 0.74 | 3.38 |
| | | 2 | 28.02.90 | 2.41 | 0.72 | 3.13 |
| | | 3 | 03.04.90 | 2.64 | 0.73 | 3.37 |
| | | 4 | 26.04.90 | 2.70 | 0.80 | 3.50 |
| | | 5 | 31.05.90 | 2.97 | 0.84 | 3.81 |
| | | 6 | 27.06.90 | 2.65 | 0.79 | 3.44 |
| | | 7 | 12.07.90 | 2.28 | 0.75 | 3.03 |
| | | 7 | 04.08.90 | 2.41 | 0.71 | 3.12 |
| | | 9 | 14.08.90 | 2.62 | 0.68 | 3.30 |
| | | 10 | 22.08.90 | 2.67 | 0.66 | 3.33 |
| | | 8 | 28.08.90 | 2.65 | 0.65 | 3.30 |
| | | 12 | 04.09.90 | 2.75 | 0.70 | 3.45 |
| | | 9 | 25.09.90 | 2.61 | 0.83 | 3.44 |
| | | 16 | 16.10.90 | 2.58 | 0.75 | 3.33 |
| | | 10 | 23.10.90 | 2.58 | 0.86 | 3.44 |
| | | 11 | 21.11.90 | 2.87 | 0.82 | 3.69 |
| | | 12 | 21.12.90 | 2.60 | 0.79 | 3.39 |
| 3 | 1991 | 1 | 25.01.91 | 2.45 | 0.79 | 3.24 |
| | | 2 | 22.02.91 | 2.46 | 0.80 | 3.26 |
| | | 3 | 20.03.91 | 3.20 | 1.00 | 4.20 |
| | | 4 | 23.04.91 | 3.26 | 1.03 | 4.29 |
| | | 5 | 21.05.91 | 3.68 | 1.12 | 4.80 |
| | | 6 | 21.06.91 | 3.55 | 1.00 | 4.55 |
| | | 7 | 30.07.91 | 2.91 | 0.89 | 3.80 |
| | | 8 | 03.09.91 | 2.54 | 0.63 | 3.17 |
| | | 9 | 03.10.91 | 2.74 | 0.70 | 3.44 |
| | | 10 | 04.11.91 | 2.68 | 0.82 | 3.50 |
| | | 11 | 04.12.91 | 2.60 | 0.70 | 3.30 |
| | | 12 | 23.12.91 | 2.77 | 0.90 | 3.67 |
| 4 | 1992 | 1 | 28.01.92 | 2.71 | 0.71 | 3.42 |
| | | 2 | 24.02.92 | 2.74 | 0.62 | 3.36 |
| | | 3 | 26.03.92 | 2.72 | 0.62 | 3.34 |
| | | 4 | 29.04.92 | 2.84 | 0.88 | 3.72 |
| | | 5 | 28.05.92 | 3.03 | 0.75 | 3.78 |
| | | 6 | 24.06.92 | 2.94 | 0.82 | 3.76 |
| | | 7 | 21.07.92 | 2.73 | 0.79 | 3.52 |
| | | 8 | 31.08.92 | 2.73 | 0.78 | 3.51 |
| | | 9 | 22.09.92 | 2.67 | 0.78 | 3.45 |
| | | 10 | 29.10.92 | 2.60 | 0.79 | 3.39 |
| | | 11 | 02.12.92 | 2.53 | 0.77 | 3.30 |
| 5 | 1993 | 1 | 20.01.93 | 2.41 | 0.64 | 3.05 |
| | | 2 | 17.02.93 | 2.46 | 0.72 | 3.18 |
| | | 3 | 16.03.93 | 2.30 | 0.65 | 2.95 |
| | | 4 | 03.04.93 | 2.73 | 0.85 | 3.58 |
| | | 5 | 12.05.93 | 2.97 | 0.80 | 3.77 |
| | | 6 | 05.06.93 | 2.90 | 0.90 | 3.80 |
| | | 7 | 07.07.93 | 2.70 | 0.76 | 3.46 |
| | | 8 | 06.08.93 | 2.40 | 0.64 | 3.04 |

Table AN.1 Spring Yield of Rashche I & II (2/2)

| No | Year | No | Date | Rashche I m3/sec | Rashche II m3/sec | Total |
|---|---|---|---|---|---|---|
| | | 9 | 14.09.93 | 2.74 | 0.76 | 3.50 |
| | | 10 | 14.10.93 | 2.40 | 0.75 | 3.15 |
| | | 11 | 10.11.93 | 2.42 | 0.61 | 3.03 |
| | | 12 | 10.12.93 | 2.51 | 0.70 | 3.21 |
| 6 | 1994 | 1 | 14.01.94 | 2.46 | 0.84 | 3.30 |
| | | 2 | 10.02.94 | 2.71 | 0.86 | 3.57 |
| | | 3 | 25.03.94 | 2.79 | 0.91 | 3.70 |
| | | 4 | 26.04.94 | 3.15 | 0.95 | 4.10 |
| | | 5 | 30.05.94 | 2.84 | 0.92 | 3.76 |
| | | 6 | 28.06.94 | 2.86 | 0.81 | 3.67 |
| | | 7 | 28.07.94 | 2.95 | 0.86 | 3.81 |
| | | 8 | 22.08.94 | 2.73 | 0.82 | 3.55 |
| | | 9 | 19.09.94 | 2.76 | 0.81 | 3.57 |
| | | 10 | 14.10.94 | 2.80 | 0.85 | 3.65 |
| | | 11 | 17.11.94 | 2.79 | 0.78 | 3.57 |
| | | 12 | 14.12.94 | 2.71 | 0.92 | 3.63 |
| 7 | 1995 | 1 | 17.01.95 | 2.71 | 0.87 | 3.58 |
| | | 2 | 16.02.95 | 2.72 | 0.82 | 3.54 |
| | | 3 | 17.03.95 | 2.62 | 0.80 | 3.42 |
| | | 4 | 20.04.95 | 2.79 | 0.83 | 3.62 |
| | | 5 | 26.05.95 | 3.15 | 0.92 | 4.07 |
| | | 6 | 28.06.95 | 2.76 | 0.91 | 3.67 |
| | | 7 | 28.07.95 | 2.82 | 0.63 | 3.45 |
| | | 8 | 29.08.95 | 2.70 | 0.72 | 3.42 |
| | | 9 | 26.09.95 | 2.77 | 0.73 | 3.50 |
| | | 10 | 31.10.95 | 2.58 | 0.79 | 3.37 |
| | | 11 | 28.11.95 | 2.63 | 0.67 | 3.30 |
| | | 12 | 26.12.95 | 3.01 | 0.91 | 3.92 |
| 8 | 1996 | 1 | 30.01.96 | 3.68 | 1.16 | 4.84 |
| | | 2 | 29.02.96 | 3.57 | 1.06 | 4.63 |
| | | 3 | 29.03.96 | 3.90 | 1.09 | 4.99 |
| | | 4 | 24.04.96 | 4.48 | 1.26 | 5.74 |
| | | 5 | 23.05.96 | 5.01 | 1.28 | 6.29 |
| | | 6 | 03.07.96 | 4.12 | 1.15 | 5.27 |
| | | 7 | 30.07.96 | 3.59 | 0.96 | 4.55 |
| | | 8 | 05.09.96 | 3.77 | 0.91 | 4.68 |
| | | 9 | 10.10.96 | 3.07 | 0.78 | 3.85 |
| | | 10 | 15.11.96 | 3.04 | 0.76 | 3.80 |
| | | 11 | 13.12.96 | 2.98 | 0.84 | 3.82 |
| 9 | 1997 | 1 | 29.01.97 | 3.67 | 0.95 | 4.62 |
| | | 2 | 07.03.97 | 3.42 | 0.94 | 4.36 |
| | | 3 | 26.03.97 | 3.28 | 0.59 | 3.87 |
| | | 4 | 25.04.97 | 3.25 | 0.89 | 4.14 |
| | | 5 | 15.05.97 | 4.27 | 1.20 | 5.47 |
| | | 6 | 30.05.97 | 4.43 | 1.10 | 5.53 |
| | | 7 | 16.07.97 | 3.73 | 0.62 | 4.35 |
| | | 8 | 15.08.97 | 3.54 | 1.04 | 4.58 |
| | | 9 | 09.09.97 | 3.42 | 0.87 | 4.29 |
| | | 10 | 01.10.97 | 2.87 | 1.05 | 3.92 |
| | | 11 | 27.11.97 | 3.14 | 0.84 | 3.98 |
| | | 12 | 25.12.97 | 3.63 | 0.98 | 4.61 |
| 10 | 1998 | 1 | 29.01.98 | 2.92 | 0.78 | 3.70 |
| | | 2 | 27.02.98 | 3.31 | 0.78 | 4.09 |
| | | 3 | 27.03.98 | 3.65 | 0.80 | 4.45 |
| | | 4 | 30.04.98 | 3.46 | 0.93 | 4.39 |
| | | 5 | 29.05.98 | 3.65 | 0.84 | 4.49 |
| | | 6 | 30.06.98 | 3.29 | 0.86 | 4.15 |
| | | 7 | 25.07.98 | 3.42 | 0.88 | 4.30 |
| | | 8 | 02.09.98 | 3.07 | 0.67 | 3.74 |
| | | 9 | 02.10.98 | 2.80 | 0.68 | 3.48 |

Table AN1.2 Water Quality of Rashche Spring

| | |
|---|---|
| **RIVER BASIN:** | VARDAR-SKOPJE |
| **LOCALITY:** | RAŠČE |
| **SAMPLING:** | CAPTURED SPRING |
| **Elevations and coordinates** | x =4.655.300 y = 7.520.700 z =350.0 |
| **Registry number:** | 4143361111001 |
| **Date of sampling:** | 16.09.1998. |
| **Date of analysis:** | 14.10.1998. |
| **Number of a map:** | A57 |
| **Inventory number:** | 032 |

**Results of Chemical Components of Water Quality Analysis**

| | | | | | |
|---|---|---|---|---|---|
| 1. | Water temperature | 7.0 (°C) | 21. | Chromium (Cr) | 0.004 (mg/l) |
| 2. | Turbidity | 0.0 (mg/l si. g.) | 22. | Arsenic (As) | 0.0 (mg/l) |
| 3. | pH | 7.13 | 23. | Mercury (Hg) | 0.0 (mg/l) |
| 4. | Electrolitic conductivity | 581.3 (µs/cm) | 24. | Selenium (Se) | 0.0 (mg/l) |
| 5. | Carbonates ($CO_3$) | 0.0 (mg/l) | 25. | Potassium (K) | 5.90 (mg/l) |
| 6. | Bicarbonates ($HCO_3$) | 366.0 (mg/l) | 26. | Sodium (Na) | 24.8 (mg/l) |
| 7. | Ammonium as N($N\text{-}NH_4$) | 0.0 (mg/l) | 27. | Silica ($SiO_2$) | ---- (mg/l) |
| 8. | Nitrites as N ($N\text{-}NO_2$) | 0.0 (mg/l) | 28. | Aldrine & Dieldrine | 0.0 (µg/l) |
| 9. | Nitrates as N ($N\text{-}NO_3$) | 1.36 (mg/l) | 29. | Total as DDT | 0.0 (µg/l) |
| 10. | Chloride (Cl) | 10.0 (mg/l) | 30. | Phenols ($C_6H_5OH$) | 0.0 (µg/l) |
| 11. | Sulphates ($SO_4$) | 19.6 (mg/l) | 31. | Trichorophenols | 0.0 (µg/l) |
| 12. | Iron (Fe) | 0.006 (mg/l) | 32. | Chloroform ($CHCl_3$) | 0.0 (µg/l) |
| 13. | Manganeze (Mn) | 0.009 (mg/l) | 33. | Tetra-chloroetylene | 0.0 (µg/l) |
| 14. | Fluoride (F) | 0.1 (mg/l) | 34. | 3,4 D | 0.0 (µg/l) |
| 15. | Calcium (Ca) | 114.9 (mg/l) | 35. | Tri-chloroctylene | 0.0 (µg/l) |
| 16. | Magnesium (Mg) | 9.3 (mg/l) | 36. | Chlordane ($C_{10}H_6Cl_8$) | 0.0 (µg/l) |
| 17. | Total hardness | 17.7 (dH°) | 37. | Lindane (gama HCH) | 0.0 (µg/l) |
| 18. | Copper (Cu) | 0.006 (mg/l) | 38. | Total α radio-activity | ------ ($Bq/m^3$) |
| 19. | Lead (Pb) | 0.007 (mg/l) | 39. | Total β radio-activity | ------ ($Bq/m^3$) |
| 20. | Cadmium (Cd) | 0.0 (mg/l) | 40. | Total coliform MPN | ------ |

According to the results of the performed examinations and expert analysis, the sample of drinking water **fullfills** the requirements of the regulations for health correctness.

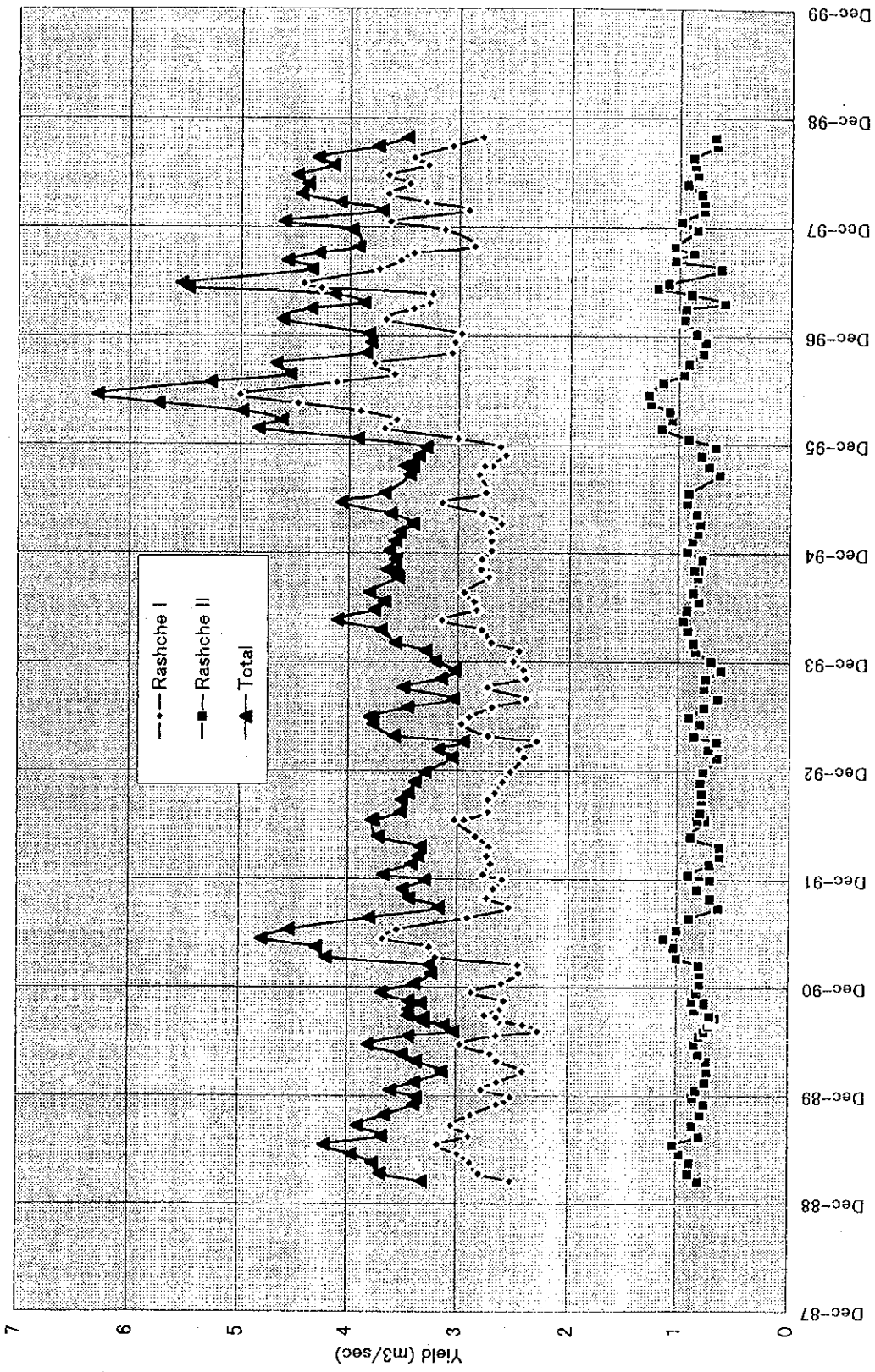



Figure AN.1 Annual Fluctuation of Spring Yield of Rashche