REPUBLIC OF TURKEY
THE GENERAL DIRECTORATE OF STATE HYDRAULIC WORKS

No.

FEASIBILITY STUDY
ON
ADATEPE IRRIGATION PROJECT

FINAL REPORT

VOLUME 1
MAIN REPORT

FEBRUARY 1990

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF TURKEY

THE GENERAL DIRECTORATE OF STATE HYDRAULIC WORKS

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PREFACE

In response to a request from the Government of the Republic of Turkey, the Japanese Government decided to conduct a survey on Adatepe Irrigation Development Project and entrusted the study to Japan International Cooperation Agency.

JICA sent to the Republic of Turkey a survey team headed by Mr. Tatsumi Tanabe from October 1988 to December 1989

The team held discussions with the officials concerned of the Government of the Republic of Turkey and conducted a field survey in Adatepe area. After the team returned to Japan, further studies were made and the present report was prepared.

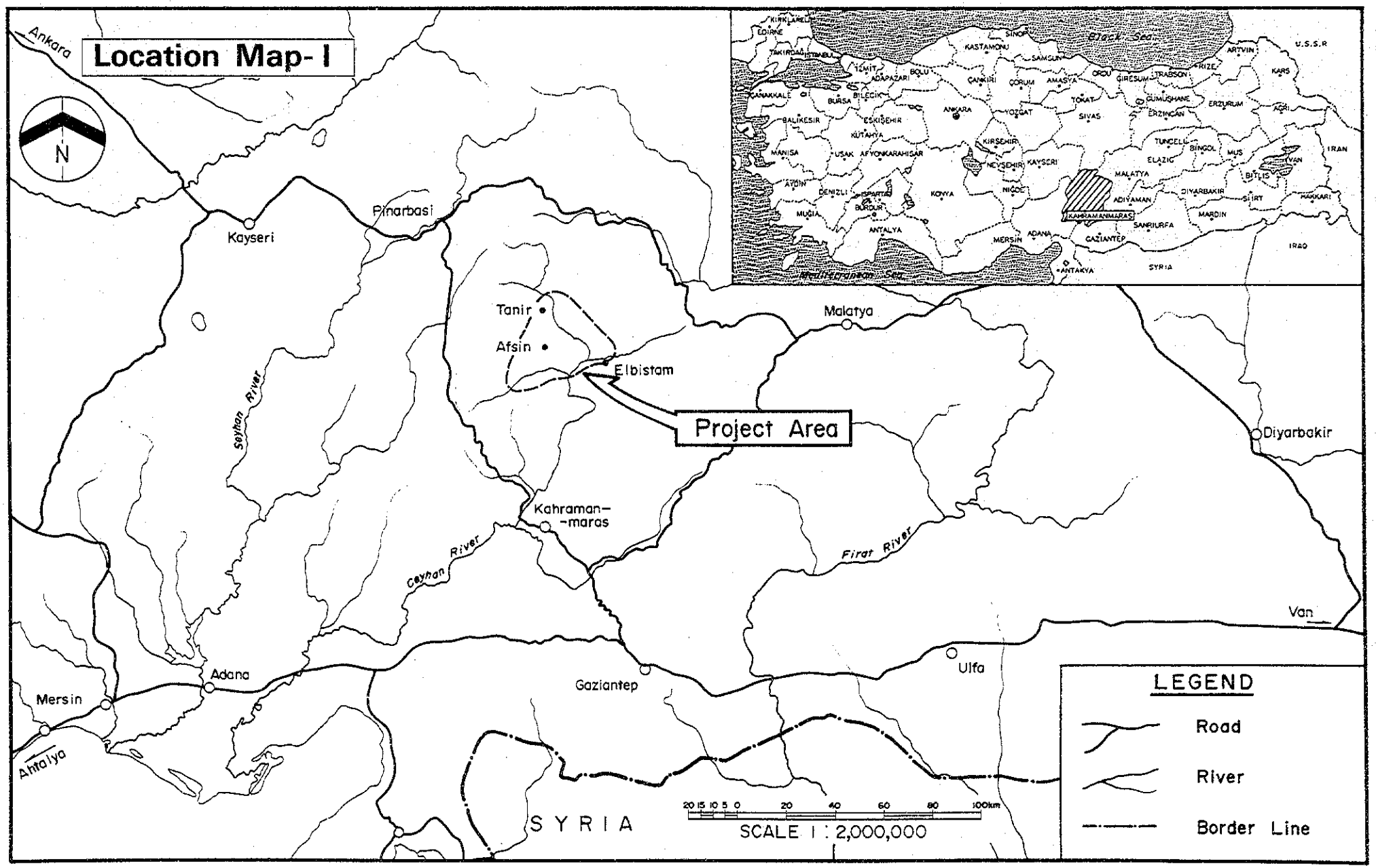
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

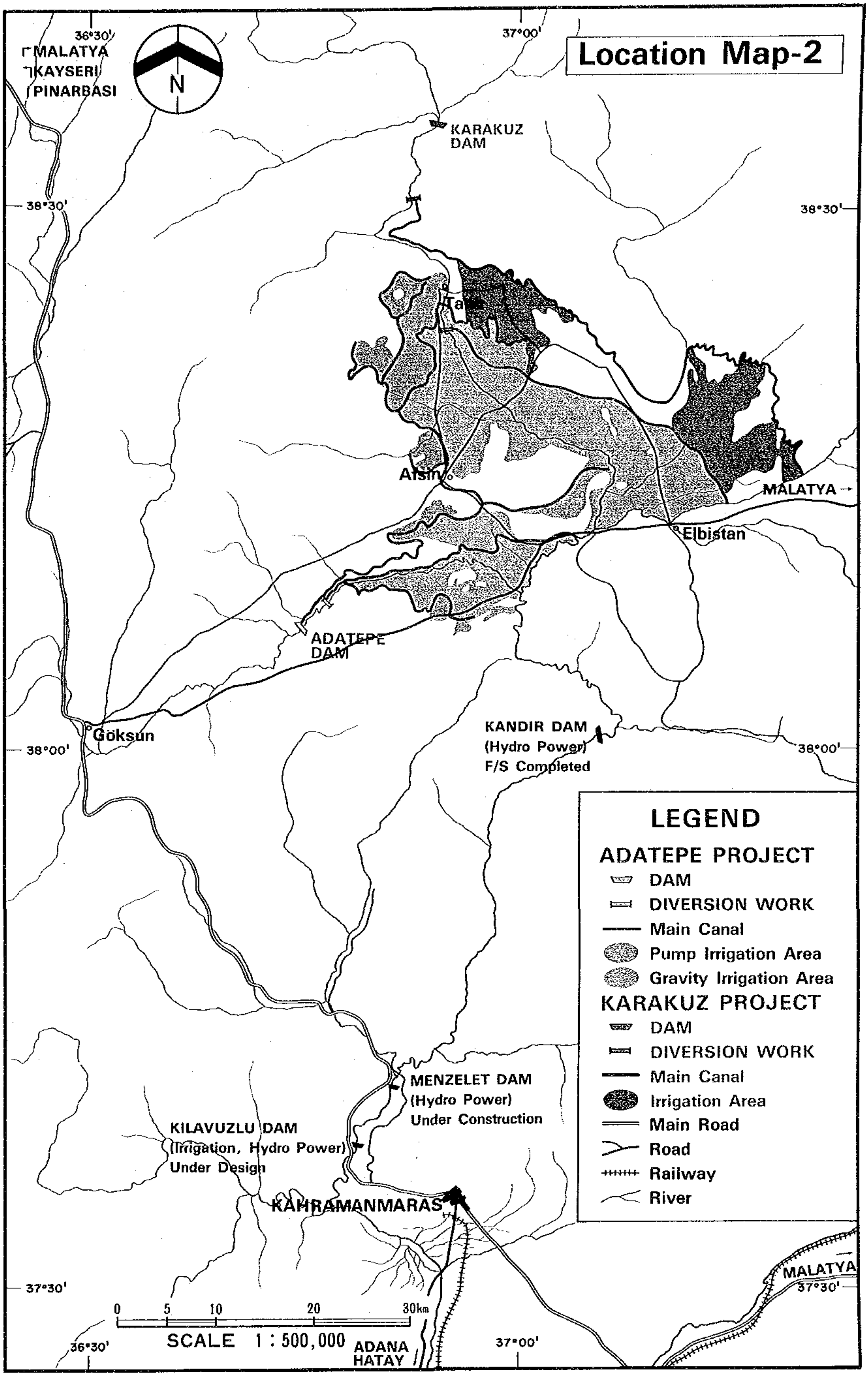
I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Turkey for their close cooperation extended to the team.

February 1990

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency


Location Map- I
N
Ankara
Kayseri
Pinarbasi
Tanir
Afsin
Elbistam
Project Area
Malatya
Diyarbakir
Seyhan River
Ceyhan River
Kahraman-
-maras
Firat River
Van
Ulfa
Gaziantep
Adana
Mersin
Antalya
SYRIA
20 15 10 5 0 20 40 60 80 100km
SCALE 1 : 2,000,000
LEGEND
Road
River
Border Line
Black Sea
Mediterranean Sea
IRAN
IRAQ
SYRIA
U.S.S.R



Location Map-2
MALATYA
KAYSERI
PINARBASI
36°30'
37°00'
N
KARAKUZ DAM
38°30'
Tanir
Afsin
MALATYA →
Elbistan
ADATEPE DAM
Göksun
KANDIR DAM
(Hydro Power)
F/S Completed
38°00'
LEGEND
ADATEPE PROJECT
DAM
DIVERSION WORK
Main Canal
Pump Irrigation Area
Gravity Irrigation Area
KARAKUZ PROJECT
DAM
DIVERSION WORK
Main Canal
Irrigation Area
Main Road
Road
Railway
River
MENZELET DAM
(Hydro Power)
Under Construction
KILAVUZLU DAM
(Irrigation, Hydro Power)
Under Design
KAHRAMANMARAS
MALATYA
37°30'
0 5 10 20 30km
SCALE 1 : 500,000
ADANA
HATAY

SUMMARY

(Preface)

1.01 This document constitutes the Final Report (hereinafter called the Report) for the Feasibility Study on Adatepe Irrigation Project based on the Scope of Works concluded between the Government of Turkey in June 1988, represented by the General Directorate of State Hydraulic Works (DSI), and the Japan International Cooperation Agency (JICA).

The Report covers the findings and recommendations from the first stage field works (October~December 1988), first stage home office works (December 1988 ~ January 1989), second stage field works (June~September 1989) and second stage home office works (September 1989 ~ October 1989) performed by the Study Team.

(Project Area Location and Size)

2.01 The Study area is located in the upper catchment of the Ceyhan river, slightly in the southeast of the country. The said catchment area is situated at N. latitude 38°00'~38°45' and E. longitude 36°15'~37°45'. It is bordered on the north and east by the Firat river catchment area, on the west by the catchment of the Seyhan river, and on the south by the Taurus range.

The headwaters of the Ceyhan river flow from the Taurus range. The size of the upper catchment of the Ceyhan is 6,365km^2.

The Study area is at N. latitude 38°09'~38°25' and E. longitude 36°44'30~37°45'. It is partially undulating terrain generally ranging in elevation from 1,150~1,300m.

2.02 The Study area for development under the Project encompasses 60,000 ha.

(Natural Environment of the Study Area)

3.01 The Study area is located on an intra-mountain plain at the north side of the southeast Taurus range, between E. longitude 36°44'30" and 36°44' and N. latitude 38°09' and 38°25'. Elevation is 1,150~1,300m. Annual mean precipitation and temperatures are 420mm, 9.9°C at Afşin, and 390mm, 10.2°C at Elbistan. Average temperature at Elbistan in January

is -3.5°C, and 23°C in July. Minimum temperature recorded at Elbistan is -26°C (1980), and maximum temperature is 36.°C (1978).

3.02 Plain formed of Quaternary sediments is almost entirely farm land, on which beet, beans, various vegetables, wheat, barley, apple and grape are cultivated.

Mountainous area is formed largely from limestone. Outcropping is dominant, and vegetative cover is poor.

(Turkish Economy)

4.01 Since 1980, the Government has pursued a policy of structural adjustment. The World Bank has established a Structural Adjustment Loan (SAL) to assist countries with this type of policy, and the first SAL for Turkey was approved in March 1980. Since then, the World Bank has continued to provide assistance to Turkey in this regard.

4.02 The 3 major targets of the Government's structural readjustment policy are: ① promotion of external oriented economy, ② emphasis on market mechanisms and ③ stimulation of the private sector. The policy places a major emphasis on a shift from a closed economy of import substitutes, to an externally open economy promoting exports. Under the program, the following are pursued: ① shift in exchange rate policy, ② promotion of exports and removal of restrictions on imports, ③ encouragement of foreign investment in domestic industries, ④ reform of government run industries, ⑤ fiscal policy reforms, ⑥ funding reforms and ⑦ loosening of price controls.

Benefits from this policy to date are: ① expansion of trade, ② reduction of government deficit, ③ recovery of economic growth and ④ increase in domestic savings rate. On the other hand, however, inflation has accelerated and foreign debt has increased. In response to this, the Government is taking its policy of structural adjustment a step further to tighten up on the macro approach and further strengthen supply side policy.

(Turkish Agriculture)

5.01 Agriculture continues to be a major sector of the Turkish economy, despite some relative decline in dominance with continued

industrialization of the country. However, agriculture continues to be a mainstay of the economy, accounting for 15.8% (1984) of the GDP, 25% of exports and 50% of employment.

Cultivated area totals 28 million ha, which is 35% of total land area of the country. Open pasture accounts for 28% and forest and wooded area for 19%.

Cereals, particularly wheat, are the most widely farmed crop. Nevertheless, there are regional variations in cropping methods and types of crop in response to differing conditions of weather, soil, etc.

5.02 Growth of the agricultural sector through increased cultivated area, and expanded animal husbandry through open range grazing of livestock has stagnated since the mid 1970s. Attention is thus being focused on increased productivity through the introduction of modern agricultural technology both for cropping and animal husbandry, and shift to a cropping pattern that offers Turkey's farm products a better competitive edge on the international market.

(Agriculture in the Study Area)

In particular, more effective use of existing farm land is to be targeted through expansion of irrigated agriculture.

6.01 Farm households in the Study area total 6,800. Farm population is 38,000. Potential farm family labor force is 21,400.

6.02 There are five major crops grown in the Study Area. They are wheat, barley, sugar beet, dry bean and chick pea, accounting for over 80% of the total area. Although limited cultivation of fruit, mainly grape, is observed in some part, most of it is on the hilly periphery and very little is included in the Area.

6.03 Yields in the Study area are lower than the Province as a whole due to topographical and meteorological constraints, and lack of irrigation. Yield for arid wheat, the crop with the largest cropped area in the Study area, is only 68% the national average. Yield for chick pea, the second most widely farmed crop in the area, is also below the national average.

(Present Irrigation)

7.01 Of the cultivated land in the area, about 9,300 ha has been irrigated. Water is most frequently drawn from rivers, followed by springs and underground sources. Most of the intake facilities at the rivers, large and small, adopt longitudinal separation works, i.e. water is obtained by piling up gravel on the riverbed or construction of coarse frameworks with wood in order to dam up the river water level.

The water from springs is often utilized by constructing a small pool with stones and concrete materials.

7.02 However, the above described irrigated area is subject to severe effects of climate due to unstable water supply and lack of diversion facilities. Furthermore, the large expanse of non-irrigated area in the Study area is restricted to either cultivation during the rainy season or cultivation of crops with low water consumption. Cultivation during the dry season is extremely constrained.

7.03 Field irrigation is almost completely by the border and furrow methods. In the case of the extremely few large scale farms in the area, irrigation by pump driven, transportable sprinkler is also performed. In all cases, the crops irrigated are sugar beet and dry bean.

(Development Objective)

8.01 With the exception of a small portion where irrigation is practiced by simple means, cultivation in the Adatepe area is rainfed. Meteorology and lack of water availability constrain crop variety and farming practices. Accordingly, many farmers cannot maintain their livelihood through agriculture alone, and the area lags behind more agriculturally developed regions of the country.

In order to correct this discrepancy, it is necessary to promote more economically viable farming in the Project area by upgrading agricultural infrastructure. This will increase farm productivity, permit wider range of crop variety and improve farm product quality, helping to bring the area into line with neighboring agricultural regions in terms of development level.

(Irrigation Development Concept)

9.01 The first step in achieving the above is the establishment of an irrigation system servicing the area with a long-term, stable and economic supply of water, as a basis for transition to modern farming practices. It will also be necessary to strengthen the farmer support system which provides guidance to farmers on crops to be cultivated, farm management practices, farm inputs (fertilizer, etc.), and both domestic and international marketing data, processing and distribution of farm products, etc.

9.02 The basic development concept for the Adatepe Irrigation Project is oriented at the above goals and fully compatible with government agricultural policy under the 5th national development plan (1985~89).

9.03 In specific terms, the Project calls for diversion from Adatepe dam and primarily gravity conveyance to fields by a system of main, secondary and tertiary canals. Water will be brought into the fields by quaternary canals (farm ditches) and applied by the border irrigation method. Main through tertiary canals are to be concrete lined.

Where topographically necessary, pump irrigation will be employed to lift discharge to distribution tanks at points from which final application can then be performed by gravity canal system.

From an economic standpoint, the canal network is designed to minimize the need for pumping.

On farm development will be given important attention under the Project, encompassing terminal irrigation facilities including Quaternary canal (farm ditch) network.

(Irrigation Source)

10.01 Potential water sources for irrigation in the Afsin-Elbistan plain are discharge from the Ceyhan and its tributaries, and limited groundwater from springs in the area.

Springs are located at 8 points in the area. Discharge is closely linked to precipitation, and fluctuates greatly from year to year. In addition, discharge at springs tends to decrease during June~September when irrigation requirement is greatest. For these reasons, springs are not

considered to offer a stable irrigation source. Also, topographically, special measures would be necessary in many cases to utilize discharge.

On the basis of the Master Plan, use of discharge from Pinarbasi and Tanir springs, although large and relatively stable, is to be avoided for irrigation under the Project as these springs constitute the headwaters of the Ceyhan and Hurman rivers.

Other springs offer only small discharge, which is already being used for domestic purposes, and are therefore excluded from consideration.

10.02 There are 3 aquifers located in the area, but these systems are all isolated and scales are small. Application of pumps to develop groundwater on such a small scale would not be cost effective given pump operation and maintenance costs.

Accordingly, river discharge is the only irrigation source to be considered under the Project. Sufficient water requirement for the irrigation period is to be secured through dam construction on the Goksun river.

(Principal Irrigation Facilities)

11.01 Principal irrigation facilities under the Project:

a) Adatepe dam (rockfill dam; 89.0 m crest height; 423 × $10^6 m^3$ effective storage)

b) Intake

Diversion to main canal is to be by pressure tunnel. Total pressure length is 1,330m.

c) Pump Station

8 pump stations are planned for the pump irrigation area totaling 8,270 ha. All pumps are to be the centrifugal type.

d) Irrigation Canal

Main, secondary and tertiary canals will be constructed. These canals will be concrete lined. Appurtenant facilities will include siphon, tunnel, aqueduct, turnout, wasteway, spillway and drop works. Quaternary canal system is to consist of earthen ditches to be constructed by the farmers themselves. However, technical guidance is to be provided by the General Directorate of Village

Services under the Ministry of Agriculture, Forestry and Rural Affairs.

e) Headworks

Headworks are planned at 2 locations, i.e. Hurman and Kargabuku. Both are to be floating type.

f) Drainage Canal

Drainage canal is designed for surface water drainage only in mainly poorly drained area (11,000 ha). All drainage canals are designed as earthen.

g) Gravel Removal and Land Leveling Works

Gravel removal and leveling works are planned for the surface layer classified as Class 2 and Class 3 soils (2,990 ha) as a result of the soil survey during the 1st and 2nd stage field works.

(Agricultural Development Plan)

12.01 Agricultural development area is based on factors of topography, soil conditions, availability of labor, economic viability of development and compatibility with existing projects and future development plans of the Government.

On this basis, development area under the Project is 44,030 ha.

(Land Use Plan)

13.01 The following items were carefully considered in formulation of the land use plan:

① Identification of soil constraints, and countermeasures therefor

② Cultivation method, soil fertility

③ Optimum cropping pattern given the environment of the target area

④ Fertilized cropping management and improvement of productivity

12.02 On the basis of the above, the land use plan was formulated as follows:

① Expansion of cultivation of other cash crops due to the relatively low yield nature of the wheat widely cultivated in the Project area

② Basic preservation of 3 crop rotation of the principal crops of the area of wheat, sugar beat and dry bean.

③ Dry bean is to be promoted as a substitute for chick pea, heretofore cultivated without irrigation in the area. Cultivation of dry bean is to be particularly emphasized in the area targeted for pump irrigation where it has been heretofore widely cultivated.

④ As a root crop, sugar beet requires much water as well as a thick top soil layer. As a result, sugar beet cultivation is to be emphasized in the area targeted for gravity irrigation, in the alluvium along the Hurman and Sarsap rivers, where it has been heretofore widely cultivated.

⑤ Cultivation of barley and alfalfa, both feed crops, is to be emphasized in the area targeted for pump irrigation, located at the periphery of the area where animal husbandry is widely practiced.

⑥ Cultivation of alfalfa is to be emphasized in areas adjacent to villages from the standpoint of convenience for animal husbandry.

⑦ Cultivation of vegetables is to focus on tomato and cucumber due to their appeal to the palate of the population of the area, and cabbage and cauliflower due to relative ruggedness when transported.

⑧ Cultivation of fruit trees is to focus on apple and apricot due to their suitability to the climate of the Project area.

⑨ Due to the relative ease of cropping management for fruit trees and grapes and their suitability for cultivation on slopes, these are to be emphasized for the sloped areas at southern Afsin, southern Tanir, and southern Goksun river.

⑩ Contour farming and contour irrigation are to be adopted in principle on sloped areas to prevent soil erosion.

⑪ Application of organic substances will be encouraged among farmers due to the low organic content of the area soil of 1~2%.

(Farm Management Plan)

14.01 The farm management plan is formulated on the basis of design crops, fertilizer and pest control techniques, past cropping performance, design animal husbandry, etc.

(Animal Husbandry Plan)

15.01 Scale and method of sheep herding is to be kept at current levels considering present husbandry capacity and methods.

15.02 Dairy cattle husbandry is to be increased to a target level of 2 head per household in an effort to improve farm household nutrition, and farm management.

(Extension of Agricultural Technology)

16.01 Under the Project, vehicles and audio visual equipment will be procured for the Agricultural Engineering Offices at Afsin and Elbistan. The lack of such has been the major obstacle to effective extension activities in the Project area by these agencies.

Extension and guidance to farmers to be provided by the staffs at the Agricultural Engineering Offices is to include cropping technology, irrigated agriculture technology, creation and operation of farmers' organizations (particularly marketing cooperatives on a villagewise basis), etc.

16.02 Farmers in the Project area have almost no experience in irrigated agriculture. To ensure the success of the Project, instruction and guidance in cropping technologies and mechanized farming appropriate to conditions under the Project will be essential.

To provide such instruction, an Agricultural Training Center is to be established under the jurisdiction of the Agriculture Engineering Office.

16.03 The envisaged Center will make use of the facilities at the Afsin Agricultural Engineering Office and the Fruit Nursery Research Station. Operation of the Center would be performed jointly by the Agricultural Engineering Offices at Afsin and Elbistan, in cooperation with the area branch of DSI. Materials, equipment and machinery for instruction in irrigated agriculture will be procured.

(Farmers' Organizations)

17.01 Under the Project, annual crop area for potato and green vegetables (mainly tomato) is to be greatly increased. Creation of a farmers'

organization is therefore planned for quality control and coordinated shipping and marketing of produce to ensure the most favorable price possible to the farmer.

17.02 Such groups would be created on a villagewise basis for ready acceptance and participation by farmers. The organizations would be run by the farmers themselves, with guidance from the Agricultural Engineering Offices.

(Project Cost)

18.01 Project cost has been computed on the basis of specifications established from the results of field survey. Computation was by the cost breakdown method.

Project cost is comprised of direct and indirect construction costs. Direct construction cost was calculated on the basis of construction items determined from design drawings, and their corresponding work quantities multiplied by unit cost.

Indirect construction costs include land acquisition costs, compensation and engineering and construction supervision costs.

Contingency was calculated at 15% of total construction cost.

18.02 Total Project cost as computed on the basis of the above criteria is TL 187,210,000,000. Of this, foreign currency portion is TL 57,360,000,000 and local currency portion is TL 129,850,000,000.

(Economic Evaluation)

19.01 Project justification examined the economic, financial and socio-economic viability of the Project. Economic viability was assessed in terms of the Economic Internal Rate of Return and net present value. Sensitivity analysis was performed for effects on the Internal Return Rate of fluctuations in Project cost and benefit resulting from various combinations of Project objectives not being achieved within the scheduled period.

Financial analysis assessed Project viability in terms of effect on farmer economy.

19.02 Basic assumed conditions in economic evaluation of the Project are as follows:

① Project life is 58 years from 1990 to 2047.

② Project construction period is 8 years including detail design; and agricultural benefits will emerge immediately upon completion of implementation.

③ Prices as of 1988 are adopted as standard costs in calculating economic cost and benefit.

④ Exchange rate adopted is the official rate as of the first quarter of 1988: US$ 1 = TL 1,220.7

19.03 Economic Internal Rate of Return based on the above criteria is 15%. This indicates that the Project is justified.

(Project Implementation Plan)

20.01 The Adatepe irrigation project will be implemented by DSI except for the terminal on-farm development to be implemented by the General Directorate of Village Services under the Ministry of Agriculture, Forestry and Rural Affairs.

20.02 It is anticipated that about 8 years will be required to complete the proposed project, judging from the scale of manpower, equipment and material, and funding input required for construction, as well as experience of DSI on previously implemented projects.

(Environment)

21.01 The Team carried out an environmental impact study of the Project through field reconnaissance and discussions with DSI.

21.02 On the basis of study, it was concluded that implementation of the Project will produce no adverse impact on the natural environment and ecosystem of the Project area and environs.

SALIENT PROJECT FEATURES

Dam name:	Adatepe dam
River basin and river name:	Ceyhan river basin, Goksun river
Location:	35 km upstream from confluence with Ceyhan river
Reservoir	
Basin area:	982.0 km²
Water surface area:	19.6 km²
Normal full water level:	1,310.52 m
Lowest water level:	1,270.50 m
Available draw down:	40.02 m
Total storage volume:	500.0 × 10^6 m³
Available storage volume:	423.3 × 10^6 m³
Dead storage volume:	76.7 × 10^6 m³
Dam	
Type:	center-cored zone type rockfill
Height:	89.0 m
Length:	651.0 m
Top elevation:	1,315.0 m
Volume:	4,685,000 m³
Saddle dam	
Type:	zone type fill dam
Height:	3.0 m
Length:	504.0 m
Top elevation:	1,315.0 m
Volume:	114,400 m³
Spillway	
Location:	left bank of Goksun river
Design flood:	992.00 m³/s
Design flood level:	1,311.02 m
Type of gate:	radial
Number of gates:	10m (B) × 8 m (H), 2 nos.
Temporary Diversion Tunnel	
Location and number:	left bank of Goksun river, 1 no.
Design flood:	55.50 m³/s
Shape and dimension:	circular tunnel, D = 3.0 m
Length and slope:	637.50 m, 7.059 ‰
Intake Facility	
Design discharge:	30.41 m³/s
Intake:	drop inlet with vertical hole with inner dia. of 4.0 m
Regulation method:	by water release under submerged condition with jet flow gate of Ø = 2000 mm × 2 nos.
Headrace tunnel:	circular type pressure tunnel (D = 4.0 m, L = 475 m)
	standard horse shoe type tunnel (2R = 4.3m, L = 770 m)

Irrigation Area	
Projected area:	44,030 ha
Net irrigated area:	38,438 ha
Gravity area:	31,218 ha
Pump area:	7,220 ha
Main Canal	
(open canal)	
Type:	trapezoidal and retaining wall type concrete lined
Design discharge:	30.41 ~ 12.38 m³/s
Length:	76,640 m
Slope:	1/4000
(tunnel)	
Type:	standard horse shoe type
Dimension:	2R = 4.0 m
Length:	L = 280 m
(siphon)	
Type:	steel pipe and reinforced concrete
Dimension:	Ø = 3200 mm (double) ~ Ø = 2,900 mm (single)
Length:	1,080 m

Pump Stations

	TOMBAK 1	TOMBAK 2	KOTURE 1	KOTURE 2
Irrigation area (ha)	290	240	1,090	370
Discharge (m³/s)	0.22	0.18	0.84	0.28
Actual head (m)	50	50	60	50
Total head (m)	55	55	63	53
Type:	double suction type centrifugal pump w/ horizontal axis			
Pump Ø and no.:	Ø 200 × 2	Ø 200 × 2	Ø 300 × 3	Ø 200 × 2
Motor output (kW):	90 × 2	75 × 2	210 × 3	125 × 2
Annual electric consumption (kWh)	243,000	200,000	846,000	328,000

	AFSIN 1	ARITAS 1	ARITAS 2	ARITAS 3
Irrigation area (ha)	576	5,229	646	925
Discharge (m³/s)	0.44	3.98	0.49	0.70
Actual head (m)	70	40	60	60
Total head (m)	73	43	64	63
Type:	double suction type centrifugal pump w/ horizontal axis			
Pump Ø and no.:	Ø 250 × 3	Ø 500 × 5	Ø 250 × 3	Ø 300 × 3
Motor output (kW):	150 × 3	500 × 5	150 × 3	210 × 3
Annual electric consumption (kWh)	598,000	3,335,000	603,000	845,000

Construction period:	8 years
Project cost:	TL 187,216 × 10^6
Net present value:	TL 360,405 × 10^6
Discount rate:	5%
Benefit - cost ratio	3.8
Economic internal rate of return:	15.0%
Financial internal rate of return:	12.4%
Foreign exchange rate:	US $ 1.00 = TL 1,220.7

CONTENTS

List of Tables

List of Figures

List of Abbreviations

DMI	Devlet Meteoroloji Isleri	State Meteorological Service
DSI	Devlet Su Isleri	General Directorate of State Hydraulic Works
EIE (EIEI)	Elektrik Isleri Etud Idaresi	Electric Power Resources Survey and Development Administration
SIS	Devlet Planlama Teskilati	State Institute of Statistics
SPO	Devlet Planlama Teskilati	State Plan Organization
TCK	Turkiye Cumhuriyeti Karayollan	General Directorate of State Highways
TEK	Turkiye Elektrik Kurumu	Turkish Electricity Authority
TIGEM	Tarim Isletmeleri Genel	General Directorate of Agricultural Enterprises
TMO	Toprak Mahsulleri Ofisi	Soil Products Office
TZDK	Turkiye Zirari Donatim Kurumu	Turkish Agricultural Supply Organization

Abbreviations of Measures

Length

mm	millimeter
m	meter
km	kilometer

Area

km^2	square kilometer
ha	hectare
m^2	square meter
da	decare = 0.1 ha

Volume

lit	liter
m^3	cubic meter
Mm^3	million cubic meter

Weight

kg	kilogram
t	ton

Time

s	second
sec	second
hr	hour
yr	year

Money

TL	Turkish Lira
US$	United States Dollar

Others

%	percent
°	degree
°C	degree Celsius

Chapter 1

Introduction

CHAPTER 1 INTRODUCTION

1.1 Authority

This document constitutes the Final Report (hereinafter called the Report) for the Feasibility Study on Adatepe Irrigation Project based on the Scope of Works concluded between the Government of Turkey in June 1988, represented by the General Directorate of State Hydraulic Works (DSI), and the Japan International Cooperation Agency (JICA).

The Report covers the findings and recommendations from the first stage field works (October~December 1988), first stage home office works (December 1988 ~ January 1989), second stage field works (June~September 1989) and second stage home office works (September 1989 ~ October 1989) performed by the Study Team.

1.2 Study Background

The Republic of Turkey has a land area of about 779,000 km^2, of which economically irrigable area is estimated to be approximately 8.5 million ha. Of the potential irrigable area of 8.5 million ha, presently irrigated area covers only 3.18 million ha.

Agriculture is the mainstay of the country's economy, accounting for a high 24.5% of total export earnings. As a result, the Government of Turkey (hereinafter GOT) has emphasized investment in the agricultural sector in recent years. The most recent 5 Year Plan (1985~1989) calls for the implementation of new irrigation projects to development 890,000 ha. The Adatepe Irrigation Project is included in this plan.

The Study area comprises 60,000 ha located in the Afsin-Elbistan plain, in the upper reaches of the Ceyhan river which flows through the southeast Anatolian region. It is an area of major agricultural production, centered on wheat and barely. However, the area suffers chronically from water shortage during the dry season in July and August. Irrigation facilities which will stabilize water resources are urgently required in the area.

Since the 1960's, GOT has implemented a number of feasibility studies with cooperation from various European nations and the United States, based on its master plan for development of water resources of the Seyhan and Ceyhan rivers. These studies have been carried out in Kahramanmaras province and its vicinity in the southeast Anatolian region. The General Directorate of State Hydraulic Works (DSI) has performed detailed design for Karakuz and Adatepe dams which are to serve as the principal water sources for irrigation of area. The feasibility study for the Karakuz irrigation project was commenced in 1983 and completed in 1985.

The major objective of the irrigation plan for the Adatepe and Karakuz areas in Afsin Elbistan plain, is to improve agricultural productivity through ① introduction of new crops which take into consideration domestic and international market structure and trends and ② improvement of farm management. It is anticipated that the Project will contribute significantly to higher agricultural productivity and a strengthened national economy.

In consideration of the above circumstances, GOT requested the Japanese Government to provide technical assistance in the execution of a feasibility study on the said Project in January 1987. In response to this request, the Japanese Government entrusted JICA to dispatch a contact mission in October 1987 and a

preliminary survey team in June 1988. On the basis of the survey, the Japanese Government studied the most effective means of providing cooperation, culminating in the conclusion of a Scope of Works (S/W) on the proposed Project between the Turkish Government, represented by DSI, and JICA on 24 June 1988. This Final Report has been compiled in line with the said S/W.

1.3 Study Objective

The objective of the Study is to formulate the optimum irrigation project, including both gravity and pump irrigation, improve agricultural productivity in the Adatepe area in the Afsin-Elbistan plain at the upper reaches of the Ceyhan river in Kahramanmaras province. Technology transfer will be carried out during the course of the Study.

1.4 Study Area

The Study Area is as indicated in the location map at the front of this Report. It encompasses a total of 60,000ha, comprises 44,000ha in the Adatepe area and 16,000 in the Karakuz area (existing feasibility study revised under the subject Study), both located in the Afsin-Elbistan plain at the upper reaches of the Ceyhan river in Kahramanmaras province.

Chapter 2

Project Background

CHAPTER 2 PROJECT BACKGROUND

2.1 General

From the 1950s to the first half of the 1970s, GOT moved aggressively to shift the nation's traditionally agricultural economy to a more industrialized one. However, since these efforts were directed primarily at products to replace imports rather than export oriented industries, the two oil crises in the 1970s with the resultant dramatic increase in the world prices for crude worsened the country's balance of international payments. Economic crisis in the form of lack of foreign exchange deepened. The industrial structure has remained mostly unchanged due to lagging economic development since the latter half of the 1970s.

The nation's socio-economic structure is characterized by (i) a mixed economic structure consisting of both nationally owned sectors and private sectors, (ii) transitional status from agriculturally based to industrially based, (iii) rapid increase in urban population and skewed economic development and demography between regions. Principal economic problems at present are (i) chronic deficit in balance of international payments, (ii) increasing cumulative foreign debt, (iii) chronic government budget deficit, (iv) high inflation rate, and (6) increasing unemployment.

At present, GOT is attempting to revitalize the economy by streamlining national industries which have formed the basis of the countries mixed, quasi-government supervised economic policy pursued since the 1930s.

Currently, GOT is in the midst of pursuing its 5th national development plan (1985~89). Industrialization focused on investment in manufacturing sectors was promoted up through the 3rd national plan. In the 4th national plan, energy, transportation and telecommunications sectors were targeted for development, and this has been continued during the current plan. Fixed capital investment rates from the 3rd to 5th national plans show a marked decrease for the industrial sector at 31.8%, 27.4% and 20.9%, respectively. That for the energy sector (electricity, gas, hydropower) showed increase at 8.7%, 10.6% and 14.9%. Investment in the transportation and telecommunications sectors likewise increased, with rates during the 3 plans at 14.7%, 16.3% and 18.6%.

Principal targets of the 5th national plan are broadly grouped as follows:

① Improvement of national welfare through the promotion of liberty, education and security

② Stable economic growth and control of inflation

③ Managed macro-economic policy

Policy relevant to agriculture is as follows:

(1) Encouragement of introduction of new crops to increase income for both independent and tenant farmers; and promotion of support service for independent farmers to improve food production in rural areas.

(2) Identification of latent development potential in designated Priority Development Areas and reduction of skewed development between regions.

Annual GDP growth rate during the 5th national plan is estimated at 3.6% in the agricultural sector. As a result, the portion of GDP accounted for by the agricultural sector is anticipated to drop from 15.8% in 1984 to 13.7% in 1989. Investment rate in agricultural facilities during the period of the plan is estimated to be 11.37%.

Sector-wise production amounts, sector-wise capital investment, and per capita consumption of agricultural products are shown in Tables 2.1-1, 2.1-2, 2.1-3.

During the pre-Republic period (prior to 1923), agriculture was overwhelmingly the mainstay of the economy, and the country prospered through supply of wheat and beans to Europe. Following establishment of the Republic, the Government has striven to promote industrialization, with a resultant relevant drop in GDP share produced in the agricultural sector. Nevertheless, agriculture remains a base sector within the national economy. This is borne out by the fact that employment in the agricultural sector was 60% of the total employed population in 1984, and primary agricultural products and processed agricultural products accounted for 35.8% of exports 1984.

Demography in the country exhibits the worldwide trend of population migration to urban areas. Underemployed population displaced by increased mechanization of agriculture migrates to urban areas such as Istanbul and Ankara.

Target for the agricultural sector under the 5th national development plan (1985~89) is to increase total production by an annual 3.6%. Targeted annual growth in the subsectors of crop production, animal husbandry, fisheries and forestry are 3%, 4.7%, 7.7% and 3.1%, respectively. The percentage of overall material production in the country accounted for by agriculture will drop from 24.8% in 1984 to an estimated 21.5% by the end of the 5th national plan in 1989. Total agricultural

Table 2.1.-1 Development of Production by Main Sectors
(At 1983 Prices, in Billion TL)

Sectors	1984 Output Value	1984 Percentage Distribution In-Sector	1984 Percentage Distribution Inter-Sectoral	1989 Output Value	1989 Percentage Distribution In-Sector	1989 Percentage Distribution Inter-Sectoral	Mean Annual percentage rise
<AGRICULTURE>	3,428.6	100.0	15.8	4,092.3	100.0	13.7	3.6
Plant production	2,008.4	58.6		2,322.7	56.8		3.0
Animal husbandry	1,129.2	32.9		1,417.7	34.6		4.7
Forestry	245.3	7.2		285.5	7.0		3.1
Fishing	45.7	1.3		66.4	1.6		7.7
<INDUSTRY>	10,399.6		47.8	14,901.8		50.0	7.5
Mining	419.4		1.9	596.2		2.0	7.3
Manuf. Industry	9,505.0	100.0	43.7	13,497.2	100.0	45.3	7.3
Consumer goods	(4,347.9)	45.7		(5,937.5)	44.0		6.4
Intermediate goods	(3,883.7)	40.9		(5,532.3)	41.0		7.3
Investment goods	(1,273.4)	13.4		(2,027.4)	15.0		9.7
Energy	475.2		2.2	808.4		2.7	11.2
<SERVICES>	7,928.6	100.0	36.4	10,832.6	100.0	36.3	6.4
Building	1,066.0	13.4		1,608.3	14.9		8.6
Trade	2,282.2	28.8		3,167.1	29.2		6.8
Transp. Communi.	1,846.8	23.3		2,508.1	23.2		6.3
Financial institutions	372.8	4.7		433.4	4.0		3.4
Housing ownership	569.4	7.2		792.7	7.3		6.8
Free professions	894.3	11.3		1,185.0	10.9		5.8
Government services	897.1	11.3		1,138.0	10.5		4.9
TOTAL GROSS PRODUCTION	21,756.8		100.0	29,826.7		100.0	6.5

Table 2.1-2 Fixed Capital Investment by Sectors
(At 1983 Prices, in Billion TL)

Sectors	4th Five Year Development Plan (79'-83', Actual)		5th Five Year Development Plan (85'-89', Target)				
	Investments	Share in percentage	Public Sectors	Private Sectors	Total	Share (%)	Index during 4th Dev. Plan = 100
Agriculture	1,059.3	10.00	799.0	810.1	1,639.1	11.37	154.7
Mining	566.4	5.35	771.1	71.3	882.4	6.12	155.8
Manufacturing	2,714.8	25.62	1,288.9	1,726.8	3,015.7	20.92	111.1
Energy	1,615.7	15.25	2,094.8	50.5	2,145.3	14.89	132.8
Transportation	1,902.3	17.95	1,635.4	1,041.8	2,677.2	18.57	140.7
Tourism	64.8	0.61	69.1	54.5	123.6	0.86	190.7
Housing	1,676.4	15.82	156.4	2,034.0	2,190.4	15.20	130.7
Education	250.3	2.36	326.5	13.2	339.7	2.36	135.7
Health							
Other	112.1	1.06	130.6	13.7	144.3	1.00	128.7
Services	633.3	5.98	966.4	288.8	1,255.2	8.71	198.2
Total	10,595.4	100.0	8,278.2	6,134.7	14,412.9	100.00	136.0

Table 2.1 -3 Per Capital Consumption of Agricultural Products
(Kg/Year)

	1983	1989
A) CERIALS		
Wheat	200.0	200.0
Rice	3.6	4.5
Other Cereals	14.8	16.6
B) PULSES	7.9	8.0
C) OTHER CERIAL CROPS	134.5	136.8
D) FRUIT, VEGETABLES	236.8	239.8
Citrus Fruit	18.4	18.2
Grapes *	25.1	25.3
Other Fruit	61.0	60.5
Vegetables	132.0	135.8
E) TOTAL MEAT	21.8	24.5
F) MILK	123.4	143.6
G) EGGS	5.4	7.0
H) FISH	8.8	11.6

* Equivalent of industrially processecd grapes, expect processed in spirits industry.

export in 1984 is estimated at TL 241.6 billion. During the present plan, sector export is anticipated to grow by an annual 9.1% to TL 374 billion by the last year of the plan. Of this total, crops will account for 66.2%, animal husbandry products for 27.4%, forestry products for 3% and fishery products for 3.4%. Target under the 5th national plan is to increase the share of agricultural products in total national export from 7.1% to 9.1%.

As can be seen from the above, strengthening of the agricultural sector is a major objective of national policy. Implementation of the Adatepe Irrigation Project, targeted at increased agricultural production, is highly compatible with this policy.

2.2 Agricultural Production

(1) Land Use

Of the total Turkish land area of 779,452 km^2, 35.8% (27,927,000 ha) is arable, while 27.9% (21,745,000 ha) is pasture.

Current land use is as shown in Table 2.2-1. Of total arable land, 20% is unused due to lack of agricultural infrastructure.

Table 2.2.1 Current Land Use (1987)

	Area (1,000 ha)	Rate (%)
Arable land	27,927	35.8
Pasture	21,745	27.9
Forest and open field	20,199	25.9
Other	8,074	10.4
Total	77,945	100.0

(2) Agricultural Production

Cereals and beans accounted for 86% of cultivated area for upland crops in 1987. Within that 86%, wheat and barley accounted for 80%. Crops for industrial purposes or for plant oil accounted for 12%. Of the industrial crops, cotton, sugar

beet and tobacco account for a large share. Sunflower accounts for 75% of oil crops.

The growth in production for major crops during the 5 year period 1983~1987 was: wheat (15.2%), barley (27.2%), cotton (3%), sugar beet (-10%), tobacco (-22%), sunflower (53.8%). In the case of cotton, a net plus was shown despite reduction of cultivated area due to a large harvest. Conversely, sugar beet showed a net minus growth despite increase in cultivated area due to a poor harvest. A large reduction in cultivated area occurred for tobacco.

Cultivated area and production amounts for major crops are shown in Table 2.2-2.

Table 2.2.2 Cultivated Area and Production Amounts for Major Crops

Crop	Cultivated Area (ha)	Production (t)	Yield (kg/ha)
Cereal and beans			
Wheat	9,415,000	18,900,000	2,035
Barley	3,314,000	6,900,000	2,092
Maize	570,000	2,400,000	4,215
Rice	53,000	165,000	3,113
Lentil	579,000	550,000	952
Chickpea	665,000	725,000	1,106
Industrial and oil crops			
Sugar beet	391,592	12,717,321	33,042
Cotton	585,800	536,786	916
Sunflower	775,000	1,100,000	1,421
Tobacco	206,247	184,712	896
Fruits			
Citrus	23,200,000 trees	1,343,000	--
Grape	590,000 trees	3,300,000	--
Olive	85,585,000	600,000	--
Vegetables (all)	608,971	15,222,465	--

2.3 Agricultural Development Policy

Targets under the Fifth 5-Year Plan (1985-1989) in the agricultural sector are: ① stabilization and increase of production, ② increased farm income, ③ improvement of the rural living environment, ④ development of potential in less developed regions and unutilized arable land, and ⑤ stimulation of export of farm products. In order to achieve these objectives, growth target in the agricultural sector is set at 3.6%, with 11.37% of the national budget (TL 1.6 trillion) earmarked for the sector during the five year period of the plan.

Measures to achieve the above target include: ① improvement of farm technology through strengthening of agricultural research and extension, ② promotion of processing and marketing organizations for farm products, ③ strengthening of farmer financial support system, ④ continued investment in irrigation projects, ⑤ development of farm land, ⑥ crop diversification, ⑦ introduction of modern farm technologies, etc.

Domestic demand for farm products is forecast to grow during the plan period 3.3% per annum on the basis of population growth, increased incomes and industrial expansion. Growth in exports of vegetables and fruits is anticipated at 9.1% per annum. Export is aimed at markets in the Mid-East, and the off-season market in Europe.

Under animal husbandry, policy aims at maintaining current numbers of head, while increasing yield per head through improved breeds, nutrition and disease prevention.

According to the 1983 agricultural census, grazing livestock (excluding poultry) numbered 82.5 million head. Beef cattle and sheep, mainly raised by open grazing, produce low yields per animal despite an increase in head, due to lack of pasture improvement and lack of development of a crude foods industry.

Meat production including poultry totaled 1 million tons in 1980. In 1984, production was 1.3 million tons. Milk production in 1980 was 5.5 million tons, increasing to 6.1 million tons in 1984.

2.4 Economic Development Policy

Since 1980, the Government has pursued a policy of structural adjustment. The World Bank has established a Structural Adjustment Loan (SAL) to assist countries with this type of policy, and the first SAL for Turkey was approved in March 1980. Since then, the World Bank has continued to provide assistance to Turkey in this regard.

The 3 major targets of the Government's structural readjustment policy are: ① promotion of external oriented economy, ② emphasis on market mechanisms and ③ stimulation of the private sector. The policy places a major emphasis on a shift from a closed economy of import substitutes, to an externally open economy promoting exports. Under the program, the following are pursued: ① shift in exchange rate policy, ② promotion of exports and removal of restrictions on imports, ③ encouragement of foreign investment in domestic industries, ④ reform of government run industries, ⑤ fiscal policy reforms, ⑥ funding reforms and ⑦ loosening of price controls.

Benefits from this policy to date are: ① expansion of trade, ② reduction of government deficit, ③ recovery of economic growth and ④ increase in domestic savings rate. On the other hand, however, inflation has accelerated and foreign debt has increased. In response to this, the Government is taking its policy of structural adjustment a step further to tighten up on the macro approach and further strengthen supply side policy.

Chapter 3

Project Area

CHAPTER 3 STUDY AREA

3.1 General

The Study area is located within a continental climatic zone. Maximum temperature in the summer is over 30°C and minimum temperature in the winter is below freezing. Annual mean precipitation is 400mm, and is concentrated in November~May. Almost no precipitation occurs in July~September.

Consequently, non-irrigated cultivation in the summer is extremely limited, with almost all non-irrigated fields fallow. Cultivation in the winter consists of wheat and barley, and yields are small and production unstable. Where irrigation is available, beet, beans, green vegetables and sunflower are farmed in the summer.

As precipitation is small and concentrated in the winter, most of the farmers in the area are engaged in dry, low productive agriculture. Chronic water shortages occur particularly in the summer. Hence expansion of irrigation facilities and securing of a stable irrigation water supply is a basic condition to the development of highly productive farming in the area.

Although some limited irrigation by groundwater and earthen canals constructed by farmers is practiced in the area, it is concluded that construction of a large scale, economically viable irrigation system is essential for any significant improvement of farm productivity.

3.1.1 Location

The Study area is located in the upper catchment of the Ceyhan river, slightly in the southeast of the country. The said catchment area is situated at N. latitude 38°00'~38°45' and E. longitude 36°15'~37°45'. It is bordered on the north and east by the Euphrates river catchment area, on the west by the catchment of the Seyhan river, and on the south by the Taurus range.

The headwaters of the Ceyhan river flow from the Taurus range. The size of the upper catchment of the Ceyhan is 6,365km^2.

The Study area is at N. latitude 38°09'~38°25' and E. longitude 36°44'30~37°45'. It is partially undulating terrain generally ranging in elevation from 1,150~1,300m.

3.2 Natural Resources

3.2.1 Natural Environment

(1) Flora

Varieties and numbers are scant, due to overgrazing of sheep, and climatic and soil constraints.

a. Mountain

Vegetation in areas of limestone karst differs markedly from that in other areas of sediments rock and granite.

i. Limestone

Extremely sparse growth of conifers consisting of pine and cedar is present. A variety of willow and planted poplar are found in depressions. Short bushes of moorwort and rosaceae can be seen.

ii. Sediment Rock, Granite

Tall trees of spruce and pine are present, as well as a variety of willow. Planted forest of poplar is also found.

Pine has been widely planted. Seedling nursery for pine is located along the highway from Kahramanmaras to Goksun.

There is almost no undergrowth in pine forest. A variety of sycamore with deeply cleft leaf is numerous along roads; it is unclear whether the tree grows naturally or has been planted.

Compositae and gramineae growth is sparse.

b. Plain

Vegetation in both cultivated areas and wasteland is generally sparse. However, euphorbiaceae is relatively numerous due to its toxicity preventing consumption by sheep. Its red foliage in the fall makes it particularly distinctive even from a distance.

Grasses, compositae and labiatae are present.

(2) Fauna

Varieties and numbers are scant.

a. Mammals

Mole and field mouse are seen. Other mammals do not appear to be present in the Study area.

b. Fowl

Sighting of kite was made in mountainous area. Owl, gray in color, are seen in both scrubland and areas of limestone formation; however, numbers are small.

Jay is the most numerous medium sized fowl. Others are crow, and dove.

A brown kingfisher was seen along rivers. Other small fowl are wagtail, sparrow, skylark, wren and flycatcher.

c. Fish

In the various large springs, small trout are found and are used for food. Carp of 30cm length and roach of 7~8cm are present in rivers. Killifish are also seen.

3.2.2 Topography

In terms of geology, the Study area is located in the southern part to the Anatolia plate on which most of the Republic of Turkey is included. Roughly 50km to the south is the East Anatolia fault (EAF) bounding the Anatolia plate and the Arabian plate. The EAF is noted for being an active fault with earthquake. Geomorphologically, the fault line is characterized by elongated flatland with wide plains such as Malatya plain, Kahramanmaras plain, etc. on its northern side.

In short, the Project area is intra-mountain Quaternary sedimentary basin in the East Taurides in terms of geology, and intra-mountain flatland on the northern flank of the southeast Taurus mountains in terms of geomorphology.

Mountain and hydrologic systems are controlled by the distribution of formations of various geological age. Broadly speaking, an overall hydrologic system and mountain system arcing to the north is recognized. The smaller hydrologic system of each sedimentation basin converges into one flow upon exiting the basin.

The flow then enters the next basin, where it is further fed by additional tributary flows, and so on.

(1) Flatland

The area is collectively called the Afsin-Elbistan plain. Topographically and geologically it is divided into 3 flatlands (see Fig. 3.2-1). Below, these are referred to as (i) the northern basin (Collolar Havzasi), (ii) eastern basin (Elbistan Havzasi), and (iii) southern basin (Yazidere Havzasi).

a. Northern Basin

The basin is bounded on the northeast by a fault scarf, and on the north, west and south by low mountains. It is 20km long east~west, and 15km wide north~south. Mouth of the basin is between Kuskayasi and Dogankoy. The basin is adjacent to the eastern basin.

Lignite deposits (currently being mined) are located only at the southern edge of the basin. A feature of the basin is the presence of 6 distinct alluvial fan formations.

The most northern alluvial fan is formed by the Hurman river and topographically is considered to be the oldest.

The alluvial fan formed by the Hunu river flowing from the west and that formed by the Tekerlek river from the northeast are the largest in terms of area. Springs are found as well at the base of the fans and hamlets have developed nearby. Narrow alluvial plains are found along the rivers cutting through the fans. In both cases, fan boundaries are formed by sharp inclines of 5~10m height.

b. Eastern Basin

The mouth of the basin is located 5~6 kilometers to the west of Elbistan. It consists of terrace and narrow alluvial plain formed by rivers which converge in radial pattern on the mouth of the basin. At the east of Elbistan, the boundary between alluvial plain and terrace is marked by a 10m high cliff from which terrace gravel is quarried as construction material. Alluvial plain at the west of Elbistan is somewhat wider, and is utilized for cultivation of beet and rice.

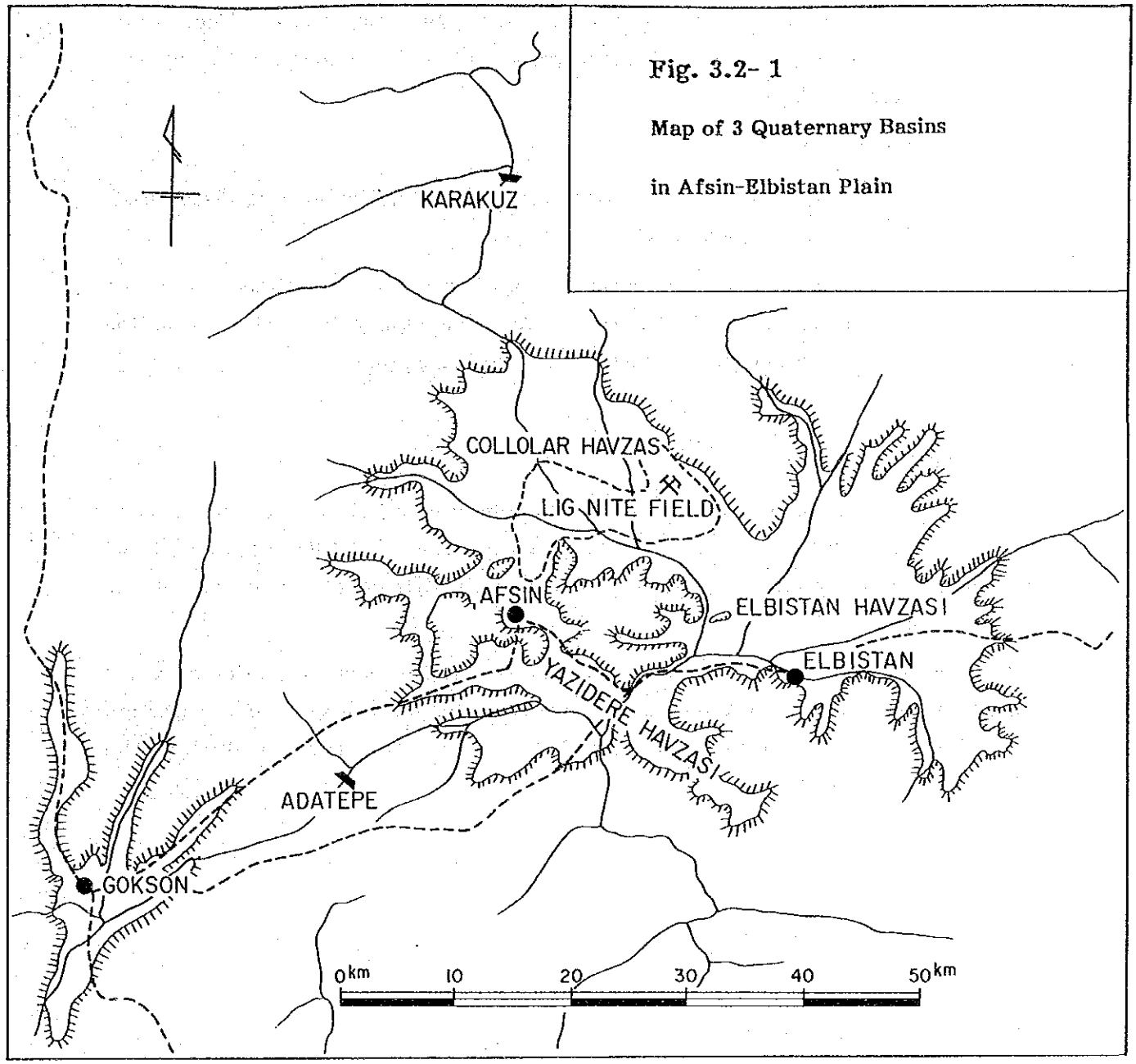


Fig. 3.2- 1

Map of 3 Quaternary Basins

in Afsin-Elbistan Plain

This lowland becomes marsh during the rainy season. The portion downstream of the large Izgin spring forms a large pond functioning as a retarding basin.

c. Southern Basin

This basin is a long, narrow flatland extending northwest~southeast. Width is 2~3km, and length is over 20km.

The mouth of the basin is located in the vicinity of the confluence of the Goksun and Ceyhan rivers. As in the case of the eastern basin, the area near the mouth is marsh, posing drainage problems.

(2) Mountain

The elevation of boundary between mountain area and flatland is (i) 1,350m at the north and 1,200m at the south of the northern basin, (ii) 1,300m at the east and 1,150m at the west of the eastern basin, and (iii) 1,150m at the center of the southern basin.

The east side of the Afsin-Elbistan plain is a 1,750~2,000m elevation erosional planation surface. The west side is a 1,750m elevation planation surface. These are old planational surfaces, considered to have been formed during the Pliocene~Pleistocene.

3.2.3 Meteorology and Hydrology

(1) General Meteorology

Weather observation in the Study area started in 1938 in Elbistan, and in Goksun and Afsin in 1953. Later, 8 precipitation stations were added. A total of 11 stations are in the area. General meteorology as recorded at Elbistan weather station is show in Table 3.2-1.

The Study area elevation ranges 1,150~1,300m. The plain is surrounded by mountains which are more than 2,000m in elevation. Extreme daily and annual changes in climate occur.

Area precipitation is 400mm year. Rainy and dry seasons are clearly defined. Precipitation in the dry season is extremely small, at only around 30mm for the 4 month period June to September.

Annual mean temperature is 10°C. Maximum temperature in the summer surpasses 30°C, and minimum temperature in the winter is below freezing. Consequently, precipitation in the winter is largely snow.

Annual mean humidity is 60%. Climate is particularly dry in the summer where humidity drops below 50%

Annual mean evaporation is 1,000mm at Göksun, 1,200mm at Adatepe and 1,600~1,800 at Elbistan.

Prevailing winds are from the northwest. Higher wind velocities occur during the summer.

As can be concluded from the above, the climate of the area is semi-arid, characterized by dry summers, and sub-freezing winters with snow accumulation.

Table 3.2-1 General Climate of Elbistan

Annual Precipitation		390 mm	Winds	Direction	North West
Average Temperature	Daily Max.	17.8 °C		Velocity	1.6 m / sec.
	Daily Mean	10.2 〃	Sunshine Hours		7.0 hours /day
	Daily Min.	3.0 〃	Evaporation		1,273 mm/year
Humidity		61.7 %			

(2) Hydrology

i) Precipitation

The rainfall pattern for the upper Ceyhan catchment including the Study area is indicated in Fig. 3.2-2. Rainfall ranges from slight to none during July to September. Duration of this dry period is generally 1~2 months, and at most 4 months. Rainfall exhibits one peak (peak - I) from the end of the dry season to December, and 1~2 peaks (peak - II) from January to the start of the dry season.

Rainfall is greatest in the western part of the catchment of the Ceyhan river at Goksun, with annual mean at 640mm and daily maximum rainfall at 85.4mm. The

rainfall patterns for Goksun and Cardak Afsin are similar. In eastern Elbistan, annual mean rainfall is 400mm. Although overall rainfall is greater in Elbistan, its pattern is similar to that of Gucuk.

Rainfall is least in Tanir in the north where average mean is 360mm. Although periods of rainfall are the same for Tanir and Akdere, patterns are different in that when rainfall is heavy at the former, it is light at the latter, and vice versa.

ii) River Discharge

Fluctuation in monthly discharge for 1976~87 at stations 2009 and 2006 on the Goksun river, 2005 on the Ceyhan river, 2007 and 2017 on the Hurman river and 2022 on the Sogutlu river is indicated in Fig. 3.2-3. Catchment area at the station on the Sogutlu river is small at 430km^2, and base discharge for the 6 month period from the end of the rainy season to January is small.

iii) Groundwater

DSI has carried out continuous survey to determine groundwater reserves throughout Turkey. In addition to these, land and water use cooperatives have carried out independent surveys. On the basis of survey results as of 1985, irrigation of 600,000 ha is judged to be irrigable using groundwater. At present, about 350,000 ha are irrigated throughout Turkey by groundwater. Areas of groundwater presence in the Study Area can be broadly divided into 3 sectors.

These are (A) Cobanbeyli area in north Afsin, (B) lignite mine area and (C) Aklayir to the east of Elbistan.

① Area A (Cobanbeyli)

Including the sectors of a) Aritas, b) Tanir and c) Cobanbeyli, Area A contains 16 wells (3 discharge fissure water). All the wells are under the jurisdiction of the General Directorate of Village Services, and provide discharge for irrigation.

② Area B (lignite mine)

Hydraulic features for this area are unclear due to insufficient boring data. Pump up amount is as described below.

In order to dewater for excavation in the open pit mine currently in operation, 14 wells (140m~250m depth) have been drilled in the limestone of the Mesozoic forming the hills at the east, and 250 wells in the Quaternary formation on the flatland.

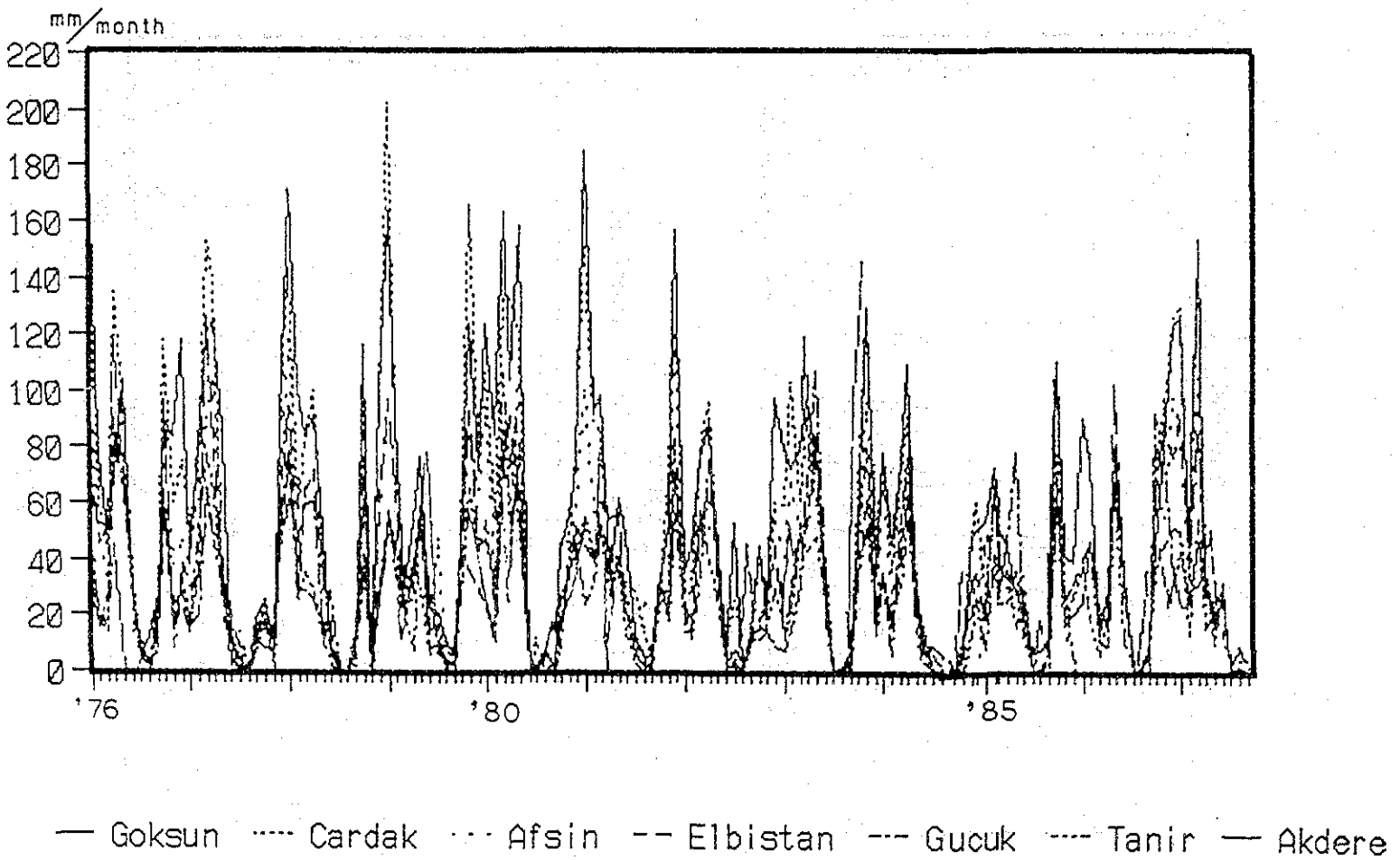


Fig. 3.2- 2 Rainfall Data 1976-87

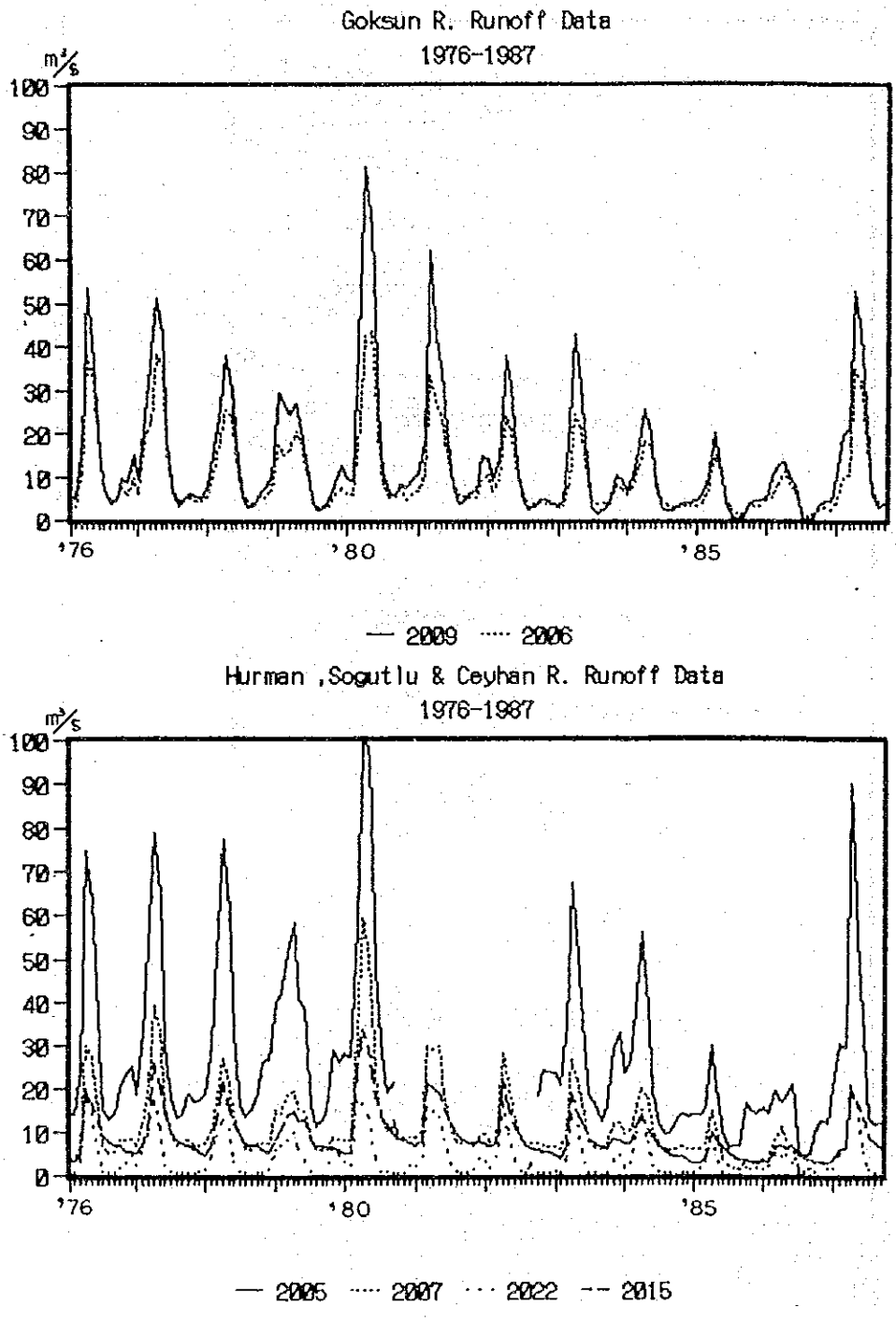


Fig. 3.2- 3 Discharge Data of Goksun and Ceyhan Rivers

A monthly mean of $2.04 \times 10^6 m^3$ ($0.787 \times 24.5 \times 10^6$ / year) is pumped from the limestone adjacent by fault to the Quaternary formation.

③ Area C (Aklayir) (see Table 3.2.3)

There are 8 wells in this area under the jurisdiction of the General Directorate of Village Services, which provide discharge for irrigation. There are also 33 private wells (Dogankoy~Bu Yapalak, etc.) utilized for irrigation.

On the basis of survey to date, the sectors of groundwater presence in the Study area are considered to be independent systems. Also, water balance calculations on the basis of findings during the first phase field survey indicate that recharge into and outflow from the aquifers is roughly in balance.

Accordingly, it is not recommended that groundwater in the Study area be developed for irrigation as this would upset the delicate aquifer balance indicated above.

Table 3.2-2 Transmissivity, Specific Discharge and Pumping Rate of Each Bore-hole

(Area A)

District	Bore-hole No	Transmissivity m^3/day/m	Specific discharge ℓ/sec/m	Pumping rate ℓ/sec	Note
Tanir	25176	175	0.85	18.0	M
〃	25177	47.4	0.32	6.0	
〃	25178	88	2.15	28.0	
〃	21005	395	2.80	30.0	
Cobanbeyli	30777	1409	1.63	44.6	P
Aritaş	36330	1424	2.90	54.0	
Arastirma	32918	1360	15.00	60.2	
Cobanbeyli	30774	1809	1.13	45.8	Pli
〃	30775	922	8.00	70.0	
〃	30776	2282	8.20	50.5	
Aritaş	33253	434	1.34	35.7	
〃	33260	737	5.20	36.0	
〃	33261	422	2.20	40.1	

Note : M ... Aquifer of Mesozoic limestone
P ... Aquifer of Paleozoic limestone
Pli . Aquifer of Pliocene Conglomerate

Table 3.2-3 Transmissivity, Specific Discharge and Pumping Rate of Each Bore-hole

(Area C)

District	Bore-hole No	Transmissivity m^3/day/m	Specific discharge ℓ/sec/m	Pumping rate ℓ/sec	Note
Aklayir	5323	-	3.64	17.7	M
	26728	860	4.47	43.5	
	26729	367	1.90	30.2	
	26730	624	9.00	55.2	
	26731	247	2.73	26.5	
	32919	940	13.53	35.7	
Demircilir	32920	2785	6.50	52.8	
	5324	486	12.88	14.3	
Dögon-B. yapalak	33 holes			mean 20.0	Pli -Qu

Note : M ... Aquifer of Mesozoic limestone
Pli . Aquifer of Pliocene Quaternary

3.2.4 Geology

(1) General (refer to Appendix II · Plate II-5: Geological Map of Afsin-Elbistan Geology)

The basement rocks forming mountain in the Study area can be divided into the following four (4) major units.

- Paleozoic sedimentary rock series
- Mesozoic sedimentary series
- Mesozoic ophiolite series
- Mesozoic granitoids

The flat land is mainly composed of Quaternary sediments which can be grouped into following three (3) units.

- Lake sediments
- Fan and terrace sediments
- Alluvial sediments

As shown in Fig.3.2-4, zones of basement rock units form large arcs fronting to the north.

Paleozoic and Mesozoic sedimentary rock series contain considerable portion of limestone resulting in steep rocky mountains. Beds of sericite-graphite schist are intercalated in the Paleozoic sequence.

Ophiolite series is composed of basic rocks such as peridotite, gabbro, basalt and fine grain sediments. A large thrust of Paleozoic limestone is at the north, while a thrust of Mesozoic limestone body is at the south.

Ophiolite series are overlaid by large thrusts causing intensive shattering of basic rocks and localized serpentinization. As a result, topography of the zone of ophiolite is low and gently rolling terrain.

The Afsin-Elbistan plain, principally formed by Quaternary sediments, can be sub-divided into three (3) small sedimentary basins. Thickest sedimentation is deposited around the mouth at the downstream side of each basin where carbonaceous sediments such as peat and lignite are found.

(2) Dam and Canal Sites

1) Dam Site (see Appendix II · Plate II-1)

The Adatepe dam site is located on periodotite formation. Foundation consists of dunite and gabbro (belonging to the dunite group), overlain by a relatively thin layer of talus and river sediments.

Dunite and gabbro exhibit heavy cracking in portions due to weathering. This cracking is grouped into 4 stages on the test boring log.

RQD values are 0 to 10~15 m depth on slopes, indicating heavy fracturing. However, values are 50~100% at greater depth, suggesting good foundation.

However, it should be noted that highly permeable rock is present despite good core recovery, as can be seen from the results of boring at SK 102 , and SK 104.

The saddle dam is planned on deeply weathered granodiorite. Surface of the granodiorite is highly weathered, and classified as sand on the DSI 1:25,000 geological map. Test boring at 8 holes was conducted on the ridge.

On this basis, DSI concludes that the depth of highly weathered zone at each test boring extends to about 10m depth. Restudy of cores by the Team,

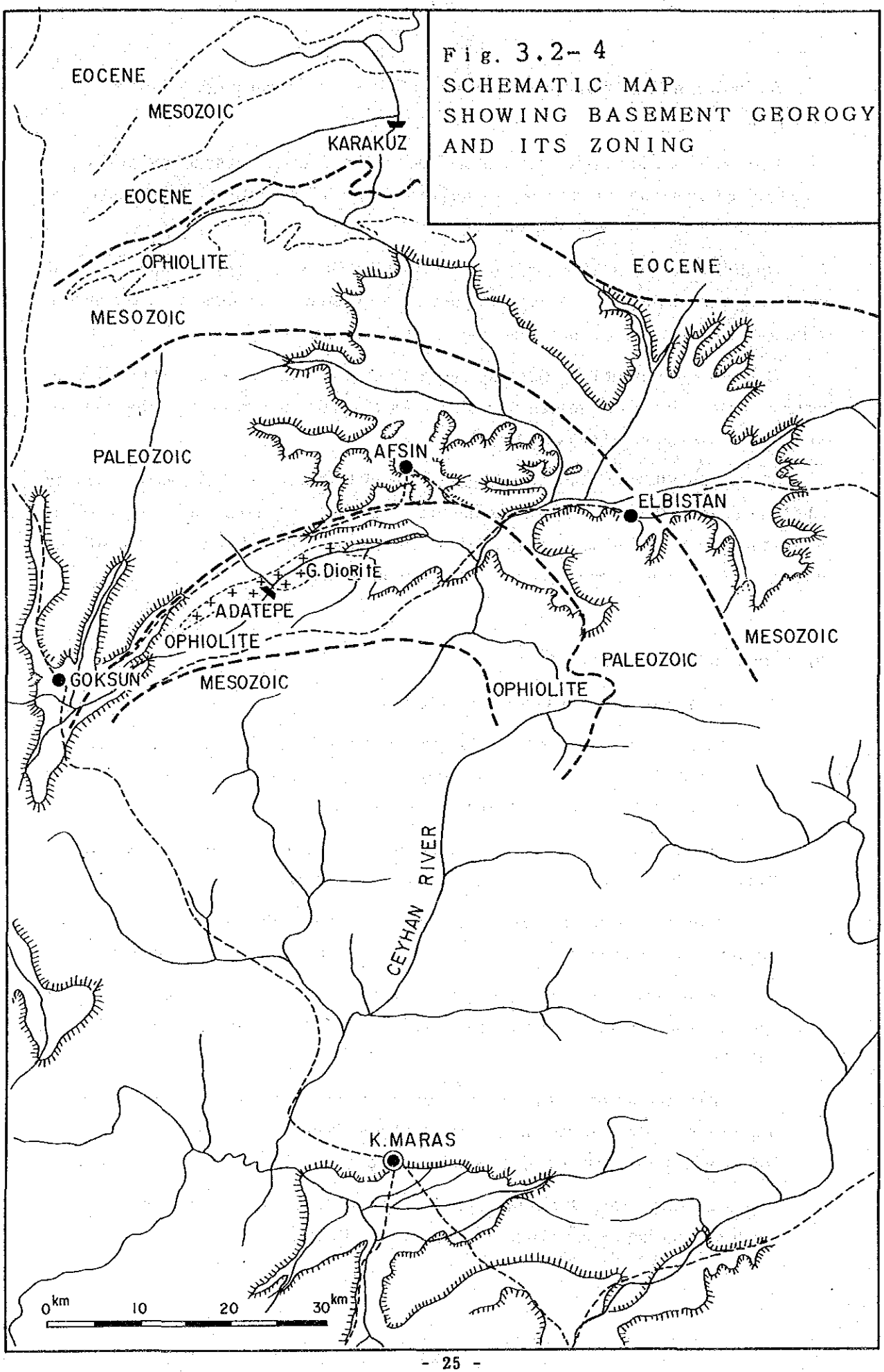


Fig. 3.2-4
SCHEMATIC MAP
SHOWING BASEMENT GEOROGY
AND ITS ZONING

however, indicates that heavy weathering extends to a depth of around 30m between DSK 3 and DSK 5, and to about 15m to the west from DSK 2. Rock is so weathered that it can be broken by finger. As a result, additional test boring at six points and seismic prospecting along 7 lines (total length: 1,760 m) was performed at the saddle dam site during the 2nd phase field survey.

Results of seismic prospecting at the saddle dam site are shown in Table 3.2-4 and Appendix II · Plate II-4.

Table 3.2-4 Seismic Wave Velocity and Geology

Line	Length	Seismic Wave Velocity		
		1st layer	2nd layer	3rd layer
1	130m	1000~1200 35m (thickness) weathered granodiorite	1400 20m gabbro~peridotite	2900~3800 26~28m granodiorite
2	300	700 10~20m weathered granodiorite	1225 22m weathered granodiorite	3725 granodiorite
3	310	915 20~21m weathered granodiorite	1950 12~19m weathered granodiorite	3800 33~38m granodiorite
4	200	Record unclear		
5	260	900~1150 8~12m weathered granodiorite	2000~2100 23~30m weathered granodiorite	3500~6000 32~42m granodiorite
6	310	950 11~13m weathered granodiorite	1450 29m gabbro~peridotite	3750 35~40m granodiorite
7	250	900 12~15m weathered granodiorite	1925 15~32m weathered granodiorite	3900 30~43m granodiorite

This results indicate a velocity of 2900~6000 m/s for Mesozoic ophiolite and granitics. Cores indicate hard foundation with little cracking.

Velocity in the weathered zone suggests 2 layers. The upper layer consist of weathered soil and upper zone of weathered rock, and has a velocity of 700~1150 m/s. It exhibits powdery decomposition due to weathering with partial presence of granodiorite gravels. On the other hand, the lower layer is a weathered zone with velocity of 1225~2100 m/s. Heavy fracturing is present as a result of weathering, with argillization partially occurring along fractures.

Total thickness of weathered zone in 30~40 m. Results of test boring indicate extremely high permeability in portions, with Lu value of over 25. However, in unweathered zone, Lu value is a low 5 or less.

With the exception of SSK-9 and SSK-10, RQD values for boring during the second phase survey are over 50% to over 20 m depth, indicating good foundation.

At SSK-9, RQD value is very bad to 25~33m depth, and foundation is weathered rock with heavy fracturing. Nearby DSK-3 shows a similar trend to 15~35 m depth. RQD at SSK-10 is less than 50% to 23~40 m depth, indicating poor foundation.

It will thus be necessary to formulate a saddle dam design and construction method which take into consideration the above.

2) Intake Tunnel and Major Structures

During the 2nd stage survey, trench survey was undertaken along the design route for the diversion tunnel form Adatepe dam, and at the 2 sites for planned headworks (Kargabuku and Hurman). Results of this survey are described below.

a. Diversion Tunnel (1.3 km in length from the diversion tower)

Tunnel alignment passes in the vicinity of the boundary between granodiorite and altered basalt. The trench at DSK-6 indicates that this boundary is the result of intrusion rather than faulting, and consequently the edge portion of neither formation requires special consideration.

Test boring indicates a groundwater level of EL 1310 around the saddle dam axis, and EL 1286 at SSK-12. Accordingly, countermeasures

are necessary for the groundwater emergence that would be anticipated during excavation for the diversion tunnel (EL 1265m).

b. Kargabuku Headworks

Granodiorite is distributed on both banks at the site. Alluvium has formed a narrow flatland along the Goksun river. A 2.5 deep trench was excavated, which indicated that alluvium consists mainly of sand and gravel. Water emergence in the trench below at greater depth permitted identification of deeper formation. However, judging from the general vicinity, sediment layer is expected to extend to 40~50 m depth.

Foundation bearing strength (N-value) is estimated at at least 30. On the basis of the above, no major problem is anticipated for construction of headworks at the site.

c. Hurman Headworks

Limestone and schist is distributed on the left bank of the Hurman river, and Quaternary alluvium is widely distributed on the right bank.

One trench excavation was made on each bank to about 2.5 m depth. At the left bank, limestone was seen below 2m depth. Sand and gravel was seen at the right bank trench. In terms of foundation bearing capacity, no major problem is anticipated for construction of headworks at the site. However, countermeasure(s) for seepage must be considered.

3.2.5 Soil and Land Classification

Major survey components are as follows:

(unit : locations)

	1st Stage	2nd Stage	Total
① Trench survey (Adatepe and Karakuz)	17	11	28
② Augur hole survey	0	6	6
③ Chemical and physical analysis	9	36	45
④ Saline contamination (near Elbistan)	0	2	2
⑤ Land classification			
⑥ Water quality analysis	12	13	25

Location of survey sites are given in Fig. 3.2-5; details are given in Appendix IV · Table IV-1. On the basis of the above survey and analysis of existing data, it was revealed that precise soil survey has been conducted in the Study area by Turkish engineers since 1960's and the results have enough accuracy to be utilized for land use planning of the Project.

3.2.5-1 Soil

(1) Trench Survey

Details of soil cross-section are given in Appendix IV · Table IV-2.

As a result of trench survey, the following findings were made with regards to soil in Afsin-Elbistan.

① Surface gravel (less than 30 cm) and stone distribute over a considerable area, especially at the foot of limestone mountains.

② Shallow soil distribute over a considerable area, especially at somewhat steeply undulating and rolling terrain area.

③ In the Study area, mechanized cultivation is observed in cultivated area. However, the cultivated depth is generally shallow, from 10 cm to 20 cm.

④ Hard pan which may be caused by machine cultivation distributes over the whole area.

⑤ Clayey soil is dominant.

⑥ The soil layer at the alluvial plain along the Goksun, Hurman and Sogutlu rivers are clayey and thick.

(2) Soil Classification

The Turkish government has compiled a soil map (Fig. 3.2-6) and explanatory text for every province, as one index showing the potentiality for farm land development. The soil map (1:25000 scale) of the Kahramanmaras province was published in 1973 and revised in 1985.

Soil classification in Turkey is carried out under the Turkish classification standard. The soils in and around the Project area are classified as follows, according to this classification.

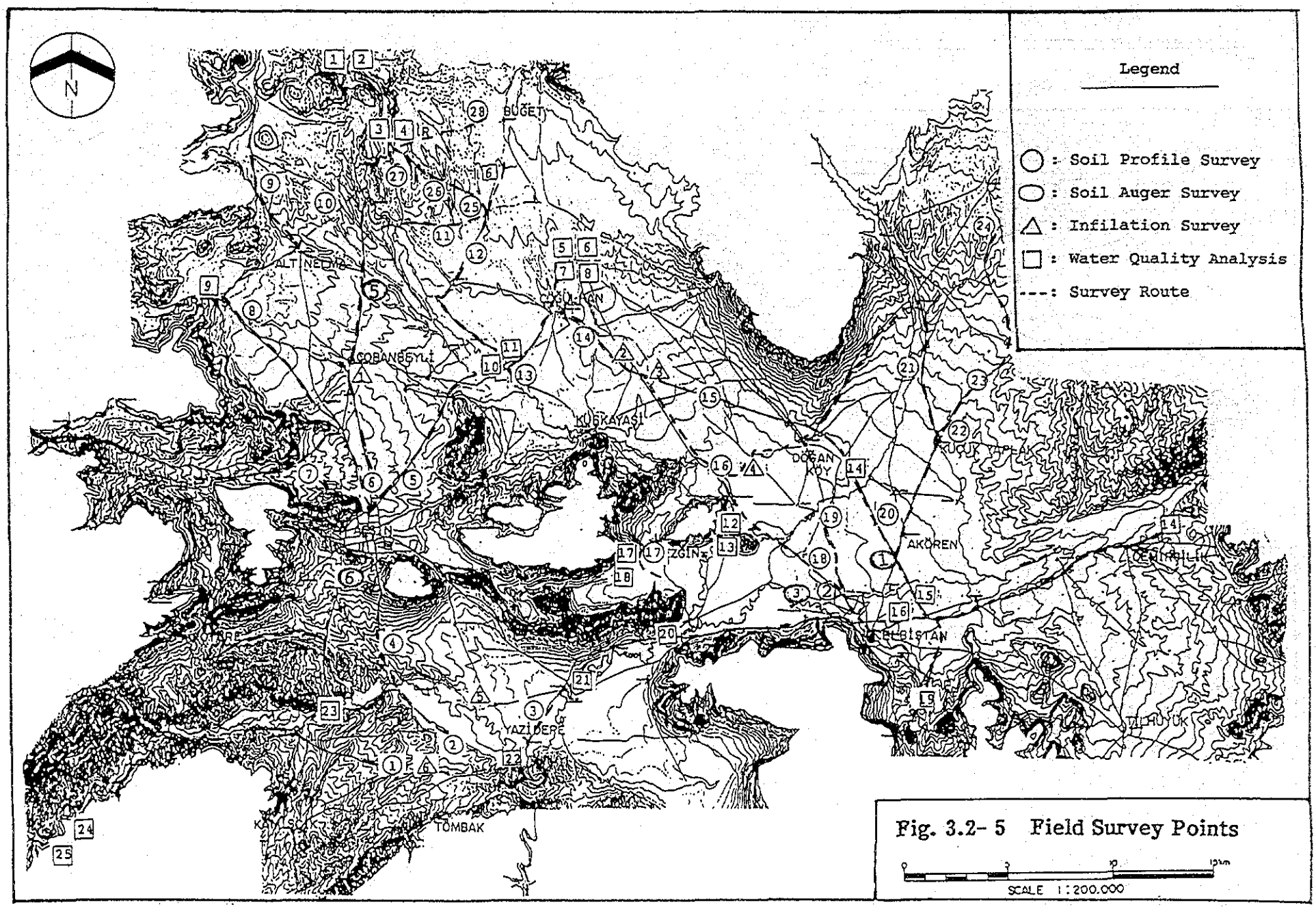


Fig. 3.2- 5 Field Survey Points

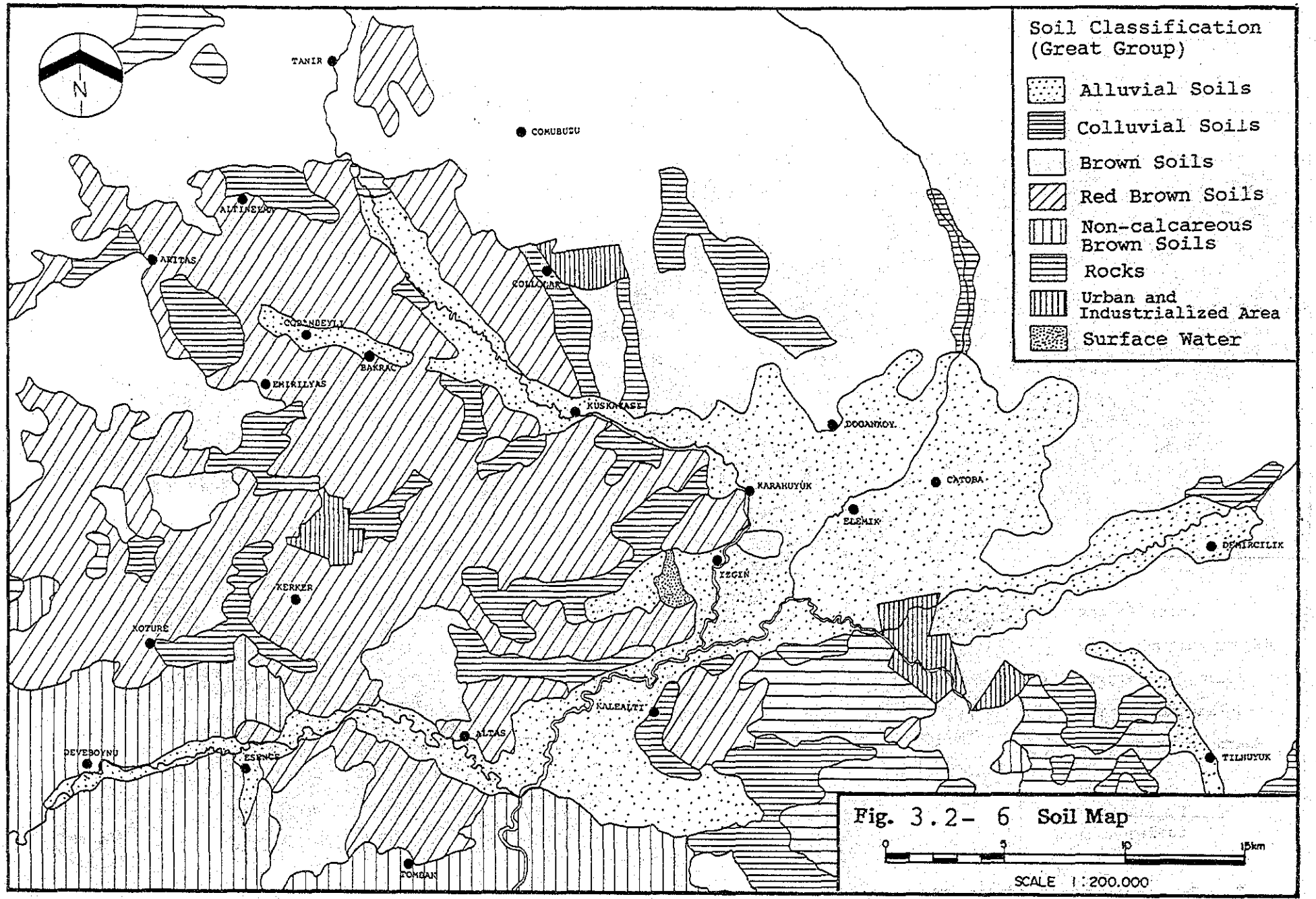


Fig. 3.2- 6 Soil Map

a) Alluvial soil (aluvyal topraklar)

b) Colluvial soil (koluvyal topraklar)

c) Brown soil (kahverengi topraklar)

d) Red brown soil (kirmizi kahverengi topraklar)

e) Lime free brown soil (kirecsiz kahverengi topraklar)

Characteristics of these soils are given in Appendix IV · IV-1.

(3) Chemical and Physical Analysis

Chemical and physical analysis was carried out for understanding of general soil fertility. The analysis was carried out on the nine samples collected at the first stage work and on the 34 samples collected through this field survey. Certain results of the analysis carried out and compiled by DSI were also checked. Analytical items by the Study Team included the following:

a) pH, electric conductivity, salt content

b) cation exchange capacity (CEC)

c) exchangeable cations (exch. Na, exch. K, exch. Ca+Mg)

d) soluble cation and anion (Na, K, Ca+Mg, Cl, CO_3, HCO_3)

e) mechanical analysis, bulk density

In view of soil fertility, CEC value showed medium to very high ranging from 17.38 to 53.04 me/100 g and CEC was almost saturated by Ca and Mg. Study suggests that soil fertility is relatively high. The values of pH were almost all 7.5 to 7.8, showing high value. Organic contents were low, ranging from 1 to 2%. The result of those data suggests that the effectiveness of fertilizer application will be high.

Sodium Absorption Ratio (SAR) however showed a very low value (ESP = 0.01 ~ 0.02%). Contents of soluble sodium and chloride ranged from 0.01 to 0.06 and 0.05 to 0.13 me/100 g, respectively. These data suggest that no salt accumulation has occurred in spite of a long cultivation period.

In terms of physical characteristics, almost all the samples taken in the Study area are classified as clayey, confirming the accuracy of test trench survey results. Natural moisture rate is 10~20%.

Details of the above described chemical and physical analysis are given in Appendix IV · Table IV-3.

(4) Saline Contamination

The Land Classification Report for Planning of Elbistan-Afsin, 1963 suggests that there is a salt contaminated area northwest of Elbistan city. The area is about 92 ha. According to the report, land classification of that area is 5D (3s/G31X h3a)wo. pH, saline concentration and grain analysis for each soil layer are given below.

Table 3.2-5 Salt Affected Area (Profile No. 252)

Depth (cm)	0 - 30	30 - 60	60 - 90	90 - 120	120 - 150
pH	7.8	8.6	8.4	8.4	8.4
Salt (%)	0.878	1.670	2.485	1.485	1.485
Grain Analysis	Clayey	Clayey	Heavy clayey	Heavy clayey	Loam

Source: Land Classification Report for Planning of Elbistan-Afsin Plain, 1963

The Team carried out survey of the area classified as 3sd/G32X h3a3o, which adjoins the above described 5D classification area. Results of the Team's survey were compared with the results of the survey performed 26 years ago, and change in soil characteristics and the need for soil improvement were studied. 2 samples were taken from the area and analysed in terms of pH, EC and granularity. Results are shown in Table 3.2-6.

As a result of comparative study, it was seen that the saline concentration in the samples recovered by the Team (0.43% for sample-1 and 0.45% for sample-2) showed a marked decrease in saline accumulation compared with the findings of survey 26 years ago. In that survey, saline concentration in each layer was identified at 0.88~2.49% for each layer.

This appears attributable to the construction of river training works in the vicinity of Elbistan which has reduced surface water accumulation in the area. This in turn has suppressed saline accumulation in the soil, and the subsequent cleansing action of precipitation has reduced the salt content. Low yield wheat cultivation is currently practiced in the area.

Table 3.2-6 Analytical Result of Collected Samples

Depth (cm)	0 - 30	30 - 60	60 - 90	90 - 120
Sample-1	Class 3sd/G32X h3a3o			
pH	7.8	8.5	8.2	7.9
Salt %	0.425	0.175	0.155	0.085
Grain analysis	--	--	--	--
Sample-2	Class 5S (3std/G33X h3)			
pH	7.8	7.8	7.7	7.6
Salt %	0.200	0.450	0.020	0.120
Grain analysis	Clayey	Clayey	--	--

No saline prevention measures for the subject sector are considered necessary at this point. The natural cleansing by precipitation and future soil improvement through irrigation are considered sufficient.

3.2.5-2 Soil Classification

The soil classification by DSI is based on the USBR (the United States Department of Interior, Bureau of Reclamation) standard with minor changes (including adoption of Turkish words for classification nomenclature) and/or adjustment in the classification to fit the country. As DSI is primarily concerned with irrigation, the agency's survey focuses on topography, layer depth, gravel content, drainage, moisture retention, soil characteristics, etc., and largely ignores such factors as soil fertility.

At the planning level, topomapping of 1:25000 is used as the control map and auger test is utilized to draw up the soil classification map. Aerophoto interpretation is also conducted for locations where aerophotos are available.

In the Afsin-Elbistan plain, the total irrigable area up to Class 5 was measured at 99,809 ha by DSI in 1963. During the said survey, trenching survey was conducted for every 50 ha in 1,800 places. Detail survey including permeability, salinity, and groundwater level has been conducted and some revisions have been made by photo-interpretation. On the basis of cross check with topography in the field during the

first stage field survey and the results of trenching survey by the Team, it is concluded that this data will suffice for land classification in the Study area.

Areas on a classification-wise basis are shown in Table 3.2-7. The land classification map is given in Fig. 3.2-7. Soil classifications according to DSI for the targeted irrigation area are shown in Table 3.2-8.

Soil features which can be gleaned from the land classification map are summarized as follows:

① Clayey soil is predominant.

② Surface layer gravel is widely seen in the area, particularly at the foot of mountains and in undulating terrain.

③ Soil pH ranges from slight alkaline to weak alkaline (pH 7.0~8.5).

④ Saline contamination is not evident.

The following information has been obtained from the Land Classification Report for Planning of Elbistan Afsin Plain:

① Wash-off of top soil is observed in and around Colhan, Sinekli and Karagoz villages.

② Shallow groundwater levels less than 150 cm, have been widely observed in the following areas:

- along the Hurman river between Hurman village and Kuskayasi village
- flat land, south of Karhuyuk and west of Elemik
- around the confluence of the Goksun and Ceyhan rivers

③ Groundwater quality is classified as C3 S1 of the United States Department of Agriculture classification for irrigation water.

Table 3.2-7 Current Land Classification

Land Classification	Area (ha)
Class 1	854
Class 2	24,329
Class 3	14,236
Class 4	2,838
Class 5	1,773
Arable land	44,030
Class 6	1,035
Village	264
Total	45,329

Table 3.2-8 Soil Classification (DSI)

Soil Classification	Area (ha)	%
h/h	31,781	71.84
h/hb	5,038	11.39
h/b	545	1.23
h/hk	1,452	3.28
h/k	889	2.01
h/L	53	0.12
h/m	1,825	4.13
L/v	46	0.10
L/h	47	0.11
L/k	27	0.06
L/L	86	0.19
m/h	971	2.20
m/k	160	0.36
m/L	38	0.09
m/m	1,241	2.81
m/v	36	0.08
Subtotal	44,235	100.00
Class 1~Class 5		
Class 6	1,049	
Village*	264	
Total area	45,548 ha	

* excludes Afsin and Elbistan towns

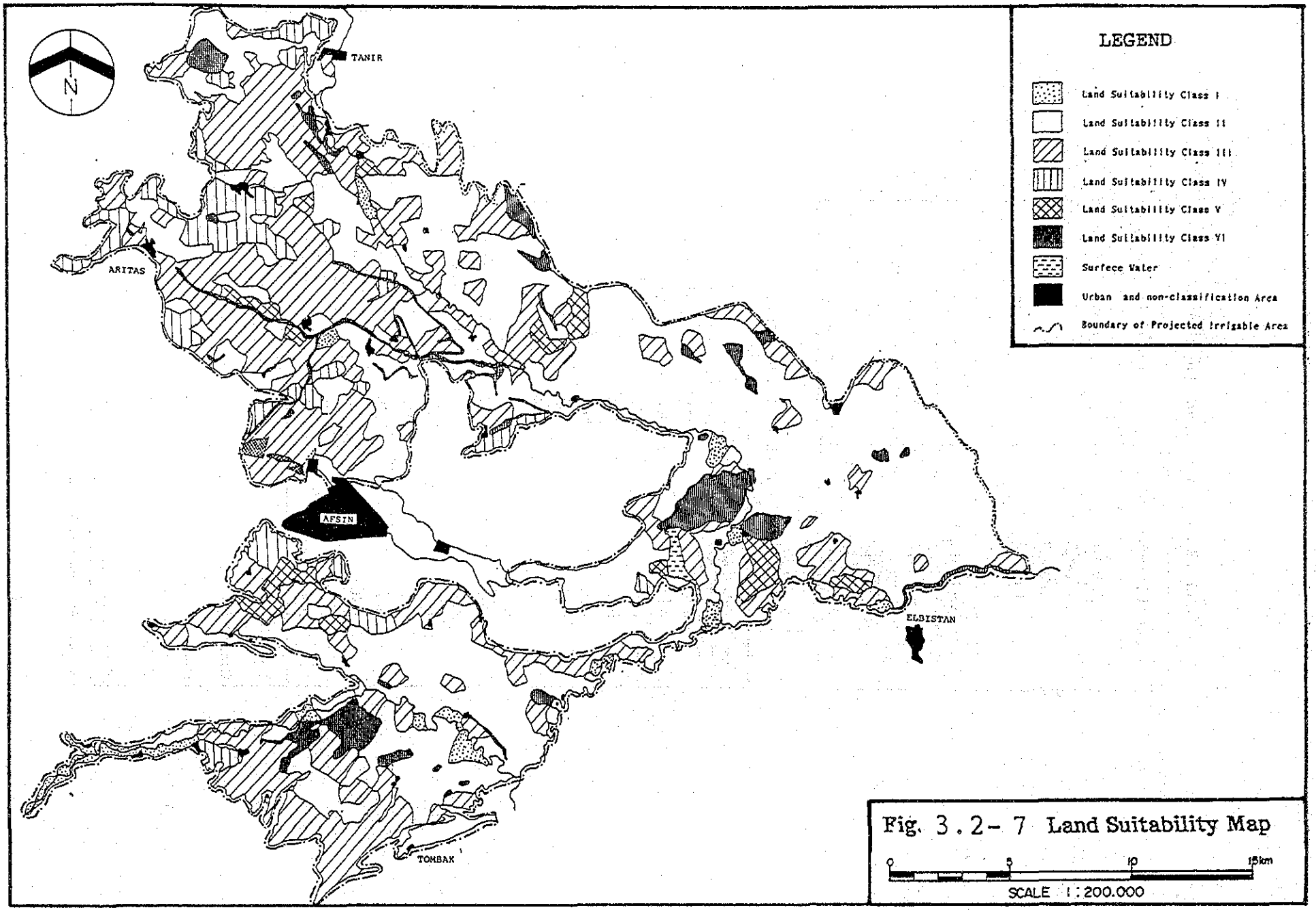


Fig. 3.2-7 Land Suitability Map

3.2.5-3 Soil Constraints

As discussed above, the soil in the Study area is suitable for the development envisaged under the Project. However, the following potential constraints illustrated in the DSI land classification map were studied from the viewpoint of the land use plan, and the countermeasures discussed below were considered.

① Topographical dip

② Soil layer thickness

③ Presence of groundwater, surface water stagnation

④ Saline contamination

Constraints in ① and ② must be addressed through selection of cropping method and type of crop.

Constraint in ③ will be effectively addressed by the river training works on the Sogutlu, Ceyhan and Hurman rivers. A sector (135 ha) of slightly high groundwater level is identified at the lower Goksun, but this can be adequately countered through appropriate crop selection.

The natural cleansing effect of precipitation will effectively counter the constraint in ④, as discussed previously.

However, the Team's survey in stages 1 and 2 revealed sectors with large amounts of surface layer gravel, as well as sectors requiring leveling works (Table 3.2-9).

Table 3.2-9 Land Improvement

	Class	Amount	Area
Removal of surface gravel	Class 1	0 - 100m³/ha	3,172
	Class 2	100 - 250m³/ha	1,361
	Class 3	250 - 450m³/ha	750
Land leveling	Class 1	0 - 500m³/ha	2,638
	Class 2	500 - 1,000m³/ha	673
	Class 3	1,000 - 1,500m3/ha	206

Of, these Class 2 and Class 3 areas (2,990 ha) will require improvement under the Project. As land conditions for Class 1 are relatively good, individual efforts by the farmers acting on their own where necessary will be sufficient.

Accordingly, cost for gravel removal is estimated at TL 350 million and land leveling works at TL 270 million. Details are given in Appendix-IV · IV-4.

Land classification after improvement works under the Project is given below.

Table 3.2-10 Land Classification After Soil Improvement

Land Classification	Area (ha)
Class 1	897
Class 2	25,830
Class 3	13,681
Class 4	2,838
Class 5	784
Arable area	44,030
Class 6	1,035
Village	264
Total area	45,329

Class 5 is poorly drained area. However, soil classification is expected to improve with river improvement works (separate project).

3.2.6 Land Use

In 1975, the General Directorate of Village Service of Ministry of Agriculture, Forestry & Rural Affairs conducted a nationwide survey of land use. Data for the Study area was revised in 1985.

According to the survey, land use in the area is classified into the following 10 categories. Land use is illustrated in Fig. 3.2-8.

S: Mainly irrigated farm land with sufficient water

Sy: Mainly irrigated farm land without sufficient water

M: Pasture (mainly natural vegetation as opposed to cultivated pasture)

K: Non-irrigated farm land with rotational cropping including fallow

N: Non-irrigated farm land with rotational cropping not including fallow

V: Grape vineyard

O: Forestry product area (cultivation of large trees for lumber production)

F: Scrub brush (natural vegetation utilizable for fuel wood)

C: Swamp

T: Exposed rock (no vegetation)

Current land use in the Project area is shown in Table 3.2-11

Table 3.2-11 Land Use in the Project Area

Land Use	Area (ha)
Irrigated Area* (Sufficient Water)	17,493
Irrigated Area* (Not Sufficient Water)	3,901
Non-Irrigated Area and Fallow	20,110
Vineyard	532
Grass Field	1,994
Total	44,030

*Note : Area with " * " does not mean that the whole area given in the Table is irrigated. It means that irrigation is markedly observed in that area.

The main 4 types of land use can be summarized as follows:

1. Irrigated farm land is found mainly along the middle and lower catchment of the principal rivers in the area (Goksun, Hurman, Sarsap and Sogutlu). Irrigation by groundwater from limestone formation is also practiced in northern Afşin.

2. Non-irrigated farm land is found on gently dipping (alluvial fan, hilly areas) and mountainous terrain at the periphery of the Afsin-Elbistan plain.

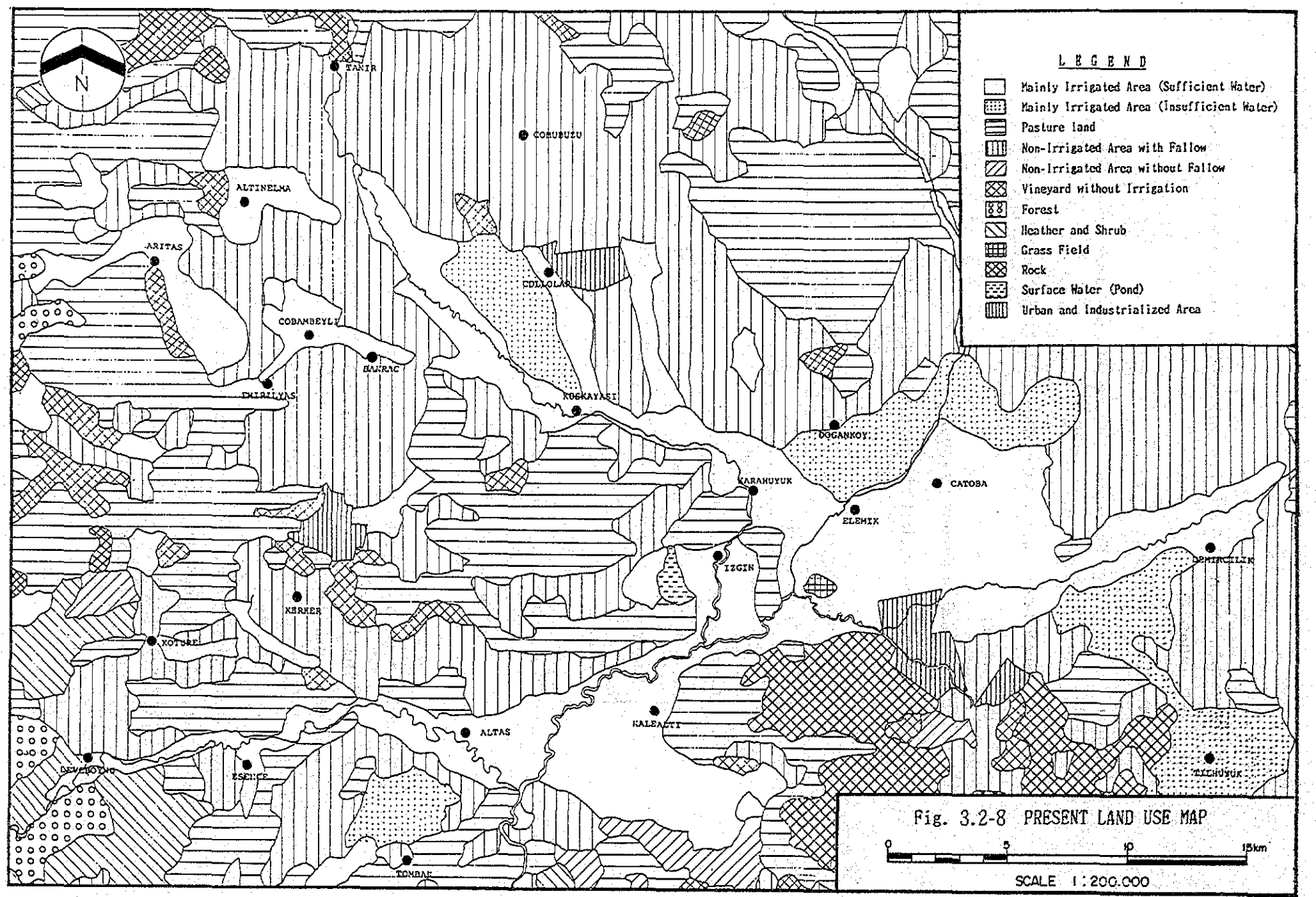


Fig. 3.2-8 PRESENT LAND USE MAP

3. Vineyard is found in the vicinity of Afsin city and on mountain slopes in northern Afsin.

4. Pasture is found on steep mountain slopes and a portion of poorly drained land.

3.2.7 Current Water Use

Base industries in the Study area are crop cultivation and animal husbandry. A secondary industry is lignite mining in adjacent area to supply the thermal generating plant in the north of the area. Also, there is a sugar plant at the south of the area which processes sugar beet cultivated in the area. Production of other various goods on an extremely minor, cottage industry scale is also seen in the area.

Accordingly, the bulk of water use in the area is for agriculture and domestic purposes. Diversion is by extremely simple intake facilities along the Ceyhan and its tributaries. Small scale use is also made of spring discharge and groundwater.

Domestic water is obtained primarily from springs. Most small towns and villages are located near springs. Shallows in rivers and wet areas caused by spring discharge are used for laundry and livestock watering. Accordingly, it will be necessary in the future to maintain river discharge.

In addition, discharge in the area is also utilized for furnace cooling at the aforementioned generating plant, and for washing sugar beets at the sugar plant.

With future population increase, improvement in living standards and introduction of other industries into the area, a change in the current water use pattern is possible.

3.2.8 Water Quality

During the Survey, 25 samples were collected and analyzed at the laboratory of DSI 20 in Kahramanmaras using the instruments newly donated by JICA. Results were compared with existing data.

The evaluation of water quality in Turkey is based on the USDA standard. This standard, being used widely in the world, is based on classification by electric conductivity (μS/cm) and sodium absorption ratio derived by the following formula:

EC (C) and SAR (S) are divided into 4 classes for evaluation of water quality.

Results of the assay can be summarized as follows:

$$SAR = \frac{(Na)}{\sqrt{(Ca+Mg)/2}} \quad \text{(unit: me/l)}$$

(1) EC varies from 250 to 400 μS/cm

(2) SAR of all samples are less than 1

As can be seen from the above figure, all samples are classified under the USDA system as C_1-S_1 or C_2-S_2, good for irrigation water. In particular, SAR is extremely low. (Table 3.2-12)

Analysis of data obtained from DSI during the 2nd stage survey supported the conclusions drawn at the end of the 1st stage survey with regards to water quality. (see Table 3.12-13).

According to the FAO report, EC value below 750 μS/cm and SAR value under 3 generally are not toxic for crops (see Table 3.2-14). Survey results show these values for the Study area to be within the above described range.

Table 3.2-14 Water Quality Classification by FAO

		None	Moderate	Heavy
Salinity	ECw(mmho/cm)	<0.75	0.75~3.0	>3.0
Permiability by SAR	ECw(mmho/cm)	<0.5	0.5~0.2	>0.2
	Montmollionite	<6	6~9	>9
	Illite	<8	8~16	>16
	Kaoline deposits	<16	16~24	>24
Toxicity (none for most trees and crops)				
	Sodium (by SAR)	<3	3~9	>9
	Chloride (me/l)*	<4	4~9	>10
	Boron (mg/l)	<0.75	0.75~2	>2

* Can cause leaf burn when applied by sprinkler, if more than 3 me/l

On the basis of the above water quality survey, it is concluded that river water in the Study area poses no problem as an irrigation source in terms of quality.

Table 3.2-12 Results of Water Analysis

Sample No.	Sample Name	Sampling Date	pH	EC (μ S/cm)	Cation (me/l) Na	K	Ca	Anios (me/l) SO4	NO3-N	NH4	SAR	Class (USDA)
1	Hurman Riv. (Karakuz)	Oct.1988	8.1	313	0.05	0.01	2.50	n.d.	0.05	Trace	0.04	C2-S1
2	Hurman Riv.(Kesirlik)	Jul.1989	7.1	483	0.20	0.02	0.95	0.32	Trace	Trace	0.29	C2-S1
3	Tanir Spring	Oct.1988	8.0	274	0.13	0.01	2.90	n.d.	1.94	Trace	0.11	C2-S1
4	Tanir Spring	Jul.1989	8.8	385	0.04	0.01	0.95	0.00	Trace	Trace	0.06	C2-S1
5	TEK(Limestone)	Oct.1988	8.2	240	0.04	0.01	2.10	n.d.	0.34	Trace	0.04	C1-S1
6	TEK(Limestone)	Jul.1989	8.4	415	0.07	0.01	0.95	0.06	Trace	Trace	0.10	C2-S1
7	TEK(Quartenary)	Oct.1988	7.9	387	0.04	0.02	3.10	n.d.	1.81	Trace	0.03	C2-S1
8	TEK(Quartenary)	Jul.1989	8.2	466	0.11	0.03	1.00	0.54	Trace	Trace	0.16	C2-S1
9	Aritas Spring	Oct.1988	7.5	375	0.04	0.01	3.40	n.d.	0.25	Trace	0.03	C2-S1
10	Hurman River(Afsin-TEK)	Oct.1988	8.2	336	0.24	0.02	2.95	n.d.	2.19	Trace	0.20	C2-S1
11	Hurman Riv.(Afsin-TEK)	Jul.1989	8.2	504	0.19	0.03	1.03	0.36	Trace	Trace	0.26	C2-S1
12	Hurman Riv.(Izgin)	Jul.1989	8.3	474	0.21	0.04	0.90	0.61	Trace	Trace	0.31	C2-S1
13	Hurman Riv.(Izgin Canal)	Jul.1989	7.8	509	0.20	0.03	0.95	0.59	Trace	Trace	0.29	C2-S1
14	Sarsap Riv.	Oct.1988	8.1	370	0.04	0.01	2.80	n.d.	0.24	Trace	0.03	C2-S1
15	Sogutlu Riv.	Oct.1988	7.9	255	0.04	0.01	2.05	n.d.	0.05	Trace	0.04	C2-S1
16	Sogutle Riv.	Jul.1989	8.1	650	0.30	0.04	1.25	1.26	Trace	Trace	0.38	C2-S1
17	Izgin Spring	Oct.1988	8.8	363	0.26	0.02	3.45	n.d.	2.48	Trace	0.20	C2-S1
18	Izgin Spring	Jul.1989	7.9	571	0.17	0.02	1.20	0.73	Trace	Trace	0.22	C2-S1
19	Pinarbasi Spring	Oct.1988	7.9	426	0.26	0.02	3.85	n.d.	2.91	Trace	0.19	C2-S1
20	Ceyhan Riv.(Kabaagac)	Oct.1988	8.2	336	0.19	0.02	3.40	n.d.	1.96	Trace	0.15	C2-S1
21	Ceyhan Riv.(Kabaagac)	Jul.1989	8.2	612	0.19	0.02	1.25	1.27	Trace	Trace	0.24	C2-S1
22	Goksun Riv.(Poskoful)	Oct.1988	8.0	239	0.03	0.01	2.20	n.d.	0.14	Trace	0.03	C1-S1
23	Goksun Riv. (Esence)	Jul.1989	8.1	566	0.00	0.03	1.10	0.52	Trace	Trace	0.00	C2-S1
24	Goksun Riv.(Adatepe)	Oct.1988	8.0	239	0.03	0.01	2.20	n.d.	0.14	Trace	0.03	C1-S1
25	Goksun Riv.(Dam Site)	Jul.1989	7.4	498	0.17	0.03	1.00	0.38	Trace	Trace	0.24	C2-S1

Table 3.2-13 Results of Water Analysis (by DSI)

Sample No.	Sample Name	Sampling Period	pH	EC (μ S/cm)	Cation (me/l) Na	K	Ca	Anios (me/l) SO4	NO3-N	NH4	SAR	Class (USDA)
1	Goksun Riv. (Adatepe Dam Site)	Apr.- Dec.'88	7.7	439	0.11	0.01	4.47	0.11	Trace	Trace	0.07	C2-S1
2	Hurman Riv. (Izgin)	May - Nov.'88	7.7	523	0.28	0.04	4.76	0.30	Trace	Trace	0.18	C2-S1
3	Hurman Riv. (Karakuz Dam Site)	Apr.- Dec.'88	7.6	425	0.22	0.05	4.48	0.10	Trace	Trace	0.15	C2-S1

(*: Each Figure Shows the Average During Sampling Period)

3.3 Socio Economic Conditions

3.3.1 Local Administration

Local government entities in Turkey include the province (Vilayet), the municipality or town (Belediye), and the village (Koy).

There are 67 provinces in the country. Each province performs a dual function as an agent of the central government as well as independently initiating policies to benefit its residents. Governors are appointed by the President, and serve under the direction of the Interior Minister. The province is further divided into districts (Ilce and Kaza) as well as smaller units called Bucak. The district head (Kaymakam) is appointed by the Interior Minister, and the Bucak head by the provincial governor.

Settlements with population over 2,000 are classified as cities and towns, while those of less than 2,000 are considered villages. Cities and towns (municipalities) are administered by a mayor and municipal council, and villages by a village chief and village council.

The Study area contains 1 city, 5 towns and 23 villages. Total population of these in 1985 was 75,000.

3.3.2 Population

(1) Present Population

According to the 1985 census, the total Turkish population is around 50 million. Annual mean population growth rate is 2.49% (1981~1985). Population density is 65/km^2. Birth rate is 3.1%.

Population is distributed 53% in urban areas, and 47% in rural areas. Population growth rate is 6.26% in urban areas, and 1.06% in rural areas. In Kahramanmaras province: total population is 840,000; population density is 59/km^2; population is distributed 40.7% in urban areas, and 59.3% in rural areas; and population growth rate is 3.93% in urban areas, and 1.74% in rural areas. (see Table 3.3-1)

Family scale is as indicated in Table 3.3-2.

Table 3.3-1 Population in Kahramanmaras Districts

Towns and Districts	Total Population	Urban Area	Rural Area	Area (km^2)	Population Density (Number/km^2)
K. Maraş	336,961	210,371	126,590	3,188	106
Afşin	99,517	26,805	72,712	1,387	72
Andirin	43,447	6,122	37,325	1,178	37
Elbistan	147,631	48,756	98,875	4,028	37
Göksun	58,512	15,785	42,727	1,920	30
Pozarcik	103,261	23,382	79,879	1,938	53
Türkoglu	51,143	11,207	39,936	688	74
Total	840,472	342,428	498,044	14,327	59

Table 3.3-2 Family Size by Areas

	Number of Households	Number of Family	Average Number of Family Members
K. Maraş Districts	134,547	853,413	6.3
Afşin	4,883	25,818	5.3
Elbistan	8,261	46,409	5.6
Rural Areas	77,902	527,881	6.8

(2) Economically Active Population

Geographic breakdown of the economically active population (over 12 years old) is given in Table 3.3-3.

Economically active population by sector is given in Table 3.3-4.

Table 3.3-3 Active Working Population

	Working Population	Employed	Unemployed	Unemployment Rate
K. Maraş Districts	356,394	338,726	17,668	4.96
Afşin	6,948	5,599	1,349	19.42
Elbistan	13,674	11,100	2,574	18.82
Rural Areas	258,522	257,957	565	0.22

Note: Absorption into the family labor force is assumed to be the cause for the extremely low unemployment rate for rural area.

Table 3.3-4 Economically Active Population

	Economically Active Population	Rate (%)
Agriculture and Forestry	257,577	76.0
Mining	2,938	0.9
Manufacture	15,957	4.7
Electricity, Water	499	0.1
Construction	12,422	3.7
Commerce	13,151	3.9
Communication	5,862	1.8
Finance	2,077	0.6
Public Administration	27,217	8.0
Others	1,026	0.3
Total	338,726	100.0
Unemployed	17,668	

Population growth in the area in 1975~80 was 3.4%. This increased dramatically to 34.7% in 1981~85. Marked growth was particularly seen in Altas, Afsin and Cobanbeyli.

Population movement into the Study area is shown in Table 3.3-5. This is attributable to the employment opportunities generated by lignite mining by the Turkey Coal Corporation (TKI), the power generating plant (start up in 1984)

operated by the Turkey Electric Power Corporation (TEK) and the sugar plant (start up in 1985).

Table 3.3-5 Population in the Study Area

	1975	1980	1985
Afsin	18,231	20,084	30,369
Bakrac (Aristil)	2,020	1,935	1,925
gdemlik (Sinekli)	374	429	483
Karagoz	1,154	1,226	1,238
Aritas (Hunu) (B)	6,245	5,564	9,656
Kargabuku	694	762	655
Eminilyas	699	767	783
Cobanbeyli (B)	2,420	2,437	3,694
Tanir (B.M.)(B)	4,235	5,122	6,223
Kangal	282	304	362
Ncikoy	332	320	354
Altinelma (Lorsun)(B)	3,617	3,352	3,019
Yazidere (Poskoflu)	427	454	429
Esence (Kitiz)(B)	1,728	1,025	1,544
Deveboynu	581	478	586
Kabaagac	795	812	1,039
Sogucak	325	396	382
Nadirkoy	749	829	928
Alimpinar	551	634	679
Ordekkoy	273	345	426
Koture	695	739	767
Emirli-Gerker Mah.	300	320	1,153
Cagilhan	427	282	238
Ercene	705	846	755
Altas	872	944	1,125
Hoyukiu (Tilarsin)	1,256	1,252	1,433
Kamiscik	621	712	708
Tombak	1,295	1,555	1,760
Izgin-Pinarbasi Mah.	1,750	1,538	1,998
Total	53,653	55,463	74,711