REPUBLIC OF INDONESIA
MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT

FINAL REPORT FOR THE STUDY OF WIDAS FLOOD CONTROL AND DRAINAGE PROJECT PART-II STUDY

MAIN REPORT

MARCH 1986

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO, JAPAN

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PREFACE

It is with great pleasure that I present this report on a study of the Widas Flood Control and Drainage Project, Part-II Study to the Government of the Republic of Indonesia.

This report embodies the result of a multidisciplinary survey which was carried out in the Widas river basin area, East Java of Indonesia from June 1985 to December 1985 by a study team commissioned by the Japan International Cooperation Agency following the request of the Government of the Republic of Indonesia to the Government of Japan.

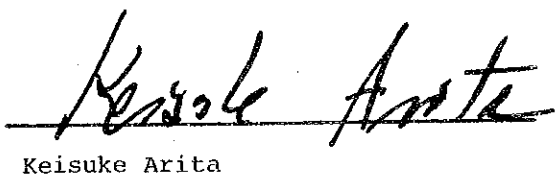
The study team, headed by Mr. Hideki Sato, had a series of close discussions on the Project with the officials concerned of the Government of the Republic of Indonesia and conducted a wide scope of field survey and data analyses.

After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will be useful as a basic reference for development of the Widas river basin 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 Indonesia for their close cooperation extended to the study team.

March, 1986



Keisuke Arita
President
Japan International Cooperation Agency

THE STUDY

OF

WIDAS FLOOD CONTROL AND DRAINAGE PROJECT

PART-II STUDY

March, 1986

Mr. Keisuke Arita
President
Japan International
Cooperation Agency
Tokyo

Dear Sir,

LETTER OF TRANSMITTAL

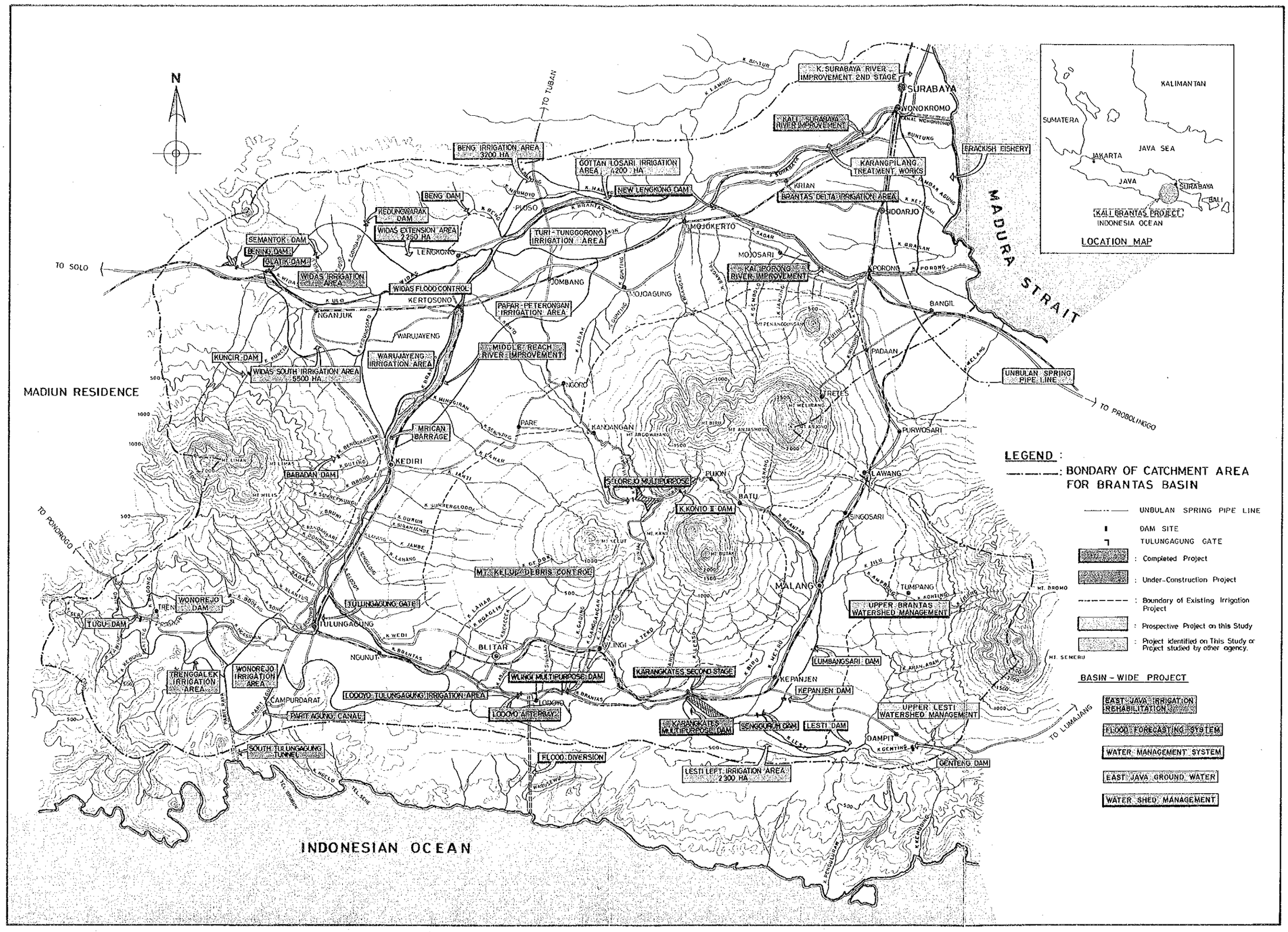
We are pleased to submit to you the Final Report for the Study of Widas Flood Control and Drainage Project, Part-II Study, prepared for consideration by the Government of Indonesia in implementing flood control and drainage plan, dam and irrigation development plan in the Widas river basin. The projects are those accorded higher priorities in Part I Study.

The Report consists of the Main Report and Supporting Report. The Main Report contains background and conditions, flood control and drainage improvement plan, dam and irrigation development plan, conclusion and recommendation. Supporting Report contains supporting data and technical details.

All members of Study Team wish to express grateful acknowledgement to the personnel of your Agency, Advisory Committee, Ministry of Foreign Affairs, Ministry of Construction, Ministry of Agriculture, Forestry and Fisheries, and Embassy of Japan in Indonesia as well as officials and individuals of Indonesia for their assistance extended to the Study Team. The Study Team sincerely hopes that the study results would contribute to socio-economic development and well-being in Widas river basin.

Yours sincerely,

Hideki Sato
Team Leader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K. SURABAYA RIVER IMPROVEMENT 2ND STAGE
SURABAYA
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KALI SURABAYA RIVER IMPROVEMENT
BRACKISH FISHERY
KARANGPILANG TREATMENT WORKS
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GOTTAN LOSARI IRRIGATION AREA 4200 HA
NEW LENGKONG DAM
KRIAN
BRANTAS DELTA IRRIGATION AREA
BENG DAM
KEDUNGWARAK DAM
PLOSO
WIDAS EXTENSION AREA 2250 HA
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MOJOKERTO
SEMANTOK DAM
BENING DAM
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KALI BRANTAS PROJECT
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BONDARY OF CATCHMENT AREA FOR BRANTAS BASIN
UNBULAN SPRING PIPE LINE
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: Under-Construction Project
: Boundary of Existing Irrigation Project
: Prospective Project on this Study
: Project identified on This Study or Project studied by other agency.
BASIN - WIDE PROJECT
EAST JAVA IRRIGATION REHABILITATION
FLOOD FORECASTING SYSTEM
WATER MANAGEMENT SYSTEM
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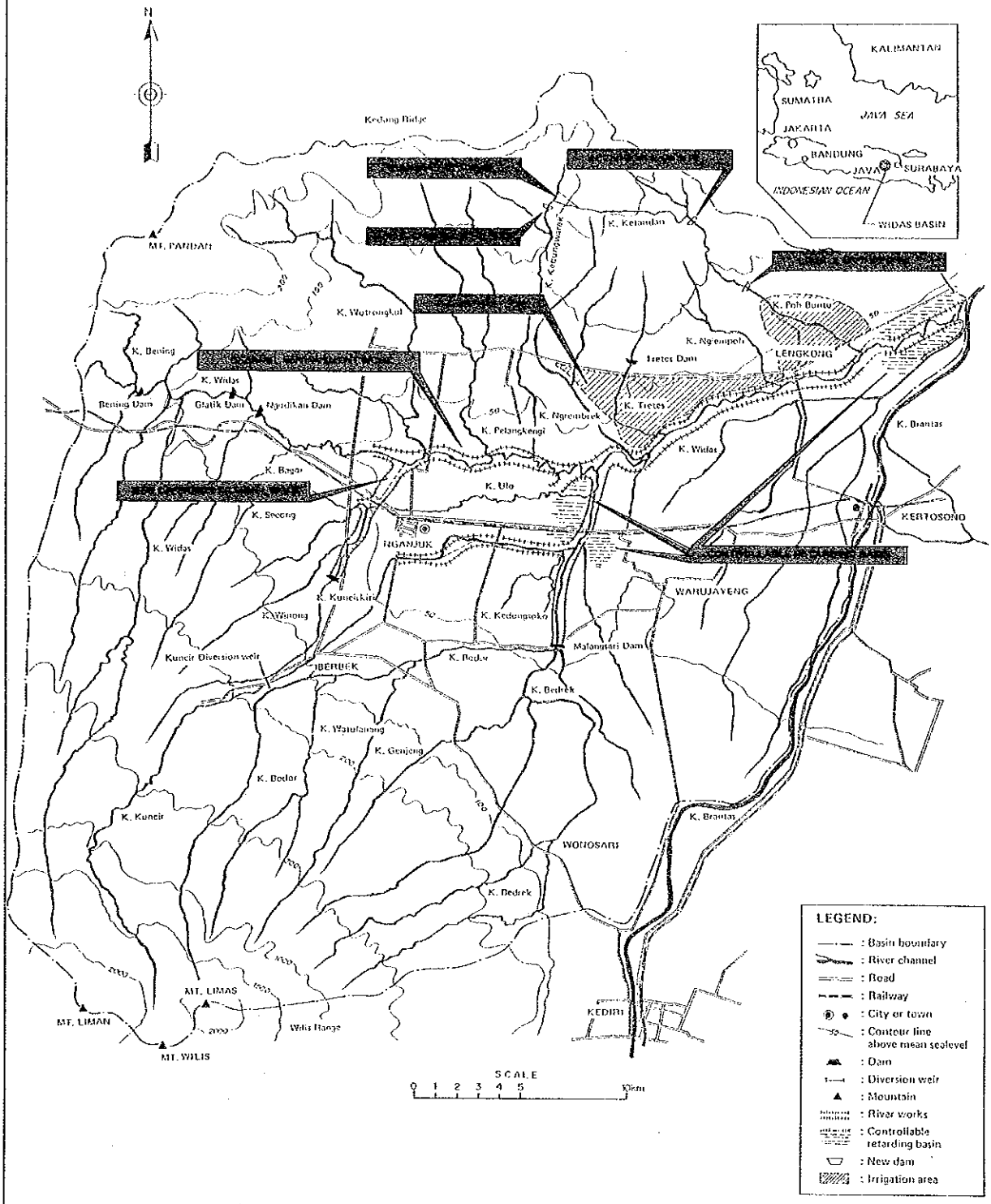
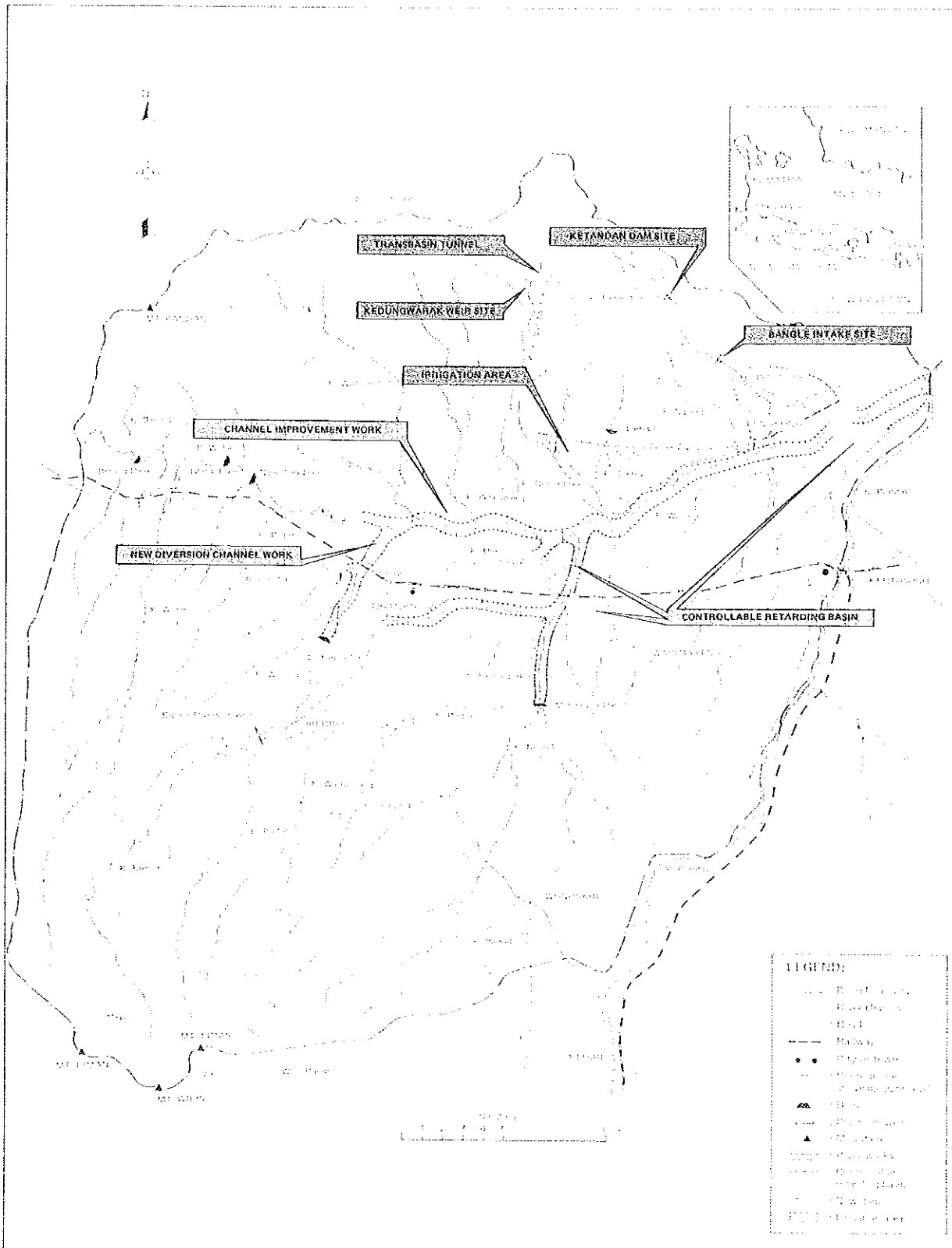


PROPOSED DEVELOPMENT PROJECT FOR WIDAS RIVER BASIN



PROPOSED DEVELOPMENT PROJECT FOR WIDAS RIVER BASIN

SUMMARY

Background of the Project

1. The Study of the Widas Flood Control and Drainage Project (the Project) consists of Part I Study and Part II Study. The Part I Study was carried out in 1984 - 1985 for review of the master plan for land and water resources development in the Brantas river basin in East Java. The Part II Study (the Study) aims to conduct feasibility studies on flood control and drainage improvement and dam and irrigation development in the Widas river basin, a tributary of the Brantas river. The components of the Project are those accorded higher priorities in the Part I Study.

2. In accordance with the mutual agreement between the Government of Indonesia (GOI) and the Government of Japan (GOJ) which was attested in the Minutes of Meeting of March 3, 1984, Japan International Cooperation Agency (JICA), the official agency responsible for implementation of technical cooperation programmes of GOJ, organized a Study Team and Advisory Committee for implementation of the Study. JICA despatched the Study Team for the Part II Study to the Project site from June 3, 1985 to December 29, 1985. The Study Team is composed of fifteen experts in various sectors. GOI provided the Study Team with appropriate offices and counterparts through the Brantas River Basin Development Execution Office (BRBDEO).

3. In accordance with the Terms of Reference for the Study, the Study Team prepared and submitted an Inception Report and a Progress Report of the Part II Study, which were prepared based on investigation and study carried out during the Part I Study. An Interim Report was submitted in August 1985, presenting the optimum development plans both for the flood control and drainage improvement and the dam and irrigation development. The Optimum development plans proposed were accepted by GOI. A Draft Feasibility Report was submitted in January 1986 and a discussion was held between GOI and the Study Team in Jakarta on January 14, 1986.

Comments of GOI on the Draft Feasibility Report were communicated to JICA by Letter dated February 11, 1986. The Study Team finalized the Feasibility Report incorporating those comments.

4. This Feasibility Report consists of four Parts and 21 Chapters. Part I describes background and basic conditions. Part II presents the flood control and drainage improvement plan covering analysis of present river conditions, flood flow analysis, comparative study of alternative plans, proposed development plan, construction plan and cost estimate, and evaluation. Part III presents the dam irrigation development plan covering analysis of present agricultural and irrigation conditions, hydrological analysis, proposed agricultural development, comparative study of alternative plans, proposed development plan, construction plan and cost estimate, and evaluation. Part IV presents a summary of conclusion and recommendation.

Basic Condition for Study

5. The following basic conditions which were resulted from the Part I Study are set for the PART II Study.

Flood Control Scheme

(a) In order to make it possible to implement the flood control works in the Widas river basin independently from the main Brantas, the maximum outflow from the Widas river into the main Brantas is to be 270 m^3/sec, which is the estimated maximum under the present river conditions. Namely, the Widas river flood control scheme is to be formulated in such a manner that no increase of outflow from the Widas river into the main Brantas is brought about from improvement of the Widas river.

(b) Design flood for the overall flood control scheme is a 25-year probable flood.

(c) Stage-wise implementation is to be considered. The first stage plan is to be formulated with 10-years probable flood.

(d) Flood control by dams is not considered in the Project since it would be less viable in economic viewpoint.

Dam and Irrigation Scheme

(a) Kedungwarak dam and its command area for irrigation are the objectives of the feasibility study.

(b) Other dam and irrigation schemes are not taken up for feasibility study this time.

Present Conditions in the Widas River Basin

6. The Widas river basin is one of the major tributaries of the Brantas river and has a total catchment area of 1,538 km^2. The basin is bounded by the Brantas river on the east, Mt. Wilis on the south and west, and Kedung Ridge on the north. The Widas river, originating from the northern slope of Mt. Wilis, flows northerly up to confluence with the Bening river. Then, it flows easterly on the low and flat alluvial plain through Nganjuk and Lengkong towns and debouches into the Brantas river on the north of Kertosono town. The total length of the Widas river is about 80 km. Tributaries of the Widas river are small ones originating from the Kedung Ridge on the left bank and Kedungsoko, Ulo and Kuncir rivers originating from Mt. Wilis on the right bank. At present, there are three natural retarding basins on the Widas, Kedungsoko and Ulo rivers, where no dikes are provided. The total retarding area is about 3,000 ha.

7. The present land use in the basin is estimated as follows;

Paddy	471 km^2	30.6 %
Upland	129 km^2	8.4 %
Forest	455 km^2	29.6 %
House Yard	206 km^2	13.4 %
Others	277 km^2	18.0 %
Total	1,538 km^2	100.0 %

The paddy fields extend on the low and flat alluvial plain. The house yards scatter on the alluvial plain as well as on the high land.

8. Administratively, majority of the basin belongs to Kab. Nganjuk, and the rest to Kabs. Kediri and Madiun. The basin population in 1980 was about one million, and average annual growth rate of population from 1971 to 1980 was 1.39%. The basin economy largely depends on the agriculture sector, both in terms of production and employment. Production of major crops in 1983 was 330,000 tons of paddy, 70,000 tons of maize, 19,900 tons of soybeans, 137,000 tons of cassava, 2,700 tons of sweet potato, 31,000 tons of sugar cane and 8,000 tons of tobacco. Manufacturing industry is composed mostly of cottage industries and does not contribute much to the basin economy. Per capita gross regional domestic product in 1982 was 68% of the national average.

9. There are many small scale irrigation facilities and flood control works constructed in old days. The Bening dam and irrigation project covering the northwestern part of 8,600 ha was completed in 1981. Rehabilitation of the Warujayeng irrigation system covering 12,800 ha and taking water from Brantas is on going. The East Java Irrigation Rehabilitation Project and the East Java Groundwater Project are also in progress at some locations in the basin.

Development Concept

10. In the Part I Study, overall economic growth in the Brantas river basin in recent decades was studied and regional imbalance was observed.

There are less-developed areas where natural conditions are less favourable for economic development. If such areas are left undeveloped, social and economic gaps among those areas and other developed areas will widen. Development of such areas shall be considered not only from the viewpoint of economic efficiency of development but also from the viewpoint of equitable regional development. The Widas river basin is one of the less-developed areas in the Brantas basin. It suffers from recurrent floodings almost every year. Although there is abundant water in rainy season, the north-eastern part of the basin suffers from severe water shortage in dry season. Development concept assumed in this Study is to furnish the Widas river basin with the production and living conditions similar to those in the developed areas in the Brantas river basin.

Flood Control Plan

11. The Widas basin has frequently suffered from flooding and inundation owing to insufficient discharge capacities of the rivers. In 1979, a large flood damaged more than 9,000 ha of paddy fields and house yards and caused loss of 20 lives. Paddy production in 1979 was about 60,000 tons less than the trend line of the production increase. Average annual flood damage in the Widas basin is estimated at Rp. 7,561 million at the 1985 price. The inhabitants in the basin strongly desire urgent implementation of flood control and drainage improvement works.

12. Within the Widas river basin, the Widas, Kedungsoko, Ulo and Kuncir rivers are selected as objective rivers for the flood control plan in view of the severity of floods caused by these rivers. Upstream and downstream sections of the respective rivers are defined as follows;

River		
Widas		
- Upstream	;	Ngudikan dam - confluence with Kedungsoko
- Downstream	;	confluence with Kedungsoko - confluence with Brantas

Kedungsoko

- Upstream ; Malangsari dam - Retarding basin
- Downstream ; Retarding basin - confluence with Widas

Ulo

- Upstream ; Kuncir Diversion point - Nganjuk town
- Downstream ; Nganjuk town - confluence with Kedungsoko

Kuncir

- Upstream ; Kuncir Diversion point - Nganjuk town
- Downstream ; Nganjuk town - confluence with Kedungsoko

13. The upstream reaches of the above rivers form rather deep valleys having large discharge capacities, while the downstream reaches have narrow and shallow channels partially provided with flood dikes. The river bed slope and bank-full discharge capacity under the present condition changes from upstream to downstream sections as shown below;

River Stretch	Bed Slope (Upstream Downstream)	Discharge Capacity (m^3/s)
Widas river		
Upstream	1/700 ⟶ 1/2,000	600 ⟶ 100
downstream	1/3,000 ⟶ 1/4,000	200 ⟶ 130
Kedungsoko river		
Upstream	1/200	50 ⟶ 120
downstream	1/700 ⟶ 1/3,300	120 ⟶ 80
Ulo river		
Upstream	1/140	200 ⟶ 40
downstream	1/1,000 ⟶ 1/1,700	50 ⟶ 10
Kuncir river		
Upstream	1/200	300 ⟶ 30
downstream	1/1,900 ⟶ 1	30 ⟶ 5

As shown above, the discharge capacities of the rivers in the Widas river basin decrease remarkably in the downstream stretches. Therefore, even small flood discharges easily turn into overland flood flow at the bottlenecks.

14. There are three natural retarding areas where no levees are provided. The extent of habitual inundation is estimated as follows;

Retarding Area	Average W.L. (SHVP m)	Area (km^2)	Storage Volume (MCM)
Widas	38.0	10.3	7.7
Ulo	44.9	6.8	7.0
Kedungsoko	45.0	11.8	9.3
Total		28.9	24.0

Since no levee is provided and the discharge capacity of the low water channel is very small, even small floods inundate these regarding areas. The duration of retarding under the present conditions is as long as two to four weeks.

15. Flood flow distribution in the entire Widas basin is estimated by Storage Function Model from the probable rainfalls. A 25-year probable flood distribution under the present river conditions with three natural retarding basins is estimated as follows;

Rivers	Flood Flow (from upstream to downstream) Unit m^3/s
Kuncir	188 → divert to Ulo → 99 → Retarding 10 → Kedungsoko
Ulo	132 → 171 → 221 → 20 → → Kedungsoko
Kedungsoko	468 → regarding → 87 → 195 → retarding → 98 → Widas
Widas	432 → 581 → 487 → 387 → 427 → retarding → → 257 → Brantas river

Retarding volume ;	Widas	;	11.9 MCM
	Ulo	;	8.6 MCM
	Kedungsoko	;	9.4 MCM

If a 25-year probable flood is fully confined in the river channel, the flood flow distribution becomes as follows;

Rivers	Flood Flow (from upstream to downstream) Unit m^3/s
Kuncir	188 → divert to Ulo → 99 → 85 → Kedungsoko
Ulo	132 → 171 → 221 → 165 → Kedungsoko
Kedungsoko	468 → 392 → 504 → 488 → Widas
Widas	432 → 606 → 544 → 612 → 648 → 579 → Brantas river

(Decrease of discharge in places other than retarding basin is due to retarding effect in the river channel.)

16. As shown in Para 15, the 25-year probable peak outflow from the Widas river basin far exceeds the allowable outflow of 270 m^3/sec explained in Para. 5. Therefore, it is necessary to control the floods within the Widas river basin. The Part I Study confirmed that there would be no suitable site for effective and economical flood storage reservoir in the watershed areas of the Widas river owing to the topographic reason. Then, it is obliged to relay on the retarding functions existing in the plain areas. The primary objective of the flood control and drainage improvement plan is to protect the urban areas like Nganjuk and Lengkong and the rural areas other than the natural regtarding areas from overland flood flows by eliminating the bottlenecks in the discharge capacities and increasing discharge capacities. Although it is obliged to use the existing retarding functions, reduction of the inundation frequency and duration as much as possible by modifying the natural retarding basin into controllable ones is another objective.

For selecting an optimum flood control plan, comparative study is made on the combination of following alternatives;

From viewpoint of retarding basin

Scheme I ; Widas retarding basin only

Scheme II ; Widas and Ulo retarding basins with alternatives in retarding capacity

Scheme III ; All three of retarding basins of Widas, Ulo and Kedungsoko with alternatives in retarding capacity.

The present natural retarding basins directly connecting with the river are to be separated from the river and converted into controllable retarding basins.

From viewpoint of river channel improvement

Case I ; Channel improvement of all four objective river as flood conveyance channels.

Case II ; Channel improvement of the Widas, Kedungsoko and Ulo rivers as flood conveyance channel with diversion of floods from the upper kuncir basin into the Ulo river. The Kuncir river will become a local drain.

Case III ; Channel improvement of the Widas and Kedungsoko rivers as flood conveyance channel with diversion of floods from the upper Kuncir and Ulo basins into the Widas river through a new flood diversion channel. The Kuncir and Ulo rivers will become local drains.

Combination of the Schemes with alternative retarding capacities produces numerous alternatives. For each alternative, flood distribution analysis is made, and the construction cost is estimated preliminarily based on the preliminary design.

17. There will be some social disturbances such as separation of farm land and irrigation facilities by canal construction in some alternatives. However, minimization of such social disturbances are included in the construction costs as cost for additional bridges and syphones, and there is no substantial difference among the alternatives in terms of magnitude of possible social disturbances. Since the target of the flood control works is set to protect the basin against the 25-year flood, the flood control benefit (reduction of the flood damage), in principle, would not differ among the alternatives. Therefore, the least cost analysis is made in terms of the net present worth of the construction costs discounted by 12% per annum. The least cost alternative selected is the combination of Scheme III and Case III which consists of river channel improvement in the Widas and Kedungsoko rivers, and construction of a new flood diversion channel to divert flood from the Kuncir river to the upper Widas river via Ulo river and three controllable retarding basins of Widas, Ulo and Kedungsoko, and the related structures.

18. Since the hydrological and hydraulic mechanism in the controllable retarding basins is so complicated and needs to be confirmed by hydraulic model tests, allowance in the retarding capacity is provided. The retarding capacity including allowance and inevitable dead storage is determined as follows;

	Retarding Capacity	H.W.L.	Retarding Area
Widas Retarding Basin	; 13.6 MCM	EL. 38.6 m	13.2 km^2
Kedungsoko Retarding Basin	; 5.1 MCM	EL. 44.6 m	6.5 km^2
Ulo Retarding Basin	; 4.8 MCM	EL. 44.4 m	6.3 km^2

With the above retarding capacity, the design flood distributions of the 25-year probable flood are determined as follows;

For Comprehensive Plan (25-year Probable Flood)

New diversion channel ; 190 m^3/s → 230 m^3/s → Widas

Lower Kuncir river ; 95 m^3/s → Kedungsoko

Kedungsoko river ; 470 m^3/s → retarding → 200 m^3/s → Widas

Ulo river ; 35 m^3/s → Widas

Upper Widas river ; 590 m^3/s → 640 m^3/s → retarding → 370 m^3

Lower Widas river ; 530 m^3/s → 570 m^3/s → retarding
→ 270 m^3/s → Brantas

19. The length of river stretches to be improved are as follows;

Lower Widas	;	21 km
Upper Widas + Lower Ulo	;	15.1 km
New Diversion channel + Upper Ulo	;	7.9 km
(New diversion channel		2.9 km)
Kedungsoko	;	9.8 km
Kuncir	;	10.3 km
Secondary tributaries	;	17.7 km (12 tributaries)
Total		81.8 km

The river bed slopes are determined mostly following the presant river bed slopes. To discharge the design discharges safely and economically, cross sections of the river channel are determined to be of combined type consisting of low water channel to be made by excavation and high water channel to be made by diking. The principal dimensions are as follows;

Rivers	River Width (Dike to Dike) (m)	Width of Low Water Channel (m)	Water Depth below D.H.W.L. (m)
Lower Widas river	100 - 300	40 - 75	5
Upper Widas river	80 - 110	45 - 70	5
New diversion Channel	50	30 - 40	5
Upper Ulo river	50	25 - 30	4
Lower Kedungsoko river	90	50	4
Upper Kedungsoko river	90 - 100	35 - 70	4
Kuncir river	40	20	4

20. Three retarding basins are designed so as to store temporarily the part of flood discharge from the upstream in three retarding basins through a non-gated fixed side overflow dike to be constructed along the river. The crest elevation and length of the side overflow dike are determined based on hydraulic analysis as summarized below;

Retarding Basin	Crest Elevation	Length
Widas	EL 38.429 m - 38.311 m	400 m x 2 places
Ulo	EL 44.786 m - 44.440 m	550 m x 1 place
Kedungsoko	EL 44.651 m - 44.466 m	360 m x 2 places

Drainage sluices are planned at the downstream end of the retarding basins to drain the water stored in the retarding basins. Time to drain the stored water is set at around 2 days. Dimensions of sluices are as follows;

Retarding Basin	Sill Elevation	Gates (H x W)	Nos	Max. Capacity (m^3/s)
Widas				
Left side	EL.35.0 m	4.0 m x 3.0 m	2	63 m^3/s
right side	EL.35.0 m	4.0 m x 4.0 m	2	84 m^3/s
Ulo	EL.42.0 m	3.0 m x 4.0 m	2	46 m^3/s
Kedungsoko				
Left side	EL.41.0 m	2.0 m x 2.0 m	2	25 m^3/s
right side	EL.41.0 m	2.5 m x 2.5 m	2	39 m^3/s

For the Widas retarding basin, collector drainage channels leading to drainage sluices are designed. In case of the Ulo and Kedungsoko retarding basins, existing channels will be used as collector drains. There would be no possibility to use the retarding basin as a storage reservoir owing to the high permeability of the soil. In this feasibility study, no dikes surrounding the retarding basin is planned from the following reasons;

(1) By converting the present natural retarding basin into the artificial regulation pond and increasing the discharge capacity of the rivers, the inundation frequency and duration in the retarding basins are expected to decrease remarkably. Then, it is considered better to allow the inhabitants to continue the present land use, instead of acquiring all the retarding basin areas and changing the land use for flood regulating purpose only.

(2) In order to continue the present land use, the existing irrigation and drainage systems in the retarding basin should be maintained. Continuous surrounding dikes which cross these systems, if constructed, needs additional facilities to check reverse flow from the retarding basin to the outer area through irrigation canals and new drainage system for outer area drainage, which should serve these functions at flood time.

For keeping the retarding capacities, the land use should be maintained as it is used presently not allowing new land reclamation by embankment and these construction.

21. The proposed flood control plan requires also improvement and/or reconstruction of the related hydraulic structures on the stretches to be improved. Major structures are as follows;

	Width (m)	Height (m)	No. of Span	Works
Kuncir Diversion weir				
Upper Ulo side	14.0	4.5	2	Reconstruction
Kuncir side	7.5	4.5	1	Improvement
Irrigation Headworks				
Tiripan	9.0	3.4	2	Reconstruction
Malangsari	6.5	4.5	4	Improvement
Kapas	4.0	4.0	3	Improvement
Kramat	3.2	3.0	2	Improvement

In case of improvement the existing structures are planned to be used as much as possible, with necessary improvements. Other small structures planned are 28 drainage sluices and culverts, 4 syphons and 2 drops.

22. Aside from the above, since the planned river channels are wider than the present channels and the new diversion channel crosses the existing railway, highway and some rural roads, replacement and new construction of bridges are required. Total number of bridges needed are counted to 34. All the road bridges are planned to be made of reinforced concrete. The railway bridge over the new diversion channel is designed to be a steel through girder bridge.
Major bridges are as follows;

23. The work quantities for the comprehensive plan against 25-year probable flood are calculated based on the basic design of each work. Major work quantities would be as follows;

1.	Dredging	3.1×10^6 m^3
2.	Excavation	4.2×10^6 m^3
3.	Embankment	1.7×10^6 m^3
4.	Revetment	
	Wet masonry (total length 13,000 m)	108,000 m^2
	Gabion (total length 10,600 m)	86,500 m^2
5.	Bridges	34 Nos
	(Natinoal road	2 Nos $\Sigma\ell$ = 133 m)
	(Provincial road	6 Nos $\Sigma\ell$ = 500 m)
	(Rural road	21 Nos $\Sigma\ell$ = 1,750 m)
	(Foot path	4 Nos $\Sigma\ell$ = 230 m)
	(Railway	1 No., L = 53 m)
6.	Pier-protection of K. Soko railway bridge	1 lot
7.	Drainage sluices and culverts	28 Nos
	(1.5 m x 1.5 m x 1 span)	(17 Nos)
	(2.5 m x 2.0 m x 2 spans)	(10 Nos)
	(2.5 m x 2.0 m x 3 spans)	(1 No)
8.	Irrigation headworks	4 Nos
9.	Syphon	4 Nos
10.	Diversion weir on Kuncir river	1 No
11.	Drops	2 Nos
	(New diversion channel L = 35 m	drop 1 m)
	(Lower Ulo river L = 20 m	drop 1 m)
12.	Side overflow dike	5 Nos
13.	Drainage sluice for retarding basin	5 Nos

24. The financial construction cost including the physical contingency is estimated at Rp.62,592.4 million at 1985 price level with the following breakdown;

		Unit Rp. million
1.	Preparatory Works	610.0
2.	Direct Construction Cost	40,802.5
	(1) Lower Widas	15,391.1
	(2) Upper Widas & Lower Ulo	8,188.3
	(3) New Diversion Channel	2,947.7
	(4) Upper Ulo	3,509.9
	(5) Kedungsoko	7,176.9
	(6) Kuncir	3,588.6
3.	Land Aquisition	7,632.0
4.	Government Administration /1	2,070.6
5.	Engineering Services /2	3,313.0
	Base Cost	54,428.2
6.	Physical Contingency /3	8,164.2
	Total Cost	62,592.4

Note: /1 5% of 1+2, /2 8% of 1+2,
/3 15% of Base Cost

Of the total cost, the foreign currency components are estimated at Rp.29,688.5 million equivalent in total, and the domestic currency component is estimated at Rp.32,903.8 million.

25. Upon request from GOI, stage-wise development is examined. The target of the first stage flood control works is to protect the Widas basin against the 10-year probable flood. The design flood distributions for the first stage plan are estimated as follows;

For 1st Stage Plan (10-year Probable Flood)

New diversion channel	170 m^3/s → 190 m^3/s → Widas
Lower Kuncir river	80 m^3/s → Kedungsoko
Kedungsoko river	410 m^3/s → retarding → 180 m^3/s → Widas
Ulo river	30 m^3/s → Widas
Upper Widas river	570 m^3/s → 580 m^3/s → retarding → 320 m^3/s
Lower Widas river	470 m^3/s → 500 m^3/s → retarding → 270 m^3/s → Brantas

26. In order to avoid reheightening or relocation of dikes and reconstruction of bridges and other related structures, the design high water level, river width and levee height in the first stage plan are determined as same as those for the comprehensive plan. The difference in the required discharge capacity between the comprehensive and first stage plan is adjusted by the width of the low water channels. The principal dimensions are as follows;

Rivers	River Width (Dike to Dike) (m)	Width of Low Water Channel (m)	Water Depth below D.H.W.L. (m)
Lower Widas river	100 - 300	40 - 60	5
Upper Widas river	80 - 110	45 - 65	5
New diversion Channel	50	25 - 35	5
Upper Ulo river	50	20 - 25	4
Lower Kedungsoko river	90	45	4
Upper Kedungsoko river	90 - 100	30 - 60	4
Kuncir river	40	15	4

27. According to the above conditions, the work quantities in the first stage become as follows;

1.	Dredging	2.8×10^6 m^3
2.	Excavation	3.6×10^6 m^3
3.	Embankment	1.7×10^6 m^3
4.	Revetment	
	Wet masonry	54,000 m^2
	Gabion	19,000 m^2
5.	Bridges	34 Nos
6.	Pier-protection of K. soko railway bridge	1 lot
7.	Drainage sluices and culverts	28 Nos
8.	Irrigation Headworks	4 Nos
9.	Syphon	4 Nos
10.	Diversion weir	1 No
11.	Drops	2 Nos
12.	Side overflow dike	5 Nos
13.	Drainage sluice for retarding basin	5 Nos

28. The construction cost of the first stages development is estimated as Rp.49,885.9 x 10^6. Large concentration of the construction cost to the first stage is caused by the following reasons;

(1) Magnitudes of the design floods do not differ between the first stage plan and comprehensive plan.

(2) Dikes, all the related hydraulic structures and bridges are planned to be constructed in the first stage in the scales of the comprehensive plan in order to avoid reheightening and reconstruction.

Then, the stage-wise implementation of the flood control works seems to be less meaningful from the viewpoint of reducing annual fund requirements. Implementation of the flood control works in one stage is recommended.

29. The flood control benefit is studied both for the 1985 basin development level and for the future development level. By implementation of flood control works, floods smaller than the 25-year probable flood will be accommodated in the river channels and the retarding basins, and will not cause flood damage. The annual flood control benefit at the 1985 price and the 1985 development level is estimated to be Rp.7,292.4 million consisting of average annual flood damage reduction (Rp.7,170 million) and land enhancement benefit (Rp. 122.4 million) which is expected in the areas to be free from habitual inundation. The annual flood control benefit considering the future socio-economic development is estimated at Rp.38,098 million at the discount rate of 12% per annum.

30. The economic construction cost is estimated to be Rp.39,656.6 million, after adjustment of transfer payment within the national economy and shadow wage rate of unskilled labour. Assuming the project implementation period of 8 years and the project life time of 50 years, the economic internal rate of return of the flood control works is estimated to be 9.8% in the case of 1985 development level and 14.1% in the case of future social and economic development.

31. Presently, the Waru-Turi Project intends to carry out flood control works in the lower Widas and Kedungsoko rivers to protect the Warujayeng-Kertosono irrigation area. Design of the Waru-Turi project has followed the first stage development plan proposed in this study. However, due to limitation of the budget available for the Waru-Turi Project, it may be difficult to implement the entire first stage development plan in the lower Widas and Kedungsoko rivers. If partial implementation would be necessitated, excavation of the low water channel is recommended from a viewpoint of avoiding adverse effects by partial construction.

Dam and Irrigation Development

32. There are 45,126 ha of irrigation areas in total in the Widas basin. According to the sources of irrigation water, the irrigation areas can be largely classified into three areas.

Area	Water Source
Widas North	
Western part	Bening reservoir and tributaries from Kedung Ridge
Eastern part	Tributaries from Kedung Ridge
Widas South	
SK Nganjuk part	Tributaries from G. Wilis
SK Kediri part	Tributaries from G. Wilis
Warujayeng - Kertosono	Brantas river

Agricultural condition in the eastern part of the Widas North area (Widas Extension Area) is quite contrasting with that in the other areas shown below.

Area	Irrigation Area* (ha)	Cropping Intensity Paddy (%)	Cropping Intensity All (%)	Canal Density (m/ha)
Widas North				
West	11,022	133	228	37
East	2,757	97	176	17
Widas South				
SK Nganjuk	11,924	146	251	84
SK Kediri	6,057	107	237	59
Warujayeng - Kertosono	13,336	153	255	59

* Area registered by Irrigation Service

Since the prime economic activity in the Widas basin is agriculture, low cropping intensity leads directly to the poverty. Poor construction of houses in the Widas Extension Area (almost bamboo made) is another proof of poverty. From the viewpoint of regional equity of development and in order to prevent widening of the economic gap, some improvements would be needed for the Widas Extension Area, even though economic efficiency of such improvements would be relatively low. Partial development in the Widas Extension Area will cause another inequity within the area. Therefore, the objective improvement area should cover the whole Widas Extension Area.

33. The Widas Extension Area covers 18 desas in Kecs. Gondang, Lengkong and Ngluyu and the gross area is about 11,000 ha. Irrigable area consisting of paddy and upland fields at present are about 3,557 ha in total adding the non-irrigated field of 800 ha to the registered irrigation area of 2,757 ha. After deducting an area of 448 ha presently covered by the groundwater irrigation, the area of 3,109 ha is selected as the Project area. The present cropping pattern in this area is estimated based on the cropping data obtained from Irrigation Service on the assumption that dry season paddy, sugercone, and tobacco are not cultivated in the non-irrigated field as follows.

Wet season paddy	2,707 ha	Dec. to Apr.
Dry season paddy	269 ha	Apr. to Aug.
Non-irrigated maize	761 ha	May to Dec.
Non-irrigated soybeans	709 ha	May to Dec.
Non-irrigated sugarcane	102 ha	May to Oct. in next year
Tobacco	775 ha	Jun. to Oct.
Cropping Intensity	171 %	

34. In planning the development of the Widas Extension Area, the following targets are taken into consideration, referring to the present conditions in the Widas basin as well as in the Brantas basin, and the current Government policies.

(1) To rise the unit yield of paddy to the level obtained in the developed areas, like Lodoyo irrigation area in the Brantas basin, in order to firm up the farmer's economy. However, further increase of the dry season paddy area is not conceived, since the Government is now intending to control rice production increase within the range of demand growth.

(2) To irrigate polowijo crop as much as possible within the limit of available water, for crop diversification which the Government is now promoting.

35. The Widas Extension Area relies on small tributaries flowing from the Kedung Ridge. The runoffs in those rivers are flushing in the rainy season, and become almost nil in the dry season. There are small pondages, but they are insufficient to control the runoff interseasonally. The groundwater in the area has already been exploited to be believed maximum extent, and there would be little possibility for further development. Therefore, a measure to develop the Widas Extension Area is to provide a storage reservoir.

36. Judging from the topography in the Kedung Ridge, site suitable for storage reservoir construction would be limited to the Kedungwarak and Ketandan rivers. Available water at both sites are estimated from rainfall by the Tank Model method as follows;

Dam Site	Catchment Area (km^2)	Mean Runoff (m^3/s)
Kengungwarak	31.5	0.89
Ketandan	15.5	0.44

Probable floods applied in design of dam are estimated by the dimensionless unit hydrograph as follows;

	Return Period (year)		
Dam Site	20	200	10,000
Kedungwarak	167 m^3/s	260 m^3/s	422 m^3/s
Ketandan	140	220	358

37. Geological investigation by core boring in the dam site areas was carried out by BRBDEO. From the core samples, the following are known so far.

Soil in the Kedungwarak site is calcareous standstone having rather high permeability values. Foundation treatment by grouting would be needed. As the N-values of sandstone are in an order of 30, allowable height of concrete structure would be limited to less than bout 20 m from the economic point of view. The Ketandan dam would be located just on the boundary of calcareous sandstone and marl. In the left abutment, a

highly weathered layer is found at about 25 m below the ground surface. In order to control seepage through this layer and to avoid land sliding along this layer, removal of all parts above this layer would be needed. As a measure to control seepage through the dam foundation, blanket would be a practical one. Since there are little rock materials, the dam should be a homogenous earth fill type. Embankment materials are available from the borrow pits in the downstream of the dam sites.

38. In order to cover this irrigation area, two alternatives are conceivable.

Alt. 1. Independent development of the Kedungwarak and Ketandan reservoirs. In this alternatives, commanding areas would are as follows;

Kedungwarak	1,505 ha in net irrigation area
Ketandan	1,328 ha in net irrigation area

Ngluyu area is not taken into account since the area would be submerged by the Kedungwarak reservoir.

Alt. 2. Combined development of the Kedungwarak and Ketandan reservoirs with a trans-basin tunnel. The Ketandan reservoir is the main reservoir. In this alternative, the commanding area are as follows;

Kedungwarak	445 ha in net irrigation area (Nglayu 120 ha; Tretes North; 325 ha)
Ketandan	2,510 ha in net irrigation area

In order to avoid another inequity of the development level within the Widas Extension area, all the Project area should be covered by the Project, even if the second dry season crops have to be grown without irrigation water supply. Then the cropping pattern with the Project condition is examined within the limitation of water to be made available by the Project, and the following are proposed.

	Period	Alt. I	Alt. II
- Net irrigable area		2,833 ha	2,955 ha
- Wet season paddy	Dec. - Apr.	2,680 ha	2,800 ha
- Dry season paddy	Apr. - Aug.	269 ha	269 ha
- Irrigated Polowijo	Apr. - Dec.	1,634 ha	2,366 ha
- Non-irrigated Polowijo	Aug. - Dec.	1,908 ha	1,420 ha
- Irrigated sugarcane	May - Oct. in next year	102 ha	102 ha
- Tobacco	May - Oct.	775 ha	775 ha
- Cropping Intensity		260 %	262 %

39. Storage requirement of each alternative is examined by simulation analysis for the period from 1954 to 1982, applying the cropping pattern to satisfy the targets. Preliminary cost and benefit analysis is made for each alternative based on the preliminary design, and the following results are obtained;

	Total Planted Area* under irrigation by Project (ha in year)	Storage Requirement (MCM)	Construction Cost (Rp.million)	Incremental Benefit (Rp.million/ Year)
Alt. I	4,678	13.1	18,081.1	1,586.1
Alt. II	5,528	14.3	17,800.6	1,814.8

* Non-irrigated maize, soybeans and tabacco are excluded.

From the above, the Alternative II consisting of the Kedungwarak weir, trans-basin tunnel, Ketandan dam and net irrigation area of 2,955 ha is selected as the project for the feasibility study.

40. The Kedungwarak weir is designed to have a concrete gravity section with an overflow weir in the center of the river, and earth-fills in the right and left abutments. The effective storage of 2.6 MCM is to be used for the Ngluyu area of 120 ha and the Tretes north area of 325 ha. Principal features would be as follows;

Kedungwarak Reservoir

Catchment area	31.5 km^2
Mean runoff	0.89 m^3/sec
Available mean runoff for trans basin	0.59 m^3/sec
Flood water level	EL. 157.0 m
High water level	EL. 154.6 m
Low water level	EL. 150.0 m
Gross storage	3.4 MCM
Effective storage	2.6 MCM
Reservoir area at FWL	135 ha

Kedungwarak Dam

Type	Concrete weir in centre with earthfill in both sides
Crest elevation of dam	EL. 158.0 m
Dam height above foundation	16 m
Crest elevation of weir	EL. 154.6 m
Design flood (200-yrx1.2)	312 m^3/s (w/o retarding)
Excavation	20,300 m^3
Concrete	9,000 m^3
Embankment	1,600 m^3

41. The trans-basin tunnel is designed to connect the Kedungwarak reservoir with the Ketandan river in the shortest route. The tunnel would penetrate low hills composed of marl. Principal features are as follows;

Trans-basin Tunnel

Inlet sill elevation	EL. 149.70 m
Outlet sill elevation	EL. 145.00 m
Length	1,500 m
Longitudinal slope	1/450
Cross section	circular

Diameter	2.0 m
Flow condition	free flow
Inlet gate	4 m x 4 m
Open excavation	53,000 m^3
Tunnel excavation	7,400 m^3
Concrete	3,350 m^3

42. The Ketandan dam is designed as homogenous earthfill type dam, owing to the limited strength of the foundation rock and the non-availability of rock materials. A large cutting in the left abutment is planned so as to remove the layer above the highly weathered zone about 25 m below the ground surface. Seepage through the foundation rock is planned to be controlled by earth blanket. A side-overflow type spillway is planned on the right bank. The diversion tunnel in the left abutment is planned to be transformed into a waterway for irrigation and mini-hydropower of 270 kW. Principal features are as follows;

Ketandan Reservoir

Catchment area	31.5 + 15.5 km^2
Mean runoff	(0.59 + 0.44) m^3/s
Flood water level	EL. 136.1 m
High water level	EL. 134.0 m
Low water level	EL. 117.5 m
Gross storage	14.0 MCM
Effective storage	11.65 MCM
Reservoir area at FWL	125 ha

Ketandan Dam

Type	Homogeneous earth fill
Crest elevation	EL. 138.5 m
Dam height	38 m
Upstream slope	1 : 3.0
Downstream slope	1 : 2.5
Excavation	355,000 m^3
Embankment in all	508,400 m^3

Diversion Tunnel

Diameter	2.0 m
Length	400 m
Tunnel Excavation	2,000 m^3
Concrete	750 m^3

Spillway

Type	Side overflow channel type
Crest elevation	EL. 134.0 m
Crest length	40 m
Design flood (200-yr x 1.2)	264 m^3/s (w/o retarding)
Excavation	54,800 m^3
Concrete	10,100 m^3

Mini Hydropower

Installed capacity	270 kW

43. The irrigation facilities would consist of the Bangle headworks, east and west main canals, and pumping stations for the Ngluyu area. The Bangle headworks is planned on the Ketandan river 3.5 km downstream from the dam. The east main canal of 2.1 km long will convey water to the Lengkon area of 1.180 ha. The 6.3 km of west main canal will convey water to the Tretes south area of 1.330 ha. The water for the Tretes north area of 325 ha would be taken at the existing Gondang headworks on the Kedungwarak river 4 km downstream from the weir. Principal features would be as follows;

Irrigation facilities

Bangle headworks	Fixed overflow weir, 2m high
West main canal	6.3 km
East main canal	2.1 km
Secondary and tertiary canals	98 km
On-farm canal density	80 m/ha
Excavation	415,900 m^3
Embankment	345,100 m^3
Wet masonary	19,300 m^3

44. The construction cost of the dam and irrigation development including the physical contingency is estimated at Rp.24,955.3 million at the 1985 price level with the following break down;

	unit: Rp.million
1. Direct construction cost /1	14,960.6
(1) Kedungwarak weir	1,811.4
(2) Trans-basin tunnel	1,414.0
(3) Ketandan dam	7,610.4
(4) Bangle head works	161.3
(5) Canals & Structures	3,763.5
(6) Ngluyu pump station	199.8
2. Land acquisition	3,000
3. Government administration /2	1,496
4. Engineering services /3	2,244
Base cost	21,700.3
5. Physical contingency /4	3,255.0
Total construction cost	24,955.3

Note: /1 including preparatory works,
/2 10% of 1,
/3 15% of 1,
/4 15% of Base Cost,

Of the total cost, the foreign currency components are estimated at Rp.13,829.6 million equivalent in total and the domestic currency component is estimated at Rp.11,125.7 million.

45. With the project condition the crop production is anticipated to increase as follows;

Unit: ton

	Without	With	Increase
Paddy	11,634	16,880	5,246
Soybean	482	1,715	1,233
Maize	1,697	5,103	3,406
Red onion	-	4,848	4,848
Tobacco	-	-	0
Sugarcane	5,804	9,180	3,376

The annual incremental benefit is estimated at Rp.2,729.3 million.

46. The economic construction cost is estimated at Rp.16,097.6 million, after adjusting transfer payments within the national economy and shadow wage rate of unskilled labour. Then, the economic internal rate of return is estimated at 10.6% assuming the implementation period of 6 years, the maturity period of 3 years and the Project life time of 50 years. Sensitivity analysis shows the following results;

Cost 10% up	9.8%
Benefit 10% down	9.7%
Combined 10% the above	8.9%

Project Implementation

47. The follwoing implementation programmes are conceivable;

Year	Flood Control	Dam and Irrigation
1st	Fund raising for detailed design (1 year)	
2nd	Detailed investigation and design (1.5 years)	
3rd	Fund raising for construction (1 year)	
4th	Construction (5 years)	Construction (3 years)
5th		
6th		
7th		
8th		
9th		

Disbursement Schedule

48. According to the above implementation schedule, the disbursement schedule of the construction costs would be as follows;

Unit: 10^6Rp

Year	Flood Control			Dam and Irrigation			
	Base Cost + Physical Con-tingency	Price Con-tingency	Sub-total	Base Cost + Physical Con-tingency	Price Con-tingency	Sub-total	Total
3rd	2,633.0	490.3	3,123.3	1,897.0	353.3	2,250.3	5,373.6
4th	7,810.1	1,670.9	9,481,9	4,688.1	959.5	5,647.6	15,128.6
5th	13,408.5	3,349.5	16,758.0	7,187.8	1,594.9	8,782.8	25,540.8
6th	14,789.6	4,200.7	18,990.2	8,094.1	2,154.4	10,248.6	29,238.8
7th	13,563.9	4,524.4	18,088.3	3,088.4	996.1	4,084.5	22,172.8
8th	7,899.0	3,076.7	10,965.7				10,965.7
9th	2,498.3	1,118.6	3,616.9				3,616.9
Total	62,592.4	18,430.9	81,023.3				112,037.1

Environmental Assessment

49. Preliminary environmental impact analysis is made qualitatively for the flood control and drainage works and the dam and irrigation development by means of risk-resultant matrix and importance analysis. Although some negative impact to the natural and human environment are identified, such as dust turbid water and noise during construction, decrease of the forest areas, separation of the land by cutoff channel and new diversion channels and increase of contamination of the river water by intensive use of fertilizer and agro-chemicals, it is considered that most of them are relatively small impact and solvable with due care. Positive impacts such as reduction of flood damages, increase of agricultural production and improvement of health condition, are considered to be more important and cumulative than the negative impacts. Therefore, it is judged that the proposed project would be environmentally sound.

Conclusion and Recommendation

50. The flood control works are proved to be technically feasible, economically viable and socialy desirable. Implementation of the flood control works is recommended. The dam and irrigation development has still uncertainty in the geological condition in the Ketandan damsite and is economically marginal. However, development of the Widas Extension Area is socially desirable from the viewpoint of equitable development. Implementation of the dam and irrigation development after further investigation is recommended.

51. Accuracy of the study results presented in the above is limited by the available data. For preparation of detailed design and cost estimates, the following will be needed.

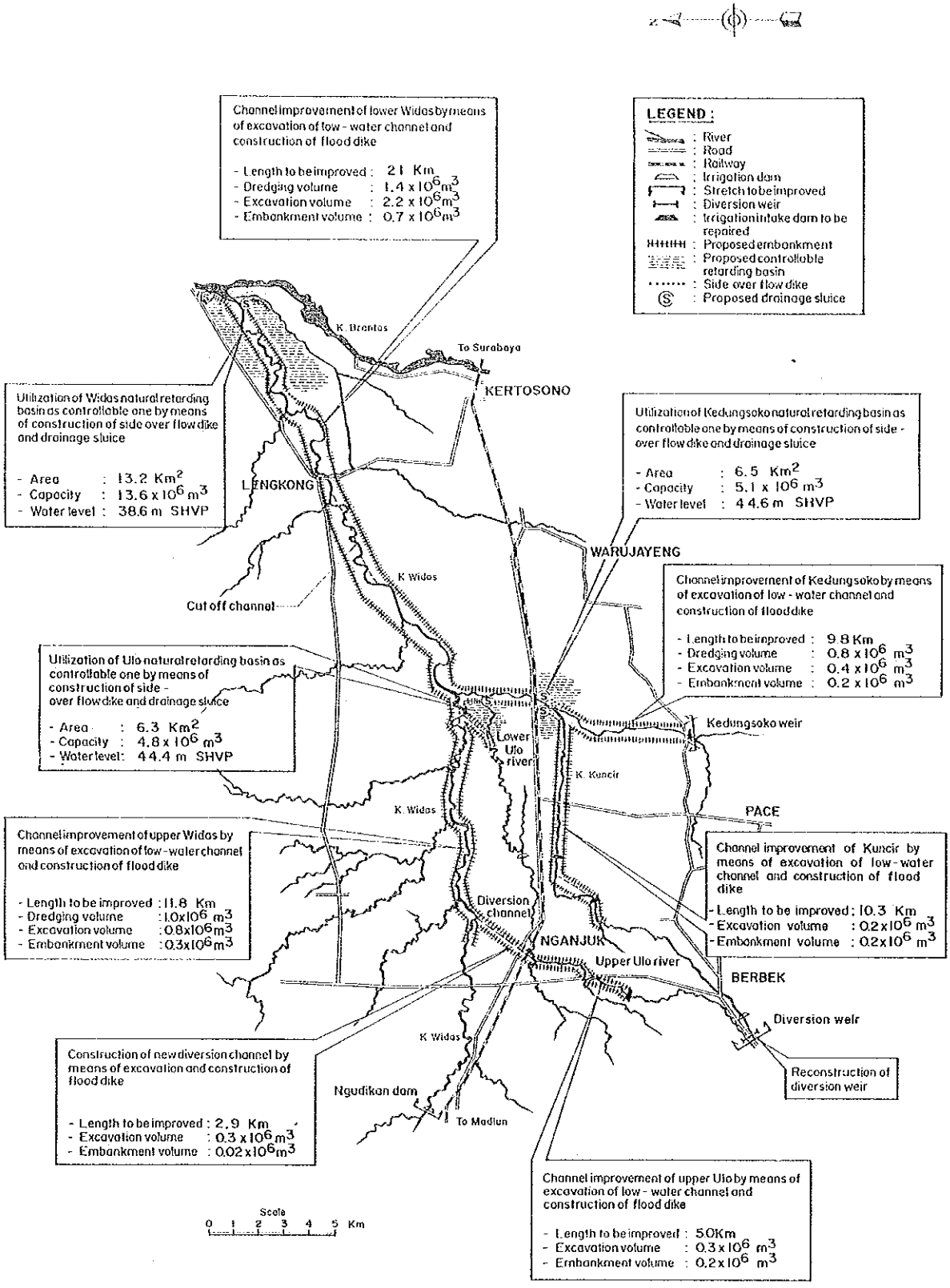
(1) Profile and cross-section survey of river channel and canal routes at an internal of 100 m or less

(2) Contour maps on 1 to 200 scale at the structure sites

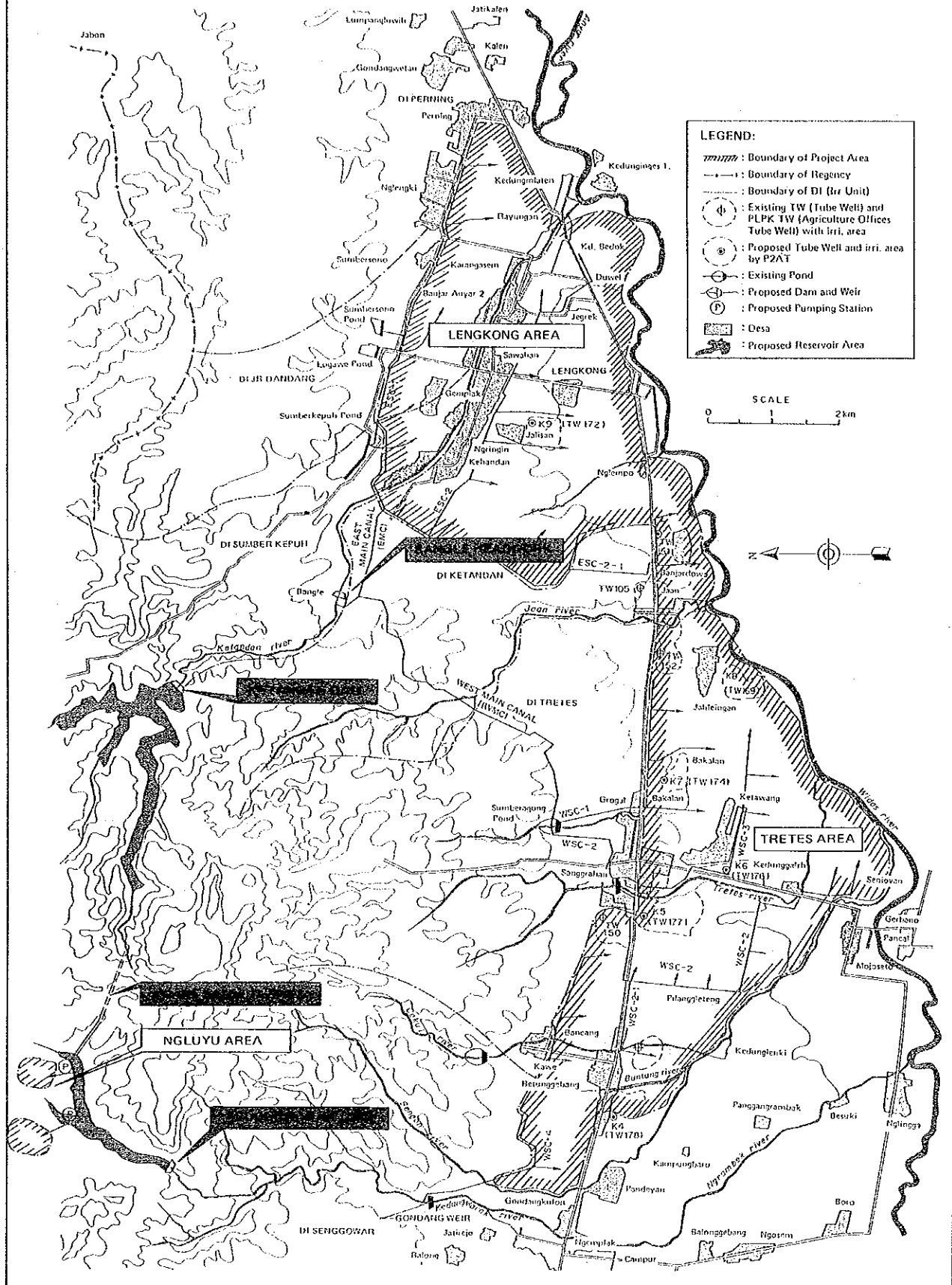
(3) Geological investigation at the structure sites

(4) Investigation of embankment materials

(5) Hydraulic model test of retarding basins



OUTLINE OF COMPREHENSIVE FLOOD CONTROL PLAN



DAM AND IRRIGATION DEVELOPMENT PLAN

FINAL REPORT

FOR THE STUDY OF

WIDAS FLOOD CONTROL AND DRAINAGE PROJECT

PART II STUDY

TABLE OF CONTENTS

ABBREVIATIONS

(1) Plan

REPELITA I	:	Rencana Pembangunan Lima Tahun Tahap I (First Five Year National Development Plan)
REPELITA II	:	Rencana Pembangunan Lima Tahun Tahap II (Second Five Year National Development Plan)
REPELITA III	:	Rencana Pembangunan Lima Tahun Tahap III (Third Five Year National Development Plan)
REPELITA IV	:	Rencana Pembangunan Lima Tahun Tahap IV (Fourth Five Year National Development Plan)

(2) Domestic Organization

BAPPENAS	:	Badan Perencanaan Pembangunan Nasional (National Development Plan Agency)
BAPPEDA	:	Badan Perencanaan Pembangunan Daerah (Regional Development Plan Agency)
BULOG/DOLOG	:	Badan Urusan Logistik/Depot Logistik (Government Rice Purchasing Agency)
BIMAS	:	Bimbingan Massal (The official scheme to make credit and other inputs available to farmers)
BPAM	:	Badan Pengelola Air Minum (Water Supply Committee)
BRBDEO	:	Brantas River Basin Development Execution Office
DATI Tk I	:	Daerah Tingkat I (Province)
DATI Tk II	:	Daerah Tingkat II (Region/Sub-division of the Province)
DEP. P.U.	:	Departemen Pekerjaan Umum (Ministry of Public Works)
DEP. KES.	:	Departemen Kesehatan (Ministry of Health)
DEP. SOS.	:	Departemen Sosial (Ministry of Social)
DEP. KEU.	:	Departemen Keuangan (Ministry of Finance)
DEP. TAN.	:	Departemen Pertanian (Ministry of Agriculture)
DDPP	:	Debris Disaster Prevention Project (so called G. Kelud Project)

DGWRD	:	Directorate General of Water Resources Development (Direktorat Jenderal Pengairan)
DGCK	:	Directorate General of Cipta Karya (Direktrorat Jenderal Cipta Karya)
DGBM	:	Directorate General fo Bina Marga (Direktorat General of Highways)
DI	:	Directorate Irrigation (Direktorat Irigasi)
DPUP	:	Dinas Pekerjaan Umum Propinsi (Provincial Public Works Service)
DPUK	:	Dinas Pekerjaan Umum Kabupaten (Kabupaten/Region Public Works Service)
BPP	:	Bolai Penyulahan Pertanian (Agricultural Extension Service)
PPS	:	Penyuluh Pertanian Spesialis (Agricultural Extension Specialist)
PPM	:	Penyuluh Pertanian Madya (Agricultural Extension Supervisor)
GOI	:	Government of Indonesia (Pemerintah Republik Indonesia)
IKK	:	Ibu Kota Kecamatan (Sub-district)
INMAS	:	Intensifikasi Massal (The continuation scheme to BIMAS after the first year)
IPEDA	:	Iuran Pendapatan Daerah (Village Land Tax)
PAB	:	Proyek Air Bersih (Water Supply Project)
PLN	:	Perusahaan Umum Listrik Negara (State Electric Co.,)
Prop.	:	Propinsi (Province)
PERHUTANI	:	Perusahaan Hutan Indonesia (Department of Forestry)
PROSIDA	:	Proyek Irigasi IDA (IDA Irrigation Project)
PDAM	:	Perusahaan Daerah Air Minum (Water Supply Authority)
PUSKESMAS	:	Pusat Kesehatan Masyrakat (Community Health Centre)
PLTA	:	Pembangkit Listrik Tenaga Air (Electric Hydro Power Plant)

EJIP	:	East Java Irrigation Project
EJGP	:	East Java Ground water Project
P2AT	:	Ground Water Development Project
SMA	:	Surabaya Metoropolitan Are
UPP	:	Unit Pelaksana Proyek (Project Implementation Unit)

(3) International or Foreign Organization

ADB	:	Asian Development Bank
FAO	:	Flood and Agriculture Organization of the United Nations
GOJ	:	Government of Japan
IBRD	:	International Bank for Reconstruction and Development
IMF	:	International Monetary Fund
IRRI	:	International Rice Research Institute
JICA	:	Japan International Cooperation Agency
MOC	:	Ministry of Construction, Japan
OECD	:	Organization for Economic Cooperation and Development
OECF	:	Overseas Economic Cooperation Fund, Japan
UK	:	United Kingdom
UNDP	:	United Nations Development Program
US or USA	:	United States of America
US/AID	:	United States of Agency for International Development

(4) Others

B	:	Benefit
BOD	:	Biochemical Oxygen Demand
C	:	Cost
CIF	:	Cost, Insurance and Freight
COD	:	Chemical Oxygen Demand
dia	:	Diameter
EIRR	:	Economical International Rate of Return
EL.	:	Elevation above mean sea level
Eq(s).	:	Equation(s)

Fig(s)	:	Figure(s)
FOB	:	Free on Board
FSL	:	Full Supply Level
FWL	:	Flood Water Level
GDP	:	Gross Domestic Product
GRDP	:	Gross Regional Domestic Product
CPI	:	Consumer Price Index
H	:	Height, or water head
HWL	:	High Water Level
LWL	:	Low Water Level
O & M	:	Operation and Maintenance
Q	:	Discharge
Ref.	:	Reference
RF	:	Rainfall
SHVP	:	Surabaya Haven Vloed Peil
SITH	:	Standard International Trade Classification
SS	:	Suspended Solid
V	:	Volume
W	:	Width
WL	:	Water Level
WCC	:	Water Control Center
WMS	:	Water Management System

(5) Special Indonesia Terms

Bupati	:	Administrative Chief of a region
Camat	:	Administrative Chief of a Kecamatan
Desa (ds)	:	Group of villages
Gunung (G)	:	Mountain
Golongan (Gol.)	:	An areal Sub-Devision
Giliran	:	Irrigation Rotation System
Juru Jogotirto	:	Village Water Distribution Supervisor
Juru Air	:	Irrigation Field Inspector responsible for several tertiary units.
Kabupaten (Kab.)	:	Regency
Kali (K)	:	River
Kecamatan	:	District

Kepala Desa	:	Head of village
Kotamadya	:	Municipality
Kota	:	Town or city
Kampung	:	Village
Lahar (cold)	:	A mud flow composed of volcanic debris. The flow is caused by heavy rainfall washing volcanic ash from the slopes of a volcano during an eruption.
Lahar (hot)	:	A mixture of hot volcanic material and crater lake water which flows down the slopes of a volcano during an eruption
Padi	:	Rice
Polowijo	:	Collective term for all annual crops other than rice and sugar
Propinsi	:	Province
Sawah	:	Rice Field
Tegal	:	Non sawah land use for crops other than rice
Tanjung (Tg)	:	Cape.

ABBREVIATIONS OF MEASUREMENT

Length

mm	:	millimeter
cm	:	centimeter
m	:	meter
km	:	kilometer
ft	:	foot
yd	:	Yard

Area

cm^2	:	square centimeter
m^2	:	square meter
ha	:	hectare
km^2	:	square kilometer

Volume

cm^3	:	cubic centimeter
l	:	liter
kl	:	kiloliter
m^3	:	cubic meter
gal	:	gallon

Weight

mg	:	milligram
g	:	gram
kg	:	kilogram
ton	:	metric ton
lb	:	pound

Time

s	:	sec : second
min	:	minute
h	:	h : hour
d	:	day
y	:	yr : year

Electric Measures

V	:	Volt
A	:	Ampare
Hz	:	Hertz (cycle)
W	:	Watt
KW	:	Kilowatt
MW	:	Megawatt
GW	:	Gigawatt

Others

%	:	percent
PS	:	horsepower
°	:	degree
'	:	minute
"	:	second
°C	:	degree centigrade
10^3	:	thousand
10^6	:	million

Derived Measure

m^3/s	:	cubic meter per second
mg/d	:	million gallon per day
kWh	:	Kilowatt hour
MWh	:	Megawatt hour
kWH/y	:	Kilowatt hour per year

Money

Rp	:	Indonesian Rupiah
US$	:	US dollar
¥	:	Japanese Yen

Exchange Rate (average in (October 1985)

US$: Rp.1,100 : ¥210

PART I BACKGROUND AND CONDITIONS

CHAPTER 1 INTRODUCTION

LIST OF TABLE

1. INTRODUCTION

1.1 Authority

The study of the Widas Flood control and Drainage Project (the Project) has been carried out in accordance with the Scope of Works agreed in the Minutes of Meeting exchanged between Directorate General of Water Resources Development, Ministry of Public Works, the Government of Indonesia (GOI) and the Government of Japan (GOJ) on March 3, 1984.

In accordance with the said Scope of Works, the study was divided into PART I and PART II. The PART I Study aimed to review the master plan for the Brantas river basin development, East Java, Indonesia, which was formulated by the then Overseas Technical Cooperation Agency (OTCA). The PART II Study covers the feasibility study of the highest priority projects among those in the Widas river basin developement plan, which were worked out in the PART I Study.

The PART I Study commenced in June, 1984 and ended in March, 1985. The PART II Study started in June, 1985 and completed in March, 1986.

This report is the Feasibility Report of the PART II Study.

1.2 Background of the Project

In the PART I Study, the overall development plan for the Brantas river basin prepared by the then Overseas Technical cooperation Agency (OTCA) in 1973 and the progress of development were reviewed and the present and furture socio-economic conditions were studied. As the results of review and study, the following points were made clear;

(1) The land and water resources development has been well performed and the available dry season runoff in the main stream of the Brantas river after regulation by reservoir is fully utilized for irrigation, domestic and industrial water supply, river maintemance, etc. To cope with the furture increase of domestic and industrial water demands, it will be necessary to exploit the water resources further as well as to coordinate water demand and supply through a basin-wide water management system.

(2) As a whole, the land and water resources development has been performed well, but there remain less-developed areas; Lesti area, Trenggalek area, Widas river basin, Beng area and Lesti area, where economical development of the water resources is difficult.

From the viewpoint of equitable development of the Brantas river basin, the Widas river basin has been taken up as the objective area of the PART II Study, and feasibility of the flood control and drainage, improvement and the dam and irrigation development are examined.

The Widas river basin having a catchment area of 1,538 km^3 locates in the northwestern corner of the Brantas river basin in East Java, Indonesia. Besides the obligation of retarding function of flood for the main Brantas river, the drainage systems in the Widas river basin have been poorly developed. The lowland areas of about 45 m above the mean sea level have suffered from habitual inundations. In 1979, a big flood which is deemed equivalent to the 25-yr probable flood attacked the basin and caused inundation over the areas of 9,000 ha for about 2 weeks, and casuality of 20 persons.

Immediately after the 1979 flood, BRBDEO examined possible countermeasures against flooding, and prepared a report titled as "Comprehensive Study Report on the Widas Basin Flood Control and Drainage Project". The report proposed three flood control dams, river channel improvement in the stretches of about 100 km long, and improvement of three retarding basins. However, this proposal was not realized so far.

Although having handicaps of habitual inundation, the basin economy has grown rapidly, and urbanization is in progress with high rate in Nganjuk, Lengkong, etc. According to accumulation of properties in the basin, it is feared that if a large flood like the 1979 flood once occurs, the flood damage would amount far beyond the 1979 flood damages. Realizing such large potential flood damages and seeing the successful drainage improvement in the Tulungagung area, the inhabitants in the Widas basin strongly desire urgent implementation of the flood control and drainage works.

1.3 Technical Cooperation

GOI has realized the necessities of the flood control and drainage improvement and dam and irrigation development in the Widas river basin as well as the necessities of review of the overall development plan for the Brantas river basin, and requested GOJ to provide a technical aid for study and planning of the above works. In request, GOJ decided to extend the technical cooperation through Japan International Cooperation Agency (JICA). Accordingly, JICA has organized a Study Team of the professional members in the respective fields of the Study and established an Advisory Committee to provide technical back-up to the Study Team. GOI provided the counter part engineers and expects and carried out field investigation and laboratory tests.

Review of the overall development plan for the Brantas river basin was carried out in 1984 - 1985 as the PART I Study. Following the PART I Study, the PART II Study was carried out in the period from June 1985 to March 1986.

The members of the Advisory Committee, the Study team and the counterpart engineers for the PART II Study are list in Table 1.1.

1.4 PART II Study

The agreement between GOI and GOJ defined the Scope of the PART II Study as follows;

To prepare a feasibility study for the purpose of flood control and irrigation development of the Widas river basin, in accordance with the review of the master plan.

(1) Collection and analysis of all data relevant to the Study

(2) Topographic survey, geological survey and soil test, if necessary

(3) Hydrological and hydraulic study

(4) Land and water use study

(5) Survey on construction material, labour force and construction method

(6) Formulation of the basin development plan (flood control, drainage irrigation and sediment control)

(7) Identification of alternative development plan

(8) Preparation of preliminary engineering design for the proposed project

(9) Verification of feasibility

a. estimation of costs and benefits

b. economic and financial evaluation

c. evaluation from social and environmental viewpoint

d. implementation schedule

In the PART I Sutdy, the water resources development in the Widas river basin was examined from the basin-wide point of view and the following were concluded. (Refer to Final Report of PART I Study Chapter 3);

(1) The Widas river basin works as retarding basin of the main Brantas as planned in the Brantas Middle Reaches River Improvement Project. If all the existing retarding functions were removed by confining the floods in the river channel, the flood peak discharge in the main Brantas would increase remarkably and reimprovement of the lower reaches of the Brantas river would be needed. Economic feasibility of the full confinement plan was found not to be high besides the social disturbances due to reimprovement of the main Brantas. Further, if the full confinement plan is taken, implementation of the flood control and drainage improvement in the Widas river basin has to wait until completion of the reimprovement works in the main Brantas. From the above, the flood control and drainage improve- ment works have to be formulated not to increase the outflow from the Widas river basin into the main Brantas beyond the outflow

under the present condition. However, owing to the topographic reason, there is no suitable site for economic and effective flood control reservoir in the watershed area. Then, it is obliged to use the existing retarding basins in the plain area.

(2) As for water source for irrigation development project, three dams were examined; Kuncir, Semantok and Kedungwarak. The Kuncir and Semantok were found not to be feasible due to the topographic and geological conditions. Although the Kedungwarak dam and irrigation development in the north-eastern part of the Widas river basin was found to be marginally feasible, this project was taken up from the viewpoint of regional equitable development, since the economic and living conditions in this area have been suppressed near to the subsitence level by shortage of irrigation water.

Based on the conclusions reached in the PART I Study.

The Study Team submitted the Inception Report in March 1985, presenting the scope of works, basic condition, approach to the project, plan of operation and study schedule. The contents of the Inception Report were accepted by GOI during the meetings on the Draft Final Report on the PART I Study held in March, 1985.

The basic conditions thus accepted by GOI are as follows;

(1) Basic condition of flood control scheme

(a) Design flood for overall flood control scheme is taken at 25-yr probable flood.

(b) Stagewise implementation is to be considered. The first stage plan is to be formulated with 10-yr probable flood.

(c) Maximum outflow from the K. Widas into the main Brantas is to be 270 m^3/s which is the estimated maximum under present river condition. Namely, the K. Widas flood control scheme is to be formulated in such that no increase of outflow from the K. Widas into the main Brantas arises from its improvement.

(d) Flood control by dams is not considered.

(2) Basic condition of dam and irrigation scheme

(a) Kedungwarak dam and its command area for irrigation are the objectives of the feasibility study.

(b) Other dam and irrigation schemes are not taken up for feasibility study this time.

The Progress Report covering the results of survey and investigation for the PART II Study carried out during the PART I Study period was submitted in March, 1985.

The Interim Report was submitted in August 1985, presenting the optimum development plans for the flood control and drainage component and the dam and irrigation component. The contents of the Interim Report were accepted by GOI.

The Draft Feasibility Report was submitted in January 1986. The comments of GOI on the Draft Feasibility Report were officially communicated to the Study Team on February 13, 1986. Then, finalization of the Report was made taking into account the comments of GOI.

1.5 Contents of Feasibility Report

The Feasibility Report presents all the results of the Study. The report consists of four major parts; PART I Backgrounds and conditions, PART II Flood Control and Drainage Plan, PART III Dam and Irrigation Development plan and PART IV Conclusion and Recommendation.

PART I consists of three chapters, including this chapter and presents introductory description of this report, present conditions of the study area and available data on which this Study is formulated. PART II consists of seven chapters and PART III consists of ten chapters. Each PART describes present conditions, hydrological analysis, comparative studies, proposed development plan, construction plan and cost estimate and evaluation of the respective project.

Table 1.1 THE MEMBER OF ADVISORY COMMITTEE
STUDY TEAM AND COUNTERPARTS

THE MEMBER OF ADVISORY COMMITTEE

1. T. IWAKIRI	CHAIRMAN	Ministry of Construction
2. T. FUJIYOSHI	RIVER	Ministry of Construction
3. K. OKAYAMA	HYDROLOGY	National Land Agency
4. M. WATANABE	AGRICULTURE/ IRRIGATION	Ministry of Agriculture, Forestry and Fisheries
5. M. HAYASHIDA	AGRICULTURE/ IRRIGATION	Ministry of Agriculture, Forestry and Fisheries

COORDINATOR

1. H. KUTSUNA	JAPAN INTERNATIONAL COOPERATION AGENCY

THE MEMBER OF STUDY TEAM AND COUNTERPARTS

No. Sector	Personnel	
	The Study Team	Counterparts
1. Team Leader	H. Sato	Ir. Sutadji Dipl. HE.
2. Co-leader and Dam	S. Ohtsuki	Ir. Sumadji
		Ir. Syariful Effendi
3. Water resource	T. Imai	Ir. Wahyudi Utomo
4. River engineering	T. Nobe	Ir. Tulus HB
		Ir. Sri Astuti
5. River structure	K. Takahashi	Ir. Rudy Suwarto
6. Agriculture	S. Kanekawa	Ir. Puguh Saktiono
		Ir. Kusharto
7. Irrigation	H. Matsuura	Ir. Dhiang Pinardi
		Ir. Ismi Farida
8. Electricity	H. Ebisawa	
9. Hydrology	S. Sakamoto	M. Sahid BE.
10. Soil Mechanics	Y. Nakano	Hardjito BE
11. Geology	M. Fujinami	Basuki Rachmad BE
12. Bridge engineering	T. Honda	Ir. Nugroho Adhy
13. Construction planning	K. Yamazaki	Ir. Didik Pudjirahardjo
14. Environment	T. Ohhashi	Drs. Widodo
15. Project Economy	M. Tada	Drs. Bambang H.S

CHAPTER 2 PRESENT CONDITIONS OF THE STUDY AREA

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2. PRESENT CONDITIONS OF THE STUDY AREA

2.1 Introduction

This Chapter explains the present conditions of the study area form viewpoints of physical, administrative, and socio-economic conditions, for clarification of the environment of the Project.

The "Study area" used in this report means the area of the Widas river basin, and the "Project area" means the areas to receive benefits (positive and/or negative) from the project facilities under the study.

2.2 Physical Conditions

2.2.1 Basin and topography

The Widas river basin is one of the large sub-basins of the Brantas river in East Java, and has a catchment area of 1,538 km^2. The Widas basin is bounded by the Brantas river in the east, by the Wilis Mountain Complex in the south and south-west, and by the low hills called as "Kedung Ridge" in the north-west and north, as shown on Fig. 2.1.

The highest peak in the basin is Mt. Liman of EL. 2,563 m in the south-west corner of the basin. The volcanic cone of the Wilis Mountain Complex covers the area around 20 km from Mt. Wilis. The highest in the Kedung Ridge is Mt. Pandan of EL. 897 m. The Kedung Ridge is low hills ranging EL. 100 - 200 m. Between the Wilis Mountain Complex and the Kedung Ridge, low alluvial plains have been developed. The area below EL. 50 m is around 360 km^2 and the area between EL. 50 and 100 m is around 440 km^2.

2.2.2 Climatic conditions

The climatic conditions in the basin are dominated by the tropical monsoons with two distinct seasons. The wet seasons extends for about six months from November to April. The average annual rainfall is about 1,600 mm and more than 80 percent of the annual rainfall occurs during the wet season. The mean temperature ranges from 27.3°C to 25.6°C. The monthly mean relative humidity varies from 87.1% to 73.3%. (Ref. Table 2.1.).

2.2.3 Geology

The Widas basin is divided into three topographic and geologic sub-regions (Fig. 2.2). The first sub-region is the Kedung Ridge which consists of Quarternary and Tertiary formation. The hill (average height 100 to 200 m) is located at the northern part and extends in the east-west direction. The second sub-region caracterized by low flat alluvial plain extends in the south of the Kedung Ridge. It is bordered by the Brantas river in the east, and bounded by the volcanic Wilis Mountain Complex. The last sub-region is the volcano Wilis (2563 m) which was composed of Tuff breccia and pyroclastic flow of pleistocene Epoch.

The general geologic condition in the Widas basin is shown in Fig. 2.2 and 2.3, and the stratigraphy is shown in Table 2.2.

The sedimentary formations of Quarternary are divided into several formations. They are mainly composed of tuffaceous sandstone, tuff, tuffbreccia, claystone, conglomeratic sandstone which belong to the Notopuro formation, Kabuh Formation and Puchangan Formation of Pleistocene in the Kedung hill.

The sedimentary formations of Tertiary in the project area of Kedung hill is mainly composed of marl and limestone which belong to the Kalibeng Formation.

The volcano Wilis consists of Wilis tuff breccia, Wilis Pyroclastic flow and Talus deposit of Wilis Group Product.

2.2.4 Soils

Soils and land capability in the Widas river basin were surveyed and studied by the Soil Research Institute, Bogor in 1973, and soil and land capability maps were also prepared on a scale of 1 to 250,000.

According to the survey of Soil Institute of Bogor, soils in the Widas basin are classified into three major groups, namely alluvial, litosol and mediteran on the basis of the soil classification system of Indonesia. The soil map in the Widas basin is presented in Fig. 2.4. The alluvial soil extends over the flat plain. In the piedomant of the Mt. Wilis, yellowish grey alluvial prevails. Dark grey alluvial widely extends over the low-lying plain. Litosol distributes locally in the Kedung Ridge. This area is covered with Jati forest. Mediterant soil covers the hilly area.

From the agricultural view point, the areas covered with alluvial soils is the most productive.

Grumosols develop over the undulating alluvial lands enclosed with flat plains and hilly lands. The soils have grey or black heavy clayey soils formed on calcareous alluvium. These soils have characteristics to be swelling and sticky when soils become wet and to be hard and deeply cracked when dry. As a result, micro-relief called gilgai is developed at the ground surface. From the drainability these soil group is poor. These soils are very suitable for paddy cultivation with irrigation practice.

Cambisols covering the Widas Extension Area is about 40% of total area. Cambisols are member of inceptisol order that generally have a cambic horizon. They are ranging from poorly drained to well drained and they normally occur on old and young deposits. They are rich in bases, with a base saturations that is 50% or more in all subhorizons between 25 cm and 120 cm. They have an ustic regime and have CEC (Cation exchange capacity) of 24 ml/100 g in all horizons above alithic contact. The content of organic carbon decreases regularly down to 0.2% or less, within 125 cm in depth. Secondary line may occur below the cambic horizon. Cracking is quite common, but it is not deep enough to satisfy the criterion of vertisols. At present such soils area are used

the criterion of vertisols. At present such soils area are used to grow rice extensively in the rainy season in particular. Undoubtedly these soils can be used extensively to grow rice with subsequent water supply.

2.2.5 River system

The Widas river which has its source on the northern slopes of Mt. Liman (EL. 2,563 m), is a main drainage way of the basin. From Mt. Liman, it flows down northerly for about 30 km, then turns to east. At the turning point, the Widas river is joined by the Bening river, a left tributary on which the Bening dam is located. Downstream from the confluence with the Bening river, the topography changes from mountain to valley. Downstream from the confluence with the Bening river it flows easterly collecting some tributaries on the left bank. In this reach, the topography changes from valley to plain and the meandering of the river course becomes remarkable. After flowing down eastwards for about 20 km, the Widas river joins the largest tributary of the Kendungsoko river on the right bank. Total catchment area and river length at this confluence are approximately 1,120 km^2 and 60 km respectively.

Downstream from the confluence with the Kedungsoko river, the Widas river flows northeasterly for about 25 km towards the confluence with the Brantas river. Also the river course of the Widas in this reach remarkably meanders. The total river length of the Widas at its river mouth is about 85 km.

The other main tributaries in the Widas river basin are the Ulo river and Kuncir river which join the Kedungsoko river on its left bank.

The river slope in the upper catchment is very steep although there is a pronounced change to the plain area. The general profiles of the main rivers are shown on Fig. 2.5. The physical features of the Widas river basin are given below.

River	Catchment Area (km^2)	River Legnth (km)	River Slope		
			Above 100 m Contour	Below 100 m Contour	Whole
Widas	714	85	1/9.1	1/955	1/35.9
Kedungsoko	637				
Kedungsoko	384	42	1/8.1	1/361	1/17.8
Ulo	112	41	1/11.8	1/408	1/28.1
Kuncir	141	42	1/10.7	1/302	1/17.8
Warujayeng area	187				
Total	1538				

2.3 Administration and Organization

Administration

Jurisdictionally, the Widas basin is composed of three Kabupatens; Nganjuk, Kediri, and Madiun as shown on Fig. 2.6. Kab. Nganjuk whose whole area (about 1,215 km^2) included in the basin covers about 79% of the basin. The total number of Kecamatans and desas entirely or partly included in the basin is 23 and 313 respectively as listed in Table 2.3.

Organization

Organizations relating to water in the Widas basin are Irrigation Section Nganjuk under Irrigation District Kediri, and BRBDEO under Bureau of River. BRBDEO taking responsibility for river management including lowflow executes construction and maintenance of the main Brantas and its major tributaries.

2.4 Socio Economic Conditions

2.4.1 General

The objective of this section is to clarify the fundamental problems by explaining present conditions of socio-economy in the Widas river basin. The present socio-economic condition covers the following aspects.

- Land use and geography
- Population and labour force
- Economic activity
- Public investment on infrastructure
- Social indicators
- Analysis of local government budget.

Most of the data referred to in this sub-section were publication issued annually and detailed data collected from Bapeda, Kecamatan office, and so on. In case of Kecamatans such as Gemarang and Saradan (Kab. Madiun) which are partially covered by the basin, data on these Kecamatans are interpreted with adjustment by area ratio. The proportion of area included in the basin to total area in Kec. Gemarang and Sarandan is taken up as 50% and 25% respectively.

2.4.2 Land use and geography

The mountaineous area in south and south-west are suitable for plantation like cloves, vegetables, and kinds of fruits. The area around low hills (Kedung Ridge) in the north of Widas river basin is characterized by lime formation geologically, having teak forest within that area. The middle area featured by low plain is endowed with water resources, where paddy and secondary crops are mainly produced. Administratively, the middle area corresponds to several Kecamatans such as Bogor, Baron, Kertosono, Tanjunganom, Ngronggot and Prambon. On the

contrary, the area of Widas North (Kec. Ngluyu, Lengkong and Gondang) suffereing from water shortage is in a poor condition in terms of crops production.

Rivers penetrating through the Widas river basin tend to cause flood in rainy season. The flood from main tributaries such as Kuncir, Ulo, Kendungsoko river pours down into the Widas river. Farm land and settlement area along these rivers suffer from innudation. In particular, the flood occured in 1979 brought about a destructive damage to houses, farm land and public facilities. The area affected by flood were Kec. Sukomoro, Lengkong, Gondang and part of Warujayeng area. Within the flood area there are railway and provincial road connecting Surabaya with Kota Nganjuk, and Kabupaten road connecting Kota Nganjuk, Kertosono with Kotamadya Kediri. So, economic activities has been regularly interrupted by flood, due to temporary deterioration of transportation function.

The categories of land use in the Widas basin are shown in the following table.

Category	Area (km^2)	Percentage (%)
Paddy field	471	30.6
Upland field	129	8.4
Forestry	455	29.6
Settlement, House Yard	206	13.4
Others	277	18.0
Total	1538	100.0

Remarks: Land use in Kec. Saradan and Gemarang of Kab. Madiun included in the Widas basin is examined based on a map with a scale of 1:50000.

The total farm land is approximately 41% of the Widas basin, of which paddy and upland field occupies 32% and 9% respectively. The area of forestry occupying 30% of the basin is mostly situated in Kecamatans belonging to Widas North. The settlement area is unevenly distributed by Kecamatan. The Kecamatan having its biggest percentage of settlement to total area is Tanjunganom. The detailed categories of land use by Kecamatan is shown in Table 1.1 of ANNEX-1.

2.4.3 Population and labour force

Population

The population in the Widas river basin was estimated at about one million in 1980. The average population density in the basin was 705 person/km^2 in 1980. The highest population density was 2,530 person/km^2 in Kec. Nganjuk, followed by Kec. Kertosono.

The population growth rate in the basin between 1971 and 1980 was 1.39% p.a. which was lower than the corresponding rate (1.50% p.a.) in East Java and (2.43% p.a.) in entire Indonesia. The highest growth rate of population was around 2% p.a. between 1971 and 1980 in Kec. Nganjuk, where urbanization process has taken place.

The average family size in the basin was about 4.7 person/house in 1980. The detailed data concerning population, and family size are shown in Table 2.4.

Migration

Table 2.5 shows the total number of migrant from Kab. Nganjuk to outside Java during Repelita III based on criteria of regional origin. The total number of migrants were about 18,500 persons during Repelita III. The biggest portion of migrants resulted from critical area in terms of soil conditions and reforestation. Flood and high population density were also major reasons of migration. The more detailed number of migrants by Kecamatans is shown in Table 1.2 of ANNEX-1. The largest number of migrants came from Kec. Rejoso whose regional condition for migration is derived from reforestation for preventing the area from land slide or critical soil condition.

Table 2.6 shows the classification of financial sources for migrants who moved from Kab. Nganjuk to outside Java during Repelita II. The financial source mostly comes from fund of Central government in terms of the number of migrants, whose percentage was about 95% of total number of migrants. The remaining migrants were supported by provincial government of East Java or spontaneous ones without financial support.

Urbanization

Central statistical offices established a realistic definition of Urban area, based on social condition of desa with the following aspects.

- population density within the desa; a density of more than 5000 per km^2 is defined as urban.
- percentage of agricultural households; a percentage of less than 25 is defined as urban.
- the number of urban facilities; a desa containing 8 or more is defined as urban.

The determination of urban desa is based on a combination of the above definition which adopts a points system shown in Table 1.3 of ANNEX-1.

Based on the above points system, urban desas are situated in Kec. Berbek, Loceret, Kertosono, Patianrowo, Baron, Tanjunganom, Nganjuk and Bogor. The most of urban population concentrates on Kec. Nganjuk, Kertosono, and Tanjunganom.

As an indicator, urbanization can be assessed by ratio of urban population to total population by area. As shown in Table 1.4 of ANNEX-1, its ratio of Kab. Nganjuk was 9.94% in 1980. However, the same ratio was around 20% and 22% in East Java and Indonesia in 1980.

Table 2.7 shows population of age group based on urban and rural area. The percentage distribution of population classified by age group in urban area was almost the same as that in rural area in 1980, however, percentage of the age from 15 to 24 in urban area was slightly higher than the corresponding one in rural area. The more detailed population by Kecamatans based on urban and rural area is shown in Table 1.5 of ANNEX-1.

Employment Condition

Employment of year 1980 specified by economic sectors is shown in Table 2.8. Population engaged in agricultural sector which was the dominant economic activity of the Widas basin, is estimated to constitute about 83.5% of total employment figures, followed by trade sector (7.5%), public & private sector (7.1%) and manufacturing sector (1.9%). As far as employment composition by kecamatan is concerned, both of Nganjuk and Kertosono shows the low percentage of agricultural population, while percentage of population engaged in public & private and trade sectors of two Kecamatans was much higher than the corresponding percentage of other Kecamatans.

Table 2.9 shows the further classification of employment composition into urban and rural area. Population engaged in agricultural sector of urban area shows 35% of total employment figures, while the corresponding percentage was around 88% in rural area. With respect to employment percentage of public & private and trade sector, urban and rural area show 57%, and 10.7% respectively.

2.4.4 Economic activity

Development Indicators

As development indicator for assessment of regional income, non-mining GRDP per capita is taken up for comparing income of Kab. Nganjuk to that of East Java and Indoensia. As shown in Table 2.10, index level of non-mining GRDP per capita only shows slight improvement from 64.5 to 67.9 during 1975-1982 in Kab. Nganjuk, provided that index of average Indonesian level is equal to 100 in 1975 and 1982 respectively.

Macro Economics Indicators

Agricultural sector which was main economic activity in the basin constituted about 60% of GRDP of Kab. Nganjuk in 1982. The GRDP share by agriculture was higher in Kab. Nganjuk than that in East Java and whole Indonesia, 34% and 26.3% respectively in 1982. Out of the GRDP share by agriculture in Kab. Nganjuk, food crop sector occupied 41% of GRDP in 1982, although its GRDP share declined from 45.3% in 1975.

Estate crops sector consisting of small holder shows the rising trend of its GRDP share from 2.2% in 1975 to 7.8% in 1982. The sector of forestry which was principal natural resource in Kab. Nganjuk kept its GRDP share constant around between 5% and 8% during 1975 - 1982.

The GRDP share of manufacturing industry (2.7%) was much lower than the corresponding share in East Java, and entire Inodnesia, 15.3% and 12.9% respectively in 1982. This is ascribed to the size of manufacturing industry in Kab. Nganjuk which mostly consist of house hold industries.

The GRDP of trade sector was the second largest share in 1982, however its GRDP share fluctuated around percentage between 10.5% and 14.0% during 1975 - 1982.

An annual growth rate of GRDP of Kab. Nganjuk was 8% at 1975 constant price during 1975 - 1982. The same rate of GDP was 7% during the same period. As far as sectoral growth rate is concerned, agricultural sector shows the lowest percentage 3.7% p.a of which annual growth rate of food crop sector was the lowest, only 1.2%. Nonetheless, the same rate performed by estate crop sector was substantially high, 24.7%. Other sectors which showed high economic performance was Mining, Manufacturing industry, Construction, and Transport. Data concerning macro economic indicators of Kab. Nganjuk are shown in Tables 2.11 and 2.12, whereas those of East Java and entire Indonesia are shown in Tables from 1.6 to 1.9 of ANNEX-1.

Agricultural Production

The major food crops produced in Kab. Nganjuk are paddy, maize, cassava, groundnut and soybean. Table 2.13 shows the production by respective food crops of the Widas basin and East Java in 1983. The production of paddy was the biggest among food crops, followed by cassava and maize in Widas basin. The total production of paddy, cassava, and maize was about 0.33×10^6 ton, 0.14×10^6 ton and 0.07×10^6 ton respectively. The ratio of these respective crop production in Kab. Nganjuk to those in East Java was around 4%.

Historical trend of food crop productions fluctuated between 1975 and 1982, which is shown in Table 2.14. In particular, the years of 1979 and 1982 were special ones when destructive flood and severe drought took place respestively. Paddy production dropped sharply in 1979, due to destructive flood which occurred before harvesting time of rainy season paddy in that year.

As shown in Table 1.10 of ANNEX-1, paddy was the principal crop in terms of its production share by Kecamatans of Kab. Nganjuk. Whereas the production share by secondary crops was virtually high in Kec. Grogol, Gemarang, and Saradan. Tables 1.11 and 1.12 of ANNEX-1 show production of food crops per household by Kecamatan and net income per ton of each food crop. Based on these Tables specified the above, agricultural income originated from food crop production is calculated in Table 2.15. The ratio of land to farm household indicates the

average size of farm land (paddy + upland field) owned by a farm housefold. Having calculated agricultural income per household by Kecamatan, an arrangement is required to express income per household as that per Ha for the purpose of income comparison between Kecamatans. The result understood by this Table can be concluded in such a way that although the average size of farm land is virtually higher in Kecamatan of Widas North area than that in Kecamatans of Warujayeng area, the net income of crops per Ha is much lower in the former than that in the latter. For example, the net income of food crops per Ha was around 0.5 x 10^6Rp. in Kec. Lengkong and Gondang, whereas it was around 1.3 x 10^6 Rp. in Kec. Tanjunganom. Nevertheless, to the extent that income is evaluated based on only food crops, it tends to be underestimated in some Kecamatans where estate crops or vegetables are also produced.

As other major crops featuring agricultural production in the basin, tobacco and sugarcane are taken up as estate crops. As shown in Table 2.16, the production of tobacco and sugarcane was around 7,900 and 31,000 ton in 1983.

Table 2.17 shows historical trends of estate crops production in 1975 and 1980, 1981 and 1982. In particular tobacco and sugarcane show a remarkable development of production.

As the promotion of estate crops, the government launches so-called UPP programme which is financed by Indonesian People's Bank Credit. Sugarcane is one of the target crops of Estate Production Development Project (UPP) programme. Estate crops in Kab. Nganjuk are produced by small holders. Therefore credit supply programme is definitely required to promote estate crops by small holders. Table 2.18 shows production and harvested area of sugarcane under UPP programme in Kab. Nganjuk in 1982/83. As far as harvested area of Kab. Nganjuk is concerned, the coverage of harvested area under UPP programme was about 13% in 1983.

Manufacturing Industry

Manufacturing industry plays a minor role of economic activity in the Kab. Nganjuk because most of manufacturing industries consists of household establishment. Although the number of small industry was much smaller than that of household industry, its production value was nearly as twice as that of household industry. Kinds of manufacturing industries are almost converged on labour-intensive or light industry. Data related to manufacturing industry is shown in Tables from 2.19 to 2.21.

Trade Sector

Most of commodity sales were related to agricultural products which constituted about 82% of total sales in 1982. Others were industrial goods or products related to mining sector. Most of sales was dealt in local market. Trade value between Kab. Nganjuk and other regions was only about 10% of total sales value dealt in local market. Data on trade sector are shown in Tables 2.22 and 2.23.

2.4.5 Public investment on infrastructure

Projects related to irrigation and rivers

Irrigation projects or projects related to flood control are properly under the responsibility of D.J. Pengairan (Irrigation Section) of Public Works. However, financial source for supporting these projects is complicated. As shown in Table 2.24, funds are divided into three sources, provincial or regional government, grants from central government and central government budget. It is clear that most of funds is originated from central government budget which occupied about 95% of total funds in 1984/85. Major projects were financed form central government budget. They are the Brantas Middle Reach Project, Ground Water Development Project, East Java Irrigation Project, Widas Project, and Waru-Turi Project, of which Projects related to rivers are Brantas Middle Reach and Widas Project.

Although projects concerning irrigation and rivers have been conducted so far, there are two problems that are not completely solvable. One is flood occurrence which mainly brings damage to areas such as Lengkong, Sukomoro, and Warujayeng. Flood damage is mostly found in the paddy field. So, improvement of flood control facilities is closely correlated to irrigation development. The other is water shortage matter during dry season. In particular, irrigation areas belonging to Widas North are often in short of water. Thus, a continuous water works have to be required. Detailed list of projects carried out in Kab. Nganjuk is shown in Table 1.13 of ANNEX-1.

Road and Bridge Project

Improvement and maintenance of these projects are under the responsibility of Bina Marga (D.J of Highway). Table 2.25 shows detailed public investment on these projects during recent two fiscal years. With respect to road projects, public investment on state/provincial road, or regional Kabupaten road, constituted about 88% and 92% of total investment in 1983/84 and 84/85 respectively. Although length of rural road under project is quite short, improvement of rural road is often carried out in the form of Padat Karya Project whose objective is to encourage rural development through minor projects. Bridges existing in Kab. Nganjuk are mostly old facilities, so improvement or replacement of thcse bridges are required. Total amount of investment was 192 x 10^6 Rp and 631 x 10^6 Rp in 1983/84 and 1984/85 respectively.

Electric Power Supply

The program of increasing electric power supply plays an important role in development of economic activity or social welfare in towns and villages.

Present conditions of electricity supply from PLN in Kec. Nganjuk and Kertosono are shown in Table 2.26. Eelctrification percentage relating to houses increased from 47% to 56% in Kec. Nganjuk and from 55% to 61% in Kertosono during 1983/1984 - 1984/1985.

Increase of electricity supply into rural areas has been a principal concern of PLN. PLN, East Java Distribution extended the network of both transmission and distribution lines into 14 villages in 1984/1985. These villages are located in Kec. Kertosono, Baron, Tanjunganom, Loceret, and Ngronggot. PLN's projects for electricity supply into rural area was financed by central government budget. However, large rural area is still dependent on lump or other type of fuel for lighting.

2.4.6 Social indicators

Education and Health

The enrollment ratio is an important indicator to assess educational development. The enrollment in primary school was quite high, over 90% during Repelita III, since primary school was under compulsory service. However, the enrollment ratio in junior high school drops sharply down to around 50%. Other graduates from primary school are directly absorbed into local labour market or remained unemployed.

The ratio of pupil to classroom and teacher was around 30 in primary school. The ratios of pupil-classroom and pupil-teacher were around 44 and 18 respectively in junior high school.

With respect to availability of schools, the number of primary school are now averagely 2 or 3 in every village in Kab. Nganjuk. Junior high school are 3 in every Kecamatan averagely. The detailed data is shown in Tables 2.27 and 2.28.

Health services are based on local health center, Puskesmas and sub-branches. Government policy is to have 1 Puskesmas (therefore 1 doctor) per 30,000 people and a minimum of one per Kecamatan. Puskesmas are situated every Kecamatan, however, the number of people per Puskesmas was about 38,400 in 1980, which was over 30,000. General hospital (RSU) are only situated in Kec. Nganjuk and Kertosono. It is reported that the average number of patients per doctor per day was about 1300 in RSU. The detailed data is shown in Table 2.29.

2.4.7 Analysis of local government budget

Both of routine and development budget under the authority of regional government are derived from regional income (contribution, tax of property and land) and subsidy & loan of the central government. The remaining portion of budget is provided by the central government as grant, which constitutes about 53% of total budget in 1984/1985. As shown in Table 2.30, most of budget relating to regional development is originated from central government grant.

In terms of per capita budget, Table 2.31 shows that per capita budget in Kab. Nganjuk was only two thirds of that in East Java in 1983/84. This comparison would mean a necessity to increase public investment in Kab. Nganjuk.

2.5 Development Plan

2.5.1 Present problem

Having discussed present conditions of socio-economy in the Widas river basin, the outline of present problems can be clarified based on categorical conditions specified in the following:

(A) Natural Condition

1. Flood which takes place successively every year.
2. Water shortage problem, especially in the area of Widas North.

(B) Economic Condition

1. Stagnant economic growth of Food crops sector.
2. The low share of GRDP by both trade and industrial sector.
3. Low level of per capita output compared to national level

(C) Social Condition

1. Successive occurrence of flood damage.
2. Insufficient level of electricity supply.
3. Unemployment and low level on enrollment ratio relating to the youth.

(D) Financial Condition

1. Low level of public investment in terms of per capita budget.

2.5.2 Objectives of development plan

Present problems analyzed from various points of view will require the following objective, which is also presented in Repelita IV of Kab. Nganjuk.

- Equalization of social welfare among areas
- Solution of social problems.

With special attention to the project of flood control and dam & irrigation, the following contents are presented on the basis of objectives specified above.

The solution of flood problems has a good influence on the stabilization of social life as well as of economic activity. In particular, since farm land is heavily damaged by flood, the improvement of flood control facilities is closely related to social welfare in terms of preventing damage. Furthermore, a continuous effort to improve flood control facilities possibly contributes to land development because areas affected by flood so far will be no longer inundated. As a

result, economic development will be expected to activate in those areas. In this sense, public investment on infrastructure to solve flood problems is strongly recommended.

Since major economic activity is still based on agriculture, and most of labour force is engaged in agricultural sector, agricultural income is one of major factors which influence social welfare of people. Agricultural income is relatively lower in Widas North than that in other areas becuase water shortage is a constraint for an increase of crop production. In this respect, a substantial amount of public fund is required to be put on water works so as to increase crop production. As a result, an augment of farmer's income would contribute to not only improvement of social welfare, but also to rural development with the possible side-effect in the light of slowing down urbanization process.

Since it is expected that the area of Widas basin will be under influence of rapid development of Surabaya Metropolitan Area, a substantial amount of public investment on the flood control facilities and water works will be prerequisite to future development of the Widas river basin.

2.5.3 Forecast of basic economic and social indicators

Economic Growth

The annual economic growth up to the year of 2000 is assumed to be 5% which is the moderate growth rate, compared to 8% performed during 1975 - 1982. An annual economic growth rate after 2000 is assumed to be 4%.

Population Projection

The population growth rate in the Widas river basin in the period from 1971 to 1980 was lower than the national average. It is assumed that the same tendency will continue in future.

The population growth rate of Indonesia up to 2000 is based on the medium estimate of birth and mortality rate estimated by the BUREAU of census, USA. After 2000, these birth and mortality rates are extended beyond the year 2000 up to the year 2050.

AS for the population growth in SMA, the population projection prepared by the Urban Study /1 is taken and after 2000, the population growth rate is assumed to be lower than that before the year 2000. It is assumed that social population increase in SMA will come from the outside area such as the Widas river basin.

In the urban area specified in 2.4.2, the urban population growth rate is assumed at 2.5% p.a. The rural population is forecast at the balance between the projected basin population and urban population and population to migrate to SMA. The detailed projection concerning the above indicators is shown in Tables 2.32 and 2.33.

NOTE: /1 Urban Development Planning Study on SMA.

Price escalation rate

The forecast of price escalation rate is required for cost estimate in Chapter 9 and 18. Price escalation rate for foreign component of construction cost is referred to historical movement of general price index related to construction in Japan, which is shown in Table 2.34. Annual increase rates of price indies such as wage, construction material, and capital goods are 5.4%, 3%, and 2.5% respectively during 1978 - 85. Since the proportion of wage, construction material, and capital goods in foreign component of construction cost is 10%, 20% and 70%, an escalation rate of combined prices in about 3%. This rate 3% is assumed to continue in the future.

Domestic price escalation rate is based on selected items such as wage, wood and quarring. Although price indies show a sharp upward movement during 1975 - 1983, escalation rates of them tend to decrease between 1983 and 1985. Annual increase rate of prices in wage, wood and quarring are 4.2%, 3.9% and 6.8%. Since the proportion of wage and construction material in domestic component of construction cost is 40% and 60%, an escalation rate of combined prices is about 5%. It is assumed that this rate 5% will continue in the future.

Table 2.1 CLIMATE AT BULAKMOJO / NGANJUK

Location : EL. 50m, Latitude 7°35'45"
Lontitude 111°55'06"

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Temperature (°C)												
Max.	31.3	31.5	31.7	32.2	32.1	31.2	31.4	32.2	32.9	34.0	33.4	32.1
Min.	22.0	21.8	21.8	21.9	21.4	20.2	20.1	20.2	21.8	21.5	21.5	21.9
Mean	26.3	26.0	26.1	26.7	27.2	25.6	26.0	25.9	27.1	27.3	26.9	26.3
Humidity (%)	86.5	87.1	84.9	83.3	82.6	78.7	78.4	75.6	73.3	74.0	79.3	84.1
Wind Velocity (km/hr)	2.6	2.0	1.9	2.4	2.9	4.6	6.7	6.9	8.2	7.2	5.6	2.9
Shushine Hours (8:00 - 16:00)	4.4	5.2	5.3	6.3	6.2	7.0	7.4	7.3	7.3	7.0	5.8	5.0

Note: Average of 11 years from 1973 to 1983

Table 2.2 STRATIGRAPHY OF THE PROJECT AREA

	Epoch	Kendeng Hill Zone Formation	Wilis Volcano Group Formation
	Holocene	River Alluvium	River Alluvium
QUATERNARY	Pleistocene	Young volcanic	Talus deposits
	upper	product	
		High Terrace	
	middle	Notopuro (Jombang)	Wilis pyroclastic
		Kabuh	Flow
	lower	Upper Puchangan	Wilis Tuff
		(volcanic faices)	Breccia
		Lower Puchangan	
		(clay faices)	
TERTIARY	Pliocene	Kalibeng	
		(marl, limestone)	
	Miocene	Kerek	

Table 2.3 KECAMATANS AND NUMBER OF DESA WITHIN WIDAS BASIN

Kabupaten	Kecamatan	No. of Desas
Nganjuk	Sawahan	9
	Ngetos	7
	Berbek	19
	Loceret	22
	Pace	18
	Prambon	14
	Ngronggot	13
	Kertosono	14
	Patianrowo	11
	Baron	11
	Tanjunganom	16
	Sukomoro	12
	Nganjuk	15
	Bagor	21
	Wilangan	6
	Rejoso	23
	Gondang	16
	Ngluyu	6
	Lengkong	14
	Jatikalen	10
Kediri	Grogol	28
Madiun	Gemarang	4
	Saradan	3
Total	23	313

Source : Dalam Angka of Kab. Nganjuk, Kediri and Madiun.

Table 2.4 BREAKDOWN OF DATA RELATED TO POPULATION BY KECAMATAN

No.	Name of Kabupaten/Kecamatan	Area (Km^2)	Population in 1971 (Person)	Population in 1980 (Person)	Annual growth Rate of Population (%)	Population Density (Person/Km^2)	No. of Household in 1980	Family Size (person/house)
Kabupaten Nganjuk								
Kec.	Lengkong	817.14	24,998	27,771	1.18	319	6,036	4.60
	Gondang	179.517	38,705	44,685	1.61	562	9,499	4.70
	Rejoso	159.170	52,982	60,505	1.49	379	13,266	4.56
	Ngluyu	88.24	12,439	14,248	1.52	162	3,032	4.69
	Jatikalen	42.03	16,040	17,207	0.78	409	3,958	4.34
	Pace	48.46	46,191	52,039	1.33	1,074	11,100	4.68
	Ngetos	60.21	25,752	28,332	1.07	471	6,243	4.53
	Sawahan	115.89	29,174	30,692	0.57	265	6,874	4.46
	Berbek	48.30	39,039	44,868	1.56	929	9,792	4.58
	Loceret	68.69	49,210	55,584	1.36	809	12,041	4.61
	Sukomoro	35.39	28,673	33,273	1.67	940	7,140	4.66
	Wilangan	50.64	21,186	24,358	1.56	481	5,403	4.50
	Nganjuk	22.59	47,556	57,152	2.06	2,530	11,620	4.91
	Baron	36.70	37,319	42,640	1.49	1,162	8,824	4.83
	Tanjunganom	170,84	80,172	93,439	1.172	1,319	19,911	4.69
	Patianrowo	32.79	32,803	36,456	1.18	1,112	8,165	4.46
	Kertosono	22.60	42,250	48,635	1.58	2,152	9,926	4.89
	Ngronggot	52.99	55,196	62,736	1.43	1,184	12,117	5.17
	Prambon	41.16	53,091	60,139	1.39	1,461	12,777	4.70
	Bagor	51.15	41,972	48,073	1.52	940	10,917	4.40
Kab.	Kediri							
	Grogol	107.04	114,635	128,714	1.25	1,198	26,748	4.79
Kab.	Madiun							
	Gemarang	94.5	14,380	14,000	-0.30	254	2,956	4.74
	Saradan	54.75	13,140	14,875	1.39	427	3,060	4.86
T O T A L		1,471.3	916,901	1,038,208	1.39	705	221,408	4.69

Table 2.5 NUMBER OF MIGRANT IN KABUPATEN NGANJUK BASED ON THE CONDITION OF REGIONAL ORIGIN DURING PELITA III

No.	Condition/Criteria of Regional Design	No Of Migrant in 1979/1980		1980/1981		1981/1982		1982/1983		1983/1984		1979/'80 to '83/'84	
		No.of Household		No.of Household		No. of Household		No. of Household		No of Household		No of Household	
1.	Natural disaster areas (flood areas)	15	75	133	576	276	1,169	215	1,009	177	783	816	3,612
2.	Critical areas	-	-	313	1,272	-	-	594	2,466	-	-	907	3,738
		-	-	-	-	193	808	100	381	-	-	293	1,189
		-	-	-	-	816	3,399	-	-	434	1,954	1,250	5,353
		118	557	-	-	-	-	-	-	-	-	118	557
3.	Areas with high population density	-	-	161	737	389	1,673	274	1,150	144	485	968	4,045
	T o t a l	133	632	607	2,585	1,674	7,049	1,183	5,006	755	3,222	4,352	18,494

Sources : Rencana Pembangunan Lima Tahun ke empat (1984/1985 to 1988/1989) of Kabupaten Nganjuk

Table 2.6 NUMBER OF MIGRANT IN KABUPATEN NGANJUK BASED ON FUND RESOURCES DURING PELITA III

No.	Fund Resources	No Of Migrant in 1979/1980		1980/1981		1981/1982		1982/1983		1983/1984		'79/80 to '83/'84	
		No of Household		No of Household		No of Household		No of Household		No of Household		No of Household	
1.	APBN /1	133	632	607	2,585	1,618	6,807	1,065	4,502	650	2,780	4,073	17,306
2.	APBD I /2	-	-	-	-	56	242	118	504	105	439	279	1,185
3.	APBD II /3	-	-	-	-	-	-	-	-	-	-	-	-
		133	632	607	2,585	1,674	7,049	1,183	5,006	755	3,219	4,352	18,491

Source : Rencana Pembangunan Lima Tahun ke Empat (1984/1985 to 1988/1989) of Kabupaten Nganjuk. (Repelita IV of Kab. Nganjuk)

Remarks : /1 APBN (Fund from Central Government)
/2 APBD (Fund from Provincial Government plus spontaneous migrants without financial support)
/3 APBD II (Fund from regional government plus spontaneous migrants without financial support)

Table 2.7 POPULATION OF AGE GROUP BY URBAN AND RURAL AREA in 1980

	0 - 4	5 - 9	10 - 14	15 - 24	25 - 49	50 - up	Total
Urban	9,958	10,734	10,892	18,842	24,465	12,941	87,832
Percentage (%)	11	12	12	21	28	15	100
Rural	117,437	133,016	120,667	172,719	287,027	136,722	951,856
Percentage (%)	12	14	12	18	30	14	100
Urban + Rural	127,395	143,750	131,559	191,561	311,492	149,663	1,038,208
Percentage (%)	12	14	12	18	30	14	100

Table 2.8 EMPLOYMENT (HAVING WORKED IN THE PREVIOUS WEEK) COMPOSITION BY KECAMATAN IN 1980

No. Kecamatan	Public & Private Sector	Agricultural Sector	Trade Sector	Manufacturing Sector	Total	Population
KAB. NGANJUK						
1. Lengkong	418 (4.5)	8,481(90.8)	303 (3.2)	142 (1.5)	9,344 (100)	27,771
2. Gondang	945 (5.0)	17,069(89.8)	734 (3.9)	242 (1.3)	18,998 (100)	44,685
3. Rejoso'	964 (4.1)	21,361(90.3)	921 (3.9)	398 (1.7)	23,644 (100)	60,505
4. Ngluyu	131 (2.5)	4,925(94.0)	123 (0.9)	61 (2.6)	5,240 (100)	14,248
5. Jatikalen	257 (4.9)	4,818(91.7)	146 (2.8)	35 (0.6)	5,256 (100)	17,207
6. Pace	486 (2.0)	23,563(94.9)	707 (2.8)	85 (0.3)	24,841 (100)	52,039
7. Ngetos	364 (5.0)	6,859(93.6)	82 (1.1)	25 (0.3)	7,330 (100)	28,332
8. Sawahan	492 (5.0)	8,921(91.5)	122 (1.3)	216 (2.2)	9,751 (100)	30,692
9. Berbek	767 (5.5)	12,199(87.8)	782 (5.6)	153 (1.1)	43,901 (100)	44,868
10. Loceret	1,215 (7.0)	13,495(77.4)	1,861(10.7)	866 (4.9)	17,437 (100)	55,584
11. Sukomoro	938 (5.7)	14,813(89.5)	618 (3.7)	186 (1.1)	16,555 (100)	32,273
12. Wilangan	318 (5.4)	5,346(90.3)	134 (2.3)	121 (2.0)	5,919 (100)	24,358
13. Nganjuk	3,687(26.7)	6,077(44.1)	3,020 (21.9)	1,186 (7.3)	13,790 (100)	57,152
14. Baron	1,081 (8.4)	10,056(77.8)	1,548(12.0)	237 (1.8)	12,922 (100)	42,640
15. Tanjunganom	3,144 (9.1)	29,648(86.0)	1,427 (4.1)	264 (0.8)	34,483 (100)	93,439
16. Patianrowo	1,541(12.0)	9,701(77.0)	1,056 (8.0)	187 (3.0)	12,485 (100)	36,456
17. Kertosono	3,042(21.8)	5,716(41.0)	4,983(35.8)	189 (1.4)	13,930 (100)	48,635
18. Ngronggot	1,008 (5.8)	15,119(87.4)	683 (3.9)	489 (2.9)	17,299 (100)	62,736
19. Prambon	493 (2.4)	18,498(90.0)	1,378 (6.7)	185 (0.9)	20,554 (100)	60,139
20. Bagor	919 (7.0)	9,856(84.0)	302 (2.0)	624 (5.0)	11,701 (100)	48,073
KAB. KEDIRI						
21. Grogol	1,839 (3.0)	52,864(86.0)	5,950 (9.6)	817 (1.4)	61,470 (100	128,065
KAB. MADIUN						
22. Gemarang + Sadaran	1,598(11.3)	11,948(85.0)	372 (2.6)	155 (1.1)	14,073 (100)	28,900
T o t a l	25,647 (7.1)	302,282(83.5)	27,252 (7.5)	6,863 (1.9)	362,044 (100)	1,038,208

Source : Statistical Office of Kab. Nganjuk,

Remarks : Data concerning Kab. Nganjuk is based on information from Statistical Office. Employment composition of Kec. Grogol, Gemarang and Sadaran is derived from a multiplication of Economical Active Population (age between 15 and 49) with percentage of Economically Active Population by sector indicating the following percentage.

	Public + Private	Agriculture	Trade	Manufacturing	Total
KAB. KEDIRI					
Grogol	2.99	86.00	9.68	1.33	100
KAB. MADIUN					
Gemarang + Sadaran	11.36	84.90	2.64	1.10	100

Source : Man power Census 1983

Table 2.9 STRUCTURE OF EMPLOYEMENT IN URBAN AND RURAL AREA

No. URBAN	PUBLIC AND PRIVATE SECTOR	AGRICULTURAL SECTOR	TRADE SECTOR	MANUFACTURING SECTOR	TOTAL	POPULATION	DEPENDENCY (8)/(7)	No OF HOUSE HOLD	FAMILY SIZE (8)/(10)	FAMILY LABOUR (11)/(9)
KAB. NGANJUK										
1. Berbek	62	712	196	8	978	5,907	3.99	814	4.79	1.20
2. Loceret	122	622	113	52	909	2,027	2.22	393	5.15	2.32
3. Kertosono	2,533	749	4,330	45	7,657	20,977	2.73	4,491	4.67	1.71
4. Patianrowo	355	269	85	10	719	2,657	3.69	571	4.65	1.26
5. Baron	301	915	183	62	1,461	4,505	3.08	876	5.14	1.67
6. Tanjunganom	1,762	4,264	374	81	6,481	18,370	2.83	3,939	4.66	1.65
7. Nganjuk	3,315	1,737	2,192	1,016	8,260	33,916	4.10	6,841	4.95	1.21
8. Bagor	22	148	30	40	240	1,473	6.13	297	4.95	0.80
Sub-Total	8,472	9,416	7,503	1,314	26,705	87,832	3.28	18,222	4.82	1.47
	(31.0)	(35.0)	(28.0)	(6.0)	(100)					
RURAL										
KAB. NGANJUK										
1. Kab. Nganjuk	13,738	237,105	13,427	4,577	268,847	795,000	2.95	170,150	4.67	1.58
KAB. KEDIRI										
2. Grogol	1,839	52,864	5,950	817	61,470	128,065	2.08	26,748	4.79	2.30
KAB. MADIUN										
3. Gemarang + Saradan	1,598	11,948	372	155	14,073	28,900	2.05	6,016	4.80	2.34
Sub-Total	17,175	301,917	19,749	5,549	344,390	951,965	2.76	202,914	4.69	1.70
	(5.0)	(87.7)	(5.7)	(1.6)	(100)					

Source : Employement composition in urban area is based on collected data concerning urban desas
Statistical Office of Kab. Nganjuk

Table 2.10 DEVELOPMENT INDICATORS (1975 - 1982)

(AT 1975 CONSTANT PRICE)

	1975	1982	Annual Growth Rate (%)		1975	1982	Annual Growth Rate (%)	Non-Mining GRDP per capita Index (Indonesia-100) 1975	1982
KAB. NGANJUK									
1. GRDP (10^6Rp.)	40,616	69,612	8.0	1. Non-Mining GRDP	40,503	68,577	7.8		
2. Population	803,173	889,833	1.5	2. Population	803,173	889.833	1.5		
3 Per capita output (Rp.)	51,000	78,000	6.3	3. Non-Mining GRDP per capita	50,000	77,000	6.4	64.5	67.9
EAST JAVA									
1. GRDP (10^6Rp.)	1,808,566	3,246,440	8.7	1. Non-Mining GRDP	1,805,382	3,238,501	8.7		
2. Population	27,093,124	30,078,800	1.5	2. Population	27,093,124	30,078,800	1.5		
3. Per capita output (Rp.)	67,000	108,000	7.1	3. Non-Mining GRDP per capita	67,000	108,000	7.1	86.5	95.2
INDONESIA									
1. GDP (10^9Rp.)	12,643	20,353	7.0	1. Non-Mining GDP	10,158	17,532	8.1		
2. Population	131,070,582	154,661,700	2.4	2. Population	131,070,582	154,661,700	2.4		
3. Per capita output (Rp.)	96,500	131,600	4.5	3. Non-Mining GRDP per capita	77,500	113,400	5.6	100	100

Source : Dalam Angka of Kabupaten Nganjuk, Jawa Timur

Statistical Indonesia 1984

Table 2.11 GRDP OF KABUPATEN NGANJUK BY INDUSTRIAL ORIGIN AT CURRENT MARKET PRICES

Unit 10^6Rp.

	Sector	1975	1976	1977	1978	1979	1980	1981	1982
1	Agriculture	23,948	31,816	33,630	39,588	54,649	70,288	78,789	92,074
		(59.0)	(62.9)	(60.4)	(59.0)	(59.6)	(61.7)	(59.1)	(60.2)
1.1	Food Crop	18,399	24,773	25,362	29,442	38,456	48,387	57,769	62,686
		(45.3)	(48.9)	(45.6)	(43.9)	(42.0)	(42.5)	(43.4)	(41.0)
1.2	Small Holder	906	1,271	1,914	2,952	7,314	11,246	7,843	11,956
	Estate Crops	(2.2)	(2.5)	(3.4)	(4.4)	(8.0)	(9.9)	(5.9)	(7.8)
1.3	Big Estate	-	-	-	-	-	-	-	-
1.4	Husbandry	1,475	2,035	2,434	2,876	3,484	5,113	5,682	5,464
		(3.6)	(4.0)	(4.4)	(4.3)	(3.8)	(4.5)	(4.3)	(3.6)
1.5	Foresting	3,077	3,643	3,810	4,232	4,869	5,230	7,389	11,816
		(7.6)	(7.2)	(6.8)	(6.3)	(5.3)	(4.6)	(5.5)	(7.7)
1.6	Fishery	91	94	110	87	346	307	105	152
		(0.2)	(0.2)	(0.2)	(0.1)	(0.4)	(0.3)	(0.1)	(0.1)
2	Mining	113	142	194	337	385	838	1,435	1,447
		(0.3)	(0.3)	(0.3)	(0.5)	(0.4)	(0.7)	(1.1)	(0.09)
3	Industry	668	827	848	1,688	2,447	3,181	3,805	4,173
		(1.6)	(1.6)	(1.5)	(2.5)	(2.7)	(2.8)	(2.9)	(2.7)
4	Utility	34	55	63	71	80	112	259	454
		(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.3)
5	Construction	705	777	1,062	1,966	2,127	3,594	5,611	5,025
		(1.7)	(1.5)	(1.9)	(2.9)	(2.3)	(3.2)	(4.2)	(3.3)
6	Trade	4,968	5,175	5,900	7,604	12,912	13,723	15,622	18,169
		(12.2)	(10.2)	(10.6)	(11.3)	(14.1)	(12.0)	(11.7)	(11.9)
7	Transport	558	790	1,000	1,264	1,494	1,925	3,507	4,618
		(1.4)	(1.6)	(1.8)	(1.9)	(1.6)	(1.7)	(2.6)	(3.0)
8	Financial	229	291	362	451	614	731	967	1,420
		(0.6)	(0.6)	(0.7)	(0.7)	(0.7)	(0.6)	(0.7)	(0.9)
9	Rental House	1,217	1,471	1,839	2,296	2,980	3,466	4,141	4,821
		(2.8)	(2.9)	(3.3)	(3.4)	(3.2)	(3.0)	(3.1)	(3.2)
10	Public Service	5,602	6,386	7,073	7,800	9,032	10,387	12,282	12,642
		(13.8)	(12.6)	(12.7)	(11.6)	(9.9)	(9.1)	(9.2)	(8.3)
11	Private Business	2,664	2,878	3,708	4,047	5,154	5,716	6,833	8,174
		(6.6)	(5.7)	(6.7)	(6.0)	(5.6)	(5.0)	(5.1)	(5.3)
	GRDP	40,616	50,609	55,679	67,114	91,623	113,961	133,250	153,017
		(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

Source : Pendapatan Regional (Regional Income) of Kabupaten Nganjuk 1975-1980 and 1981-1982

Remarks : Parentheses shows percentage distribution of GRDP

Table 2.12 GRDP OF KABUPATEN NGANJUK BY INDUSTRIAL ORIGIN AT 1975 CONSTANT PRICES

Unit 10^6Rp.

	Sector	1975	1976	1977	1978	1979	1980	1981	1982	Annual Growth Rate (%)
1	Agriculture	23,948	24,228	24,729	24,691	28,844	30,942	29,814	30,774	3.7
		(59.0)	(59.3)	(57.4)	(53.2)	(52.5)	(52.2)	(45.5)	(44.2)	
1.1	Food Crop	18,399	18,182	18,741	18,226	19,682	20,676	21,374	20,038	1.2
		(45.3)	(44.5)	(43.5)	(39.3)	(35.8)	(34.9)	(32.6)	(28.8)	
1.2	Estate	906	1,036	1,363	1,925	4,476	5,170	2,868	4,253	24.7
		(2.2)	(2.5)	(3.2)	(4.1)	(8.1)	(8.7)	(4.4)	(6.1)	
1.3	Big Estate	-	-	-	-	-	-	-	-	-
1.4	Husbandry	1,475	1,742	1,603	1,569	1,469	1,805	2,001	1,765	2.6
		(3.6)	(4.3)	(3.7)	(3.4)	(2.7)	(3.0)	(3.1)	(2.5)	
1.5	Forestry	3,077	3,174	2,923	2,904	3,005	3,114	3,502	4,644	6.1
		(7.6)	(7.8)	(6.8)	(6.3)	(5.5)	(5.2)	(5.3)	(6.7)	
1.6	Fishery	91	94	99	68	213	177	69	74	-
		(0.2)	(0.2)	(0.2)	(0.1)	(0.4)	(0.3)	(0.1)	(0.1)	
2	Mining	113	123	173	305	336	605	780	1,035	37.2
		(0.3)	(0.3)	(0.4)	(0.7)	(0.6)	(1.0)	(1.2)	(1.5)	
3	Industry	668	699	712	1,412	2,243	2,596	2,957	3,500	26.7
		(1.6)	(1.7)	(1.7)	(3.0)	(4.1)	(4.4)	(4.5)	(5.0)	
4	Utility	34	40	42	46	52	56	125	156	24.3
		(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.2)	
5	Construction	705	747	1,045	1,904	2,087	2,624	4,510	4,302	29.5
		(1.7)	(1.8)	(2.4)	(4.1)	(3.8)	(4.4)	(6.9)	(6.2)	
6	Trade	4,968	4,598	4,725	5,491	7,806	7,314	7,929	8,677	8.3
		(12.2)	(11.3)	(11.0)	(11.8)	(14.2)	(12.3)	(12.1)	(12.5)	
7	Transport	558	730	854	1,025	1,096	1,440	2,532	3,061	27.5
		(1.4)	(23.8)	(2.0)	(2.2)	(2.0)	(2.4)	(3.9)	(4.4)	
8	Financial	229	251	280	288	390	440	662	958	22.7
		(0.6)	(0.6)	(0.6)	(0.6)	(0.7)	(0.7)	(1.0)	(1.4)	
9	House Rental	1,127	1,177	1,227	1,315	1,317	1,343	1,416	1,473	3.9
		(2.8)	(2.9)	(2.8)	(2.8)	(2.4)	(2.3)	(2.2)	(2.1)	
10	Public Service	5,602	5,765	6,401	6,928	7,508	8,640	10,179	10,814	9.9
		(13.8)	(14.1)	(14.9)	(14.9)	(13.7)	(14.6)	(15.5)	(15.5)	
11	Private Business	2,664	2,492	2,916	2,984	3,277	3,317	4,634	4,862	9.0
		(6.6)	(6.1)	(6.7)	(6.4)	(6.0)	(5.6)	(7.1)	(7.0)	
	GRDP	40,616	40,850	43,104	46,389	54,956	59,317	65,538	69,612	8.0
		(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	

Source : Pendapatan Regional (Regional Income) 1975-1980 and 1981-1982

Remarks : Parentheses shows percentage distribution of GRDP

Table 2.13 FOOD CROP PRODUCTION IN 1983

Unit: ton

CROP		NGANJUK ALL (1)	KEDIRI Grogol (2)	MADIUN Gemarang + Saradan (3)	TOTAL (4)	EAST JAVA (5)	RATIO of (4) to (5) (%) (6)
Lowland Paddy	*						
Production	(ton)	308,431	11,029	10,888	330,348	7,886,989	4.19
Harvested area	(HA)	55,079	2,018	1,833	58,930	1,549,620	3.80
Unit yield	(ton)	5.60	5.46	5.94		5.08	
Maize							
Production	(ton)	64,855	3,389	1,934	70,178	1,638,461	4.28
Harvested area	(Ha)	21,089	1,285	930	23,304	1,195,266	1.95
Unit yield	(ton)	3.08	2.64	2.08		1.37	
Cassava	(ton)						
Production	(ton)	61,540	67,974	7,804	137,318	3,472,167	3.95
Harvested area	(ha)	6,729	3,071	1,131	10,931	353,014	3.10
Unit yield	(ton)	9.15	22.13	6.9		9.8	
Ground nut							
Production	(ton)	1,535	159	16.5	1,710.5	103,848	1.65
Harvested area	(ha)	1,625	170	27	1,822	134,601	1.35
Unit yield	(ton)	0.94	0.94	0.61		0.77	
Soybeans							
Production	(ton)	19,367	283	226	19,876	241,905	8.22
Harvested area	(ton)	22,805	372	333	23,510	294,582	7.98
Unit yield	(ton)	0.85	0.76	0.68		0.82	
Sweet Potatoes							
Production	(ton)	2,740		5.4	2,745.4	273,647	
Harvested area	(ha)	424		1	425	38,023	
Unit yield	(ton)	6.46		5.4	11.9	7.19	

Source : Dalam angka of Kab.Nganjuk, Kediri,Madiun and Jawa Timur

Remarks : * (1) Wet season paddy + dry season paddy

(2) Harvested area in Kec. Gemarang plus Saradan is calculated using area ratio specified in section 2.4.1.

Table 2.14 FOOD CROP PRODUCTION IN KAB. NGANJUK : 1975 - 1982

Unit : ton

Crops	1975	1976	1977	1978	1979	1980	1981	1982
* Food crops								
Paddy	228,950	238,145	212,062	241,682	208,600	271,663	301,878	297,524
Maize	31,630	31,627	47,780	35,039	51,991	59,774	67,141	52,118
Cassava	61,495	57,157	56,859	52,754	57,097	54,747	59,885	51,029
Sweet potatoes	4,520	3,655	4,714	3,761	3,928	3,280	3,018	3,869
Ground nut	1,838	1,081	1,579	1,785	1,693	1,566	1,367	1,158
Soybean	9,245	6,915	12,405	16,436	16,296	15,933	19,191	18,431
Other beans (yam)	5,923	4,618	5,934	4,061	1,802	947	1,165	1,558
Sorghum (wheat)	238	224	808	184	137	300	212	46
Green bean	337	206	258	444	429	381	558	494
* Vegetables								
Red union	52,923	49,499	34,604	24,622	55,563	29,796	3,442	7,741
Chili peper	5,301	6,695	9,106	6,450	8,481	14,800	1,095	1,507

Remarks : Form of Production : Paddy : dry mill
Maize : dry grain
Cassava : fresh root
Sweet potatoes : fresh root
Groundnut : dry grain
Soybean : grain
Other bean (yam) fresh
Green bean : grain
Sorghum : grain
Vegetables : fresh leaf

Source : Repelita IV of Kab. Nganjuk

Table 2.15 AGRO-ECONOMIC INDICATORS BY KECAMATANS IN 1983

Area Kecamatan	Farm Land (Ha)			No of Farm Household	Land-Farm Household Ratio	A /1 (Rp.)	B /2 (Rp.)	Total A + B (Rp)	Total Value per Ha
	Paddy Field	Upland Field	Total						
Lengkong	1,605	519	2,124	3,870	0.55	220,240	36,900	257,140	467,530
Gondang	4,328	480	4,808	6,589	0.73	310,460	61,640	372,100	509,730
Rejoso	4,341	517	4,858	9,136	0.53	241,580	126,230	367,810	693,980
Ngluyu	1,096	650	1,746	2,352	0.74	253,220	70,130	323,350	436,960
Jatikalen	1,017	802	1,819	2,719	0.67	193,070	20,060	213,130	38,100
P a c e	2,844	781	3,625	6,349	0.57	222,180	279,320	501,500	879,820
Ngetos	1,315	1,275	2,590	5,039	0.51	188,220	251,460	439,680	862,120
Sawahan	1,062	902	1,964	6,186	0.32	118,360	145,680	264,040	825,130
Berbek	2,028	345	2,373	4,809	0.49	336,660	90,120	426,780	870,980
Loceret	2,765	966	3,731	6,879	0.54	269,720	265,320	535,040	990,810
Sukomoro	2,666	102	2,768	5,000	0.55	363,830	113,700	477,530	868,240
Wilangan	1,133	76	1,209	2,840	0.43	381,290	108,690	489,980	1,139,490
Nganjuk	1,388	52	1,440	2,884	0.50	296,880	147,730	444,610	889,220
B a r o n	2,073	458	2,531	4,957	0.51	256,130	97,180	353,310	692,760
Tanjunganom	3,926	372	4,298	11,136	0.39	372,560	133,210	505,770	1,296,850
Patianrowo	1,805	717	2,522	4,517	0.56	309,490	18,300	327,790	585,340
Kertosono	1,241	233	1,474	2,566	0.57	321,140	71,200	392,340	688,320
Ngronggot	1,939	678	2,617	6,508	0.40	228,970	109,450	338,420	846,050
Prambon	2,424	253	2,677	4,824	0.55	433,680	87,430	521,110	947,470
Bagor	2,405	284	2,689	5,919	0.45	363,830	142,660	506,490	1,125,530
Grogol	2,750	2,460	5,210	13,704	0.38	77,620	342,880	420,500	1,106,580

Remarks :

/1 : Net income of paddy production per year per farm house

/2 : Net income of polowijo production per year per farm house

Calculation of net income is based on Table

Source : Dalam Angka of kab. Nganjuk, Kediri

Population census of East Java.

Table 2.16 SMALL HOLDERS ESTATE CROP PRODUCTION IN 1983

CROP		NGANJUK All	KEDIRI Grogol	MADIUN Gemarang + Saradan	TOTAL (1)	EAST JAVA (2)	Ratio of (1) to (2)
TOBACCO							
Production	Ton	7,969	-	1 >	7,969	82,628	9.6
Harvested area	Ha	1,052	-	-	1,052	119,525	0.9
COCONUT							
Production	Ton	2,017	-	-	2,017	79,135	2.5
Harvested area	Ha	4,401	744	-	5,145	275,134	1.9
COFFEE							
Production	Ton	3	0.2	-	3.2	13,154	0.02
Harvested area	Ha	23	0.8		23.8	43,114	0.056
SUGARCANE							
Production	Ton	28,189	2,856	-	31,045	912,828	3.4
Harvested area	Ha	5,181	449	-	5,630	147,659	3.8
ROSELLA							
Production	Ton	2,281	- *2 >	- *2 >	2,281	3,927	58.1
Harvested area	Ha	193	-	-	193	3,587	5.4

Remarks 1 > Unknown

2 > not produced

Source : Dalam Angka of Kab. Nganjuk, Kediri, Madiun (1983)

Table 2.17 HISTORICAL RECORDS OF ESTATE PRODUCTION BY SMALL HOLDERS IN KAB NGANJUK

Crops	Unit	1975	1980	1981	1982
1. Sugar cane (Sugar)	Ton	2,436	27,808	18,927	31,528
2. Kapok	Ton	286	41	111	34
3. Tobacco	Ton	642	9,186	1,995	2,175
4. Coffee	Ton	-	16	9	9
5. Clove	Ton	-	25	5	9

Table 2.18 PRODUCTION AND HARVESTED AREA UNDER UPP PROGRAME IN KAB. NGANJUK

	TRI	TRP	TRB	Total
Harvested Area (Ha)	2,728	380	607	3,716
Production (10^3ton)	217	27	48	293

Source : Repelita IV of Kab. Nganjuk

Remarks : TRI ..... complete credit package
TRP ..... partial credit package
TRPB ..... technical assistance without financial aid

Table 2.19 ECONOMIC ACTIVITY OF MANUFACTURING INDUSTRY
ECONOMIC ACTIVITY OF SMALL SIZE INDUSTRY

Unit : 10^6 Rp.

	1975	1980	1981	1982
Production	1,691	7,096	5,080	6,439
Input Cost	1,137	4,769	3,414	4,327
Value Added	555	2,328	1,666	2,112
Depreciation	37	155	111	140
Net Value Added	518	2,173	1,556	1,972

ECONOMIC ACTIVITY OF HOUSEHOLD INDUSTRY

Unit : 10^6 Rp.

	1975	1980	1981	1982
Production	300	709	3,407	3,663
Input Cost	186	441	2,116	2,275
Value Added	114	269	1,291	1,388
Depreciation	7	15	74	80
Net Value Added	107	253	1,217	1,308

ECONOMIC ACTIVITY OF ALL INDUSTRY

Unit : 10^6 Rp.

	1975	1980	1981	1982
Production	1,991	1,415	8,487	10,102
Input Cost	1,323	5,210	5,530	6,602
Value Added	669	2,597	2,957	3,500
Depreciation	44	170	185	220
Net Value Added	625	426	2,773	3,280

Source : Regional Income (Pendapatan Regional) of Kab. Nganjuk

Remarks : All figures are expressed at 1975 Constant Price

Table 2.20 THE NUMBER OF MANUFACTURING UNIT BY SIZE OF MANUFACTURING INDUSTRY

Size of Industry	1982	1983	1984
Small of Industry	187	194	204
Household Industry	12,875	12,995	12,995
T o t a l	13,062	13,189	13,199

Table 2.21 BREAK DOWN OF HOUSEHOLD INDUSTRY IN 1982

Kind of Industry	Small Industry	Household Industry
Cigarette - related	46	2,545
Food	50	1,478
Construction Material	9	2,473
Wood, Furniture	22	271
Ornament	0	4,071
Others	60	2,037
T o t a l	187	12,875

Source : Dalan Angka of Kab. Nganjuk

Table 2.22 TOTAL PRODUCTION, TOTAL SALES, AND TOTAL PROFIT IN THE TRADE SECTOR IN KABUPATEN NGANJUK IN THE YEAR OF 1982

No.	Trade Sector	Total Production (in Million Rp.)	Total Sales (in Million Rp.)	(%)	Profit (in Million Rp.)	(%)
1.	Paddy	40,467	8,093	20	809	10
2.	Maize	5,788	3,473	60	1,042	30
3.	Cassava	3,629	1,815	50	544	30
4.	Sweet potato	294	147	50	44	30
5.	Peanut	761	685	90	205	30
6.	Soybean	6,840	6,156	90	1,847	30
7.	Vegetable and fruit	9,897	6,433	65	3,216	50
8.	Public estate crop	14,196	12,777	90	2,555	20
9.	Forestry	13,948	13,251	95	1,325	10
10.	Husbandry	7,754	6,979	90	1,047	15
11.	Fishery	178	160	90	24	15
12.	Industry	11,975	11,376	95	2,844	25
13.	Mining	1,646	1,563	95	391	25
		117,373	72,908		15,893	
Trade among region			7,291		1,458	
Total		117,373	80,199		17,351	

Source : Regional Income (Pendapatan Regional) of Kabupaten Nganjuk 1981 - 1982.

Table 2.23 GROSS VALUE ADDED AND NET VALUE ADDED OF THE TRADE SECTOR AT THE CURRENT PRICES IN THE YEARS OF 1975, 1980, 1981 AND 1982

(In Million Rupiah)

No.		1975	1980	1981	1982
1.	Local trade	4,361	12,115	13,747	15,895
2.	Trade among region	342	1,080	1,216	1,458
3.	Total gross value added	4,703	13,195	14,963	17,353
4.	Depreciation (5%)	329	924	1,047	1,215
5.	Net value added	4,374	12,271	13,916	16,138

Source : Regional Income (Pendapatan Regional) of Kabupaten Nganjuk, 1981 - 1982.

Table 2.24 PROJECTS RELATED TO IRRIGATION SECTION OF KAB. NGANJUK BY FINANCIAL SOURCE

UNit : 10^3Rp

		1983/84	1984/85
(1)	Project financed by APRD II and APBDI /1	27,107	48,825
(2)	Project financed by Grants of Central Government	59,264	98,647
(3)	Project financed by Budget of Central Government /2	1,569,192	4,009,661
	Total	1,655,563	4,157,133

Source : A Report of Results During Repelita III From Head of Kabupaten to Parliament

Note : /1 APBD I ..... Provincial government
APBD II ..... Kabupaten government

/2 Of (3), Fund financed by Irrigation section of public works, and BREBDO amounts to 72,905 x 10^3Rp and 125,873 x 10^3Rp in 1983/1984 and 1984/85 respectively.

Table 2.25 REALIZATION OF DEVELOPMENT OF ROAD AND BRIDGE PROJECTS in 1983/1984 and 1984/1985

No.	Project	1983/1984 Length (km/m)	1983/1984 Investment (in million Rp.)	1984/1985 Length (km/m)	1984/1985 Investment (in million Rp.)
I.	State/Provincial road (jalan Negara/Propinsi):				
1.	Maintenance	59 km	36,196	34 km	27,710
2.	Improvement	2 km	92,288	4 km	13,650
3.	New road	-	-	-	-
	Total I	61 km	128,484	38 km	41,360
II.	State/Provincial Bridge (Jembatan Negara/Propinsi):				
1.	Maintenance	162 m	1,975	-	-
2.	Improvement	12 m	73,525	32 m	32,000
3.	New bridge	-	-	-	-
	Total II	174 m	75, 500	32 m	32,000
III.	Regional road (Jalan Kabupaten):				
	Asphalt road :				
1.	Maintenance	48 km	62,922	171 km	252,986
2.	Improvement	29 km	466,077	26 km	321,398
3.	New road	2 km	81,690	-	-
	Makadam road :				
1.	Maintenance	-	-	-	-
2.	Improvement	-	-	-	-
3.	New road	13 km	114,688	7 km	222,929
	Total III	72 km	725,377	204 km	797,313
IV.	Regional bridge (Jembatan Kabupaten):				
1.	Maintenance	-	-	-	-
2.	Improvement	8 m	21,442	43 m	511,071
3.	New bridge	22 m	96,135	23 m	88,260
V.	Rural road (jalan Desa):				
1.	Maintenance	-	-	-	-
2.	Improvement	26 km	111,149	9 km	77,610
3.	New road	-	-	-	-
	Total V	26 km	111, 149	9 km	77,610

Source : Repelita IV of Kab. Nganjuk

Table 2.26 PRESENT CONDITION OF ELECTRICITY SUPPLY FROM PLN IN NGANJUK AND KERTOSONO 1983/1984 and 1984/1985

Nos.	Kind of Application	1983 / 1984			1984 / 1985			
		Nganjuk Subscriber	Kertosono Subscriber	Total Number	Nganjuk Subscriber	Kertosono Subscriber	Total Number	
1.	Household	5,654(12,070)	5,631(10,280)	11,285	6,890(12,300)	6,423(10,570)	13,313	
2.	Light industry	13	7	20	11	7	18	
3.	Heavy industry	2	-	2	2	-	2	
4.	Government Offices	86	50	136	103	55	158	
5.	Social purposes	50	78	128	62	93	155	
6.	Road light	40	14	54	40	14	54	
7.	Commercial use	325	319	644	235	339	674	
	Total	6,170	6,099	12,269	7,433	6,931	14,374	17.15

Source : Report Results During Repelita III From Head of Kabupaten To Parliament

Remarks : Parentheses shows total number of houses (statistical Office of Kab. Nganjuk)

Table 2.27 EDUCATIONAL INDICATORS RELATED TO PRIMARY SCHOOL

Year	No. of People at the age of 7 - 12 years old	No. of People at the age of 7-12 years old, and already accepted at the primary scholl	No. of Unac-cepted	Enrollment Ratio in Percentage (%)	No. of Primary School Pupil	No. of Clasa Room	No. of Teacher	Pupil Class Room Ratio	Pupil Teacher Ratio	The No. of Schools
1979/1980	134,256	125,503	8,753	93	128,707	3,667	3,904	35	33	586
1980/1981	130,617	123,250	7,367	94	130,617	3,893	4,343	34	30	596
1981/1982	127,895	124,796	3,099	98	137,077	4,100	4,449	33	31	684
1982/1983	135,735	122,498	13,237	90	147,864	4,297	5,327	34	28	688
1983/1984	136,603	130,807	5,796	96	148,043	4,468	5,368	33	28	749

Source : Repelita IV of Kabupaten Nganjuk, 1984/1985 to 1988/1989

Table 2.28 EDUCATIONAL INDICATORS RELATED TO JUNIOR HIGH SCHOOL

Year (1)	Total No. of Primary School Graduation in the year Before (2)	Total No. of New Junior High School Pupil (3)	No. of Total Unac-cepted (4)	Enrollment Ratio (5)=(4):(2)	Total No.of Junior High School Pupil (6)	Total No. of Class Room (7)	Total No. of Teacher (8)	Pupil Class Room Ratio (9)= (6):(7)	Pupil Teacher Ratio (10)= (6):(8)	No:of Schools
1979/1980	12,484	6,232	6,252	50	14,564	327	824	45	18	45
1980/1981	13,910	6,965	6,945	50	17,467	394	1,018	44	17	52
1981/1982	15,466	7,770	7,696	50	20,209	452	1,034	45	20	50
1982/1983	16,908	8,454	8,454	50	22,652	519	1,245	44	18	60
1983/1984	19,118	9,037	10,080	53	23,822	547	1,301	44	18	67

Source : Repelita IV of Kabupaten Nganjuk, 1984/1985 to 1988/1989

Table 2.29 HEALTH FACILITIES AVAILABLE IN KAB. NGANJUK (1900)

RSU No.	Puskesmas		Sub-Pus	Doctors	
	No.	Pop/Pus	No.	No.	Pop/D
2	23	38,400	31	31	28,500

Source : Repelita IV of Kabupaten Nganjuk

Table 2.30 BUDGET OF REGIONAL GOVERNMENT (Kab. Nganjuk)

Unit : 10^6Rp.

Receipt	1983/1984	1984/1985
A. Routine Budget		
1. Remaining of last year's Budget	1.1	131.2
2. Central Government	1350.1	1515.1
3. Local Government	569.3	929.1
4. Sub-Total	1920.5	2575.4
B. Development Budget		
1. Remaining of last year's Budget	-	-
2. Central Governmnet and Ipeda	504.8	581.9
3. Others	0.1	2.9
4. Sub-Total	504.9	584.8
C. Inpress		
1. Rural Development	346.3	346.3
2. Kab./Kodya Development	1044.9	1181.5
3. Elementary school Development	1470.5	1520.6
4. Reforestation	177.0	22.3
5. Public Health	438.5	407.8
6. Road Improvement	42.0	50.0
7. Sub-Total	3519.2	3528.5
Grand Total	5944.6	6688.7

Source : Reports of Results During Repelita III From Head of Kabupaten To Parliament

Remarks : Inpress = Grants from Central Government

Table 2.31 THE COMPARISON OF PER CAPITA BUDGET IN KAB. NGANJUK TO THAT IN EAST JAVA IN 1983/84

	Total amount of Budget (10^6 Rp)	Population (person)	Per Capita Budget (Rp)
East Java	278,604	30,472,600	9,100
Kab. Nganjuk	5,945	920,210	6,500

Source : Statistik Indonesia

Table 2.32 PROJECTION OF GRDP IN KAB. NAGNJUK

Unit : 10^6 Rp.

	1985	1990	2000	2050
GRDP	205,689	261,225	427,613	3,038,910

Source : Repelita IV of Kab. Nganjuk

Remarks : The projection of GRDP of the year 1985 is shown by the above source

The projection of GRDP is expressed at 1985 constant price

Table 2.33 ASSUMED POPULATION GROWTH RATE

Unit : % p.a

	1971 1980	1980 1985	1985 1990	1990 2000	2000 2050
Indonesia /1	2.43	2.21	2.12	1.95	1.23
East Java	1.50	1.36	1.31	1.20	0.76
S.M.A. /2	-	3.86	3.86	3.86	2.83
Nganjuk	1.46	1.33	1.27	1.17	0.74
Widas Basin	1.39	1.27	1.21	1.11	0.70

Note : /1 Based on the medium birth and mortality rate estimated by the Bureau of Census, USA.

/2 From Urban Development Planning Study on SMA

POPULATION PROJECTION OF THE WIDAS RIVER BASIN

	1980	1985	1990	2000	2050
(1) East Java	29,188,852	31,328,400	33,328,200	37,587,700	54,988,300
(2) S.M.A	2,867,477	3,465,000	4,187,000	6,119,000	24,736,600
(3) Excl. SMA	26,321,375	28,160,600	30,054,100	33,895,100	49,635,600
(4) 1 - (2 + 3)	0	397,200	912,900	2,426,400	19,383,900
(5) Widas basin	1,038,200	1,105,800	1,174,300	1,311,400	1,858,700
(6) Population to SMA	-	15,600	35,700	93,900	725,900
(7) Balance (5 - 6)	1,038,200	1,090,200	1,138,600	1,217,500	1,132,800
(8) Urban	87,832	99,400	112,400	143,900	494,600
Rural	950,368	990,800	1,026,200	1,073,600	638,200

Note : (5) indicates population in the Widas basin before population from the basin to SMA is subtracted.

(7) indicates population in the basin after social movement of population to SMA is subtracted.

Urban population growth rate is assumed to be 2.5% p.a.

Table 2.34 PRICE INDEX

Year	Selected Price Indices in Japan		
	Wage	Construction Cost	Capital goods
1978	88.8	77.2	88.5
1979	94.1	91.1	93.8
1980	100.0	100.0	100.0
1981	105.3	116.0	102.0
1982	110.0	119.3	107.7
1983	113.8	94.2	105.5
1984	118.9	95.5	106.4
1985	128.5	93.3	105.1

Note: 1980=100

Source: Monthly Statistics of Japan

Year	Selected Price Indices in Indonesia		
	Wage	Wood	Quarring
1975		100	100
1980	100		
1981	136	244	230
1982	150	259	263
1983	175	267	286
1984	185	280	314
1985	190	288	326

Note: Wage 1980=100
Wood, Quarring 1975=100

Source: Buletin Ringkas (Central Bureau of Statistics)

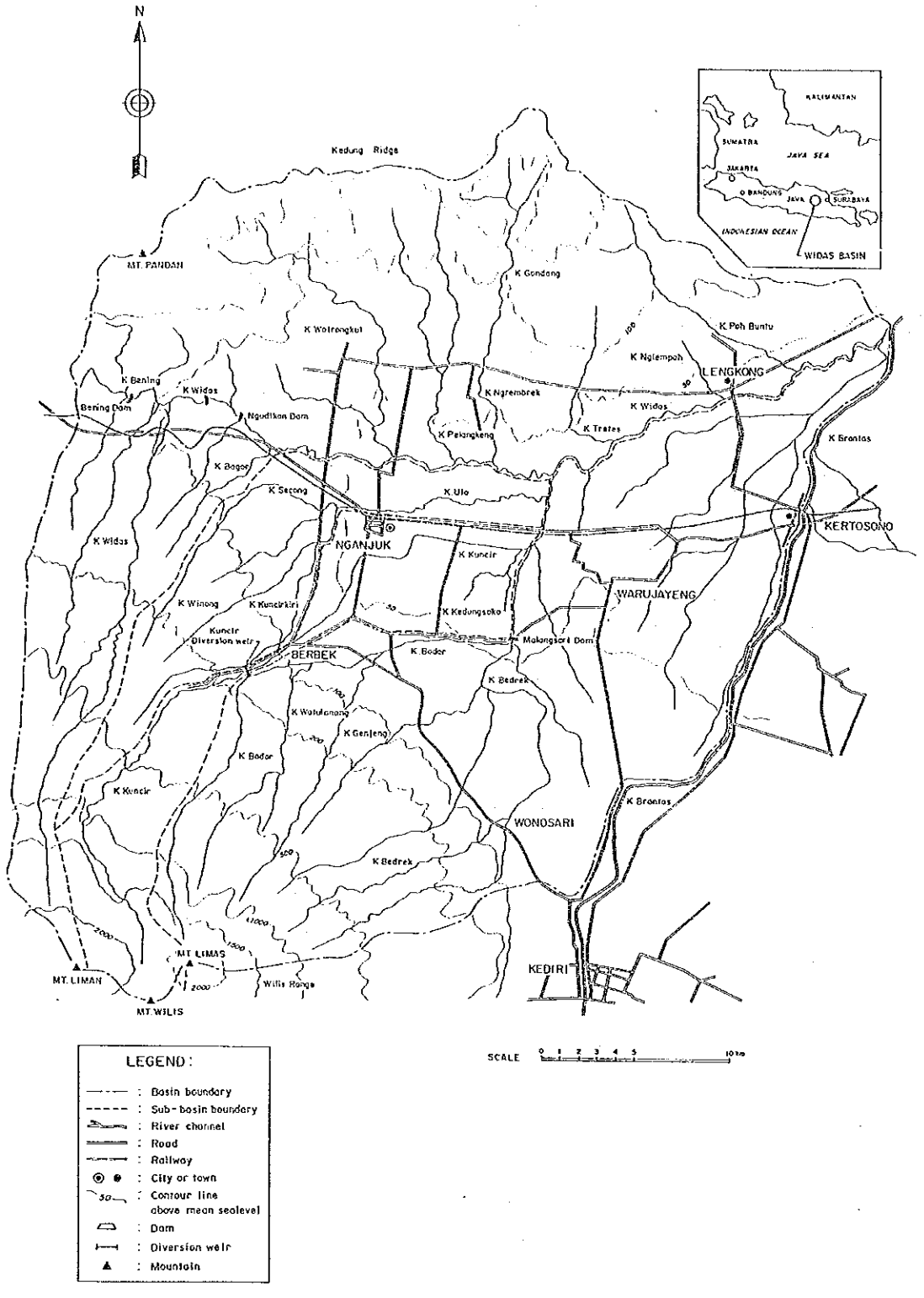


Fig. 2.1 WIDAS RIVER BASIN AND ITS RIVER SYSTEM

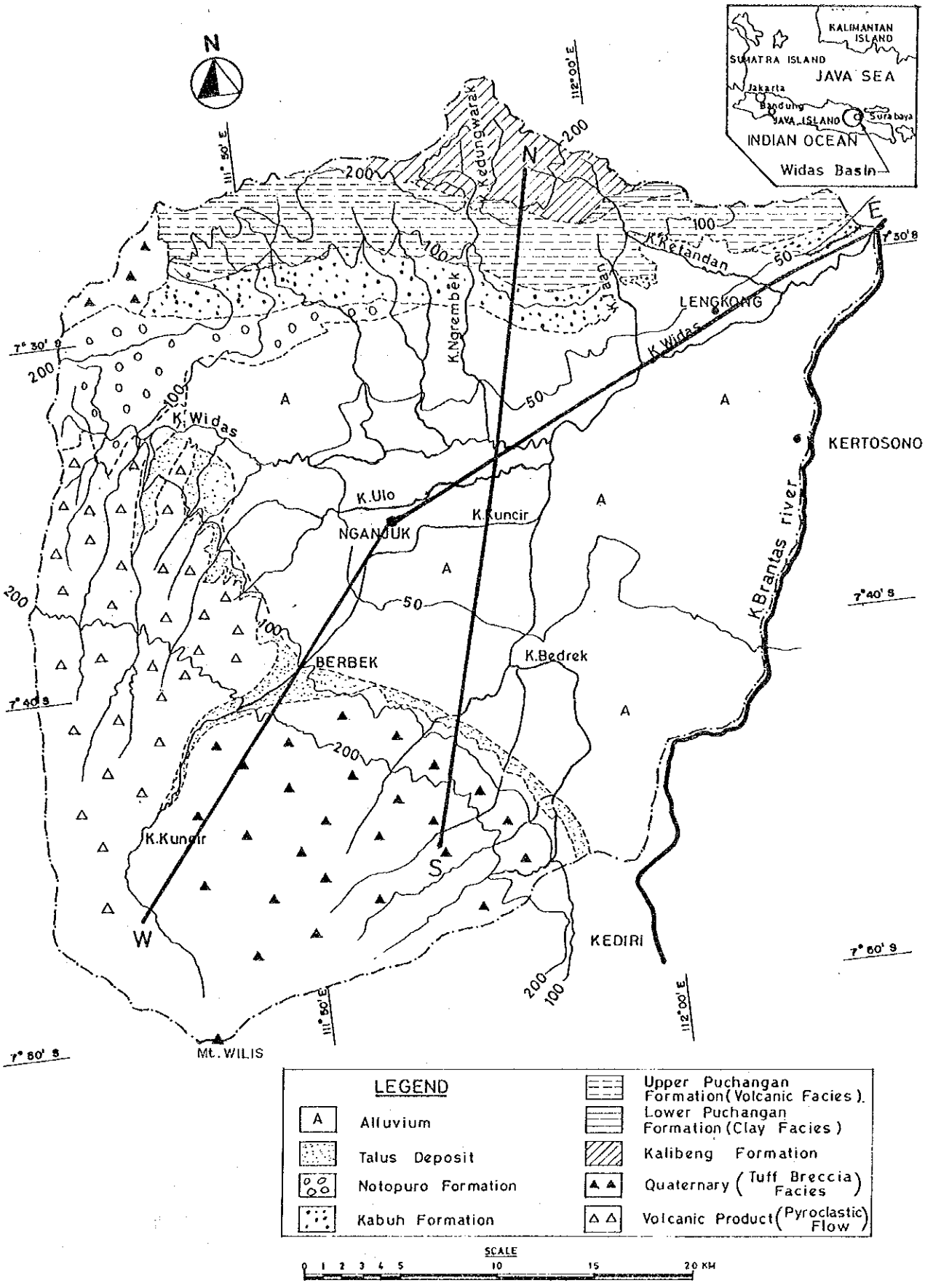
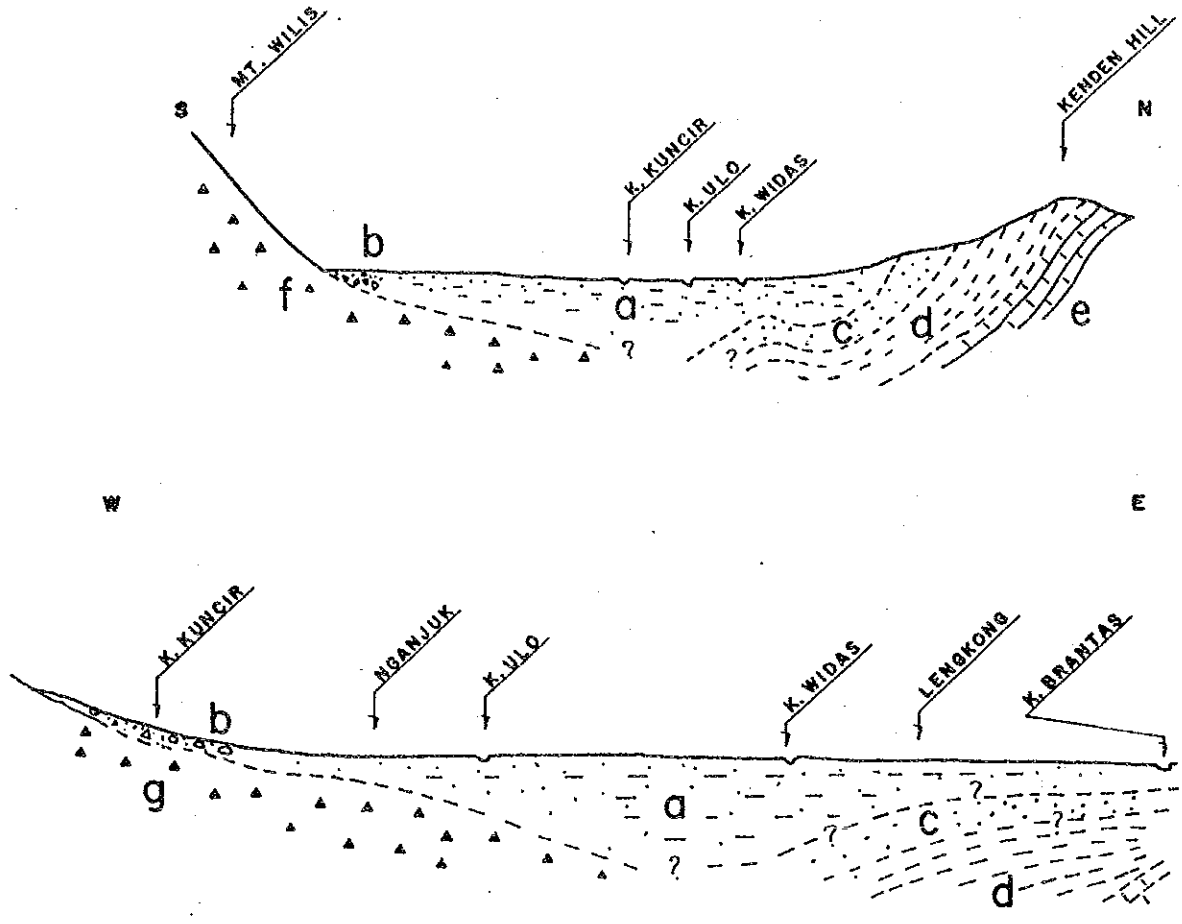


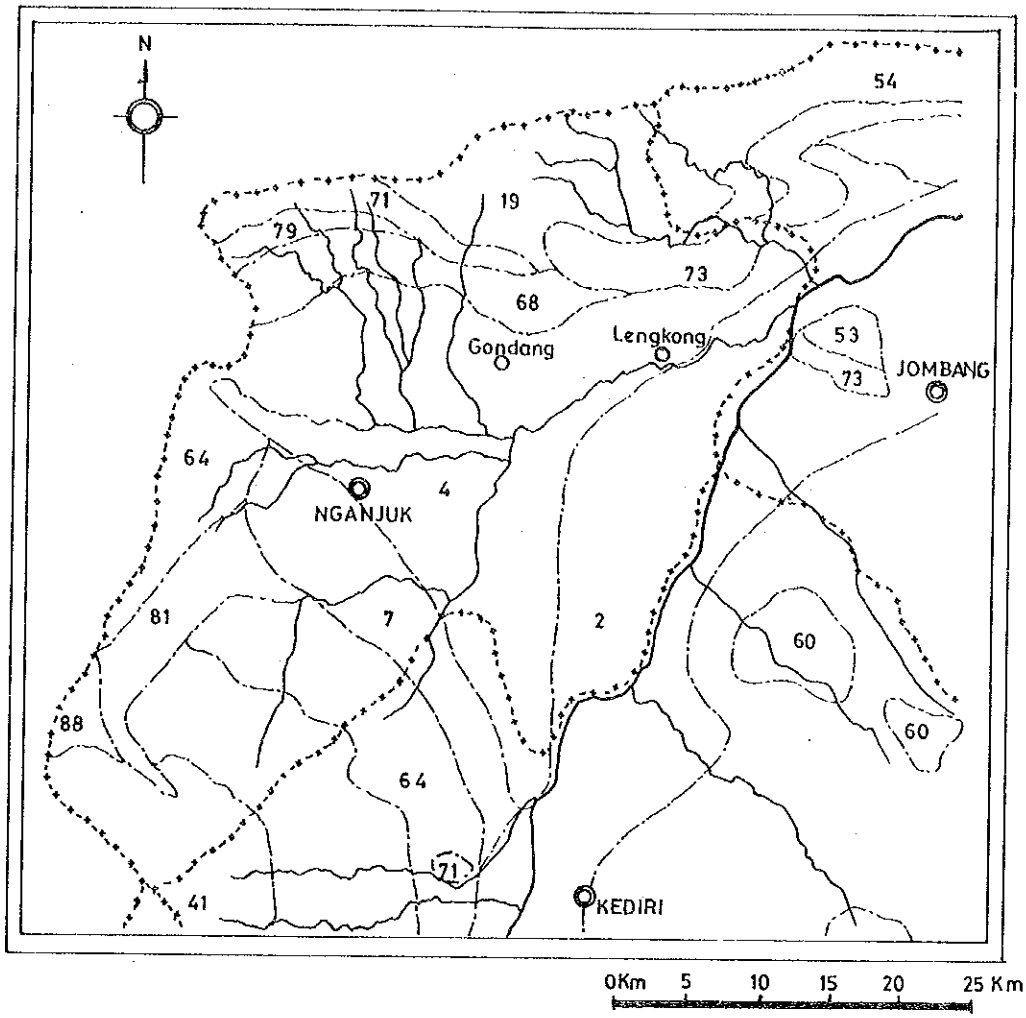
Fig. 2.2 REGIONAL GEOLOGIC MAP



LEGEND

a : ALLUVIUM	e : KALIBENG FORMATION
b : TALUS DEPOSIT	f : Mt. WILIS TUFF BRECCIA
c : KABUH FORMATION	g : Mt. WILIS PYROCLASTIC FLOW
d : PUCHANGAN FORMATION	

Fig. 2.3 DIAGRAMMATIC GEOLOGIC PROFILE OF WIDAS - NGANJUK BASIN



Symbol of Number		Kind of Soil	Parent Material	Topography
I. ALLUVIAL				
2	Ag/gb - $\frac{P}{Ag/P}$	Complex of grey Alluvial and greyish brown Alluvial	Clay and sand sediment	Plain
4	Ajg - $\frac{P}{Ac/P}$	Dark gray Alluvial	Clay and sand sediment	Plain
7	Ayg - $\frac{P}{Ac}$	Yellowish gray Alluvial	Clay sediment	Plain
III. LITOSOL				
19	LimyRZ - $\frac{F}{Sk/m}$	Complex of Litosol yellow Mediterant and Rezina	Limestone	Folded hill
VI. ANDOSOL				
41	An-yb.Re.yb. - $\frac{V}{(V-T)i}$	Association of yellowish brown Andosol and yellowish Regosol	Tuff and volcanic ash intermediatery	Volcanic
VII. GRUMOSOL				
53	G . dg - $\frac{P}{Ac}$	Dark grey Grumosol	Clay sediment-ation	Plain
54	G . dg - $\frac{F}{S.k/m}$	Dark grey Grumosol	Limestone	Folded hill

Symbol of Number		Kind of Soil	Parent Material	Topography
VIII. MEDITERANT				
60	Mb Gg - $\frac{V}{Ti}$	Association of brown mediterant	Volcanic tuft intermediary	Plain
64	Mrg Gg - $\frac{V}{Ti}$	Redish brown mediterant	Volcanic tuft intermediary	Volcanic
68	Mtb Gg - $\frac{F}{SbRi}$	Association of redish brown Mediterant and grey Grumosol	Sandstone	Folded hill
71	Mtb/Li - $\frac{F}{SK}$	Complex of redish brown Mediterant and Litosol	Limestone	Folded hill
73	Mb/Li - $\frac{F}{Sp}$	Complex of brown Mediterant and Litosol	Sandstone	Folded hill
IX. LATOSOL				
79	Lb - $\frac{V}{Ti-b}$	Brown latosol	Volcanic tuff intermediary until base	Volcanic
81	Lb.Reg - $\frac{V}{(V-T)ib}$	Association of brown Latosol and brown Regosol	Ash and volcanic tuft intermediatery until base	Volcanic
88	L rb/Li - $\frac{F}{Ri/b}$	Complex of redish brown Latosol and Litosol	Volcanic stone intermediary until base	Folded hill

Fig. 2.4 SOIL MAP IN THE WIDAS RIVER BASIN

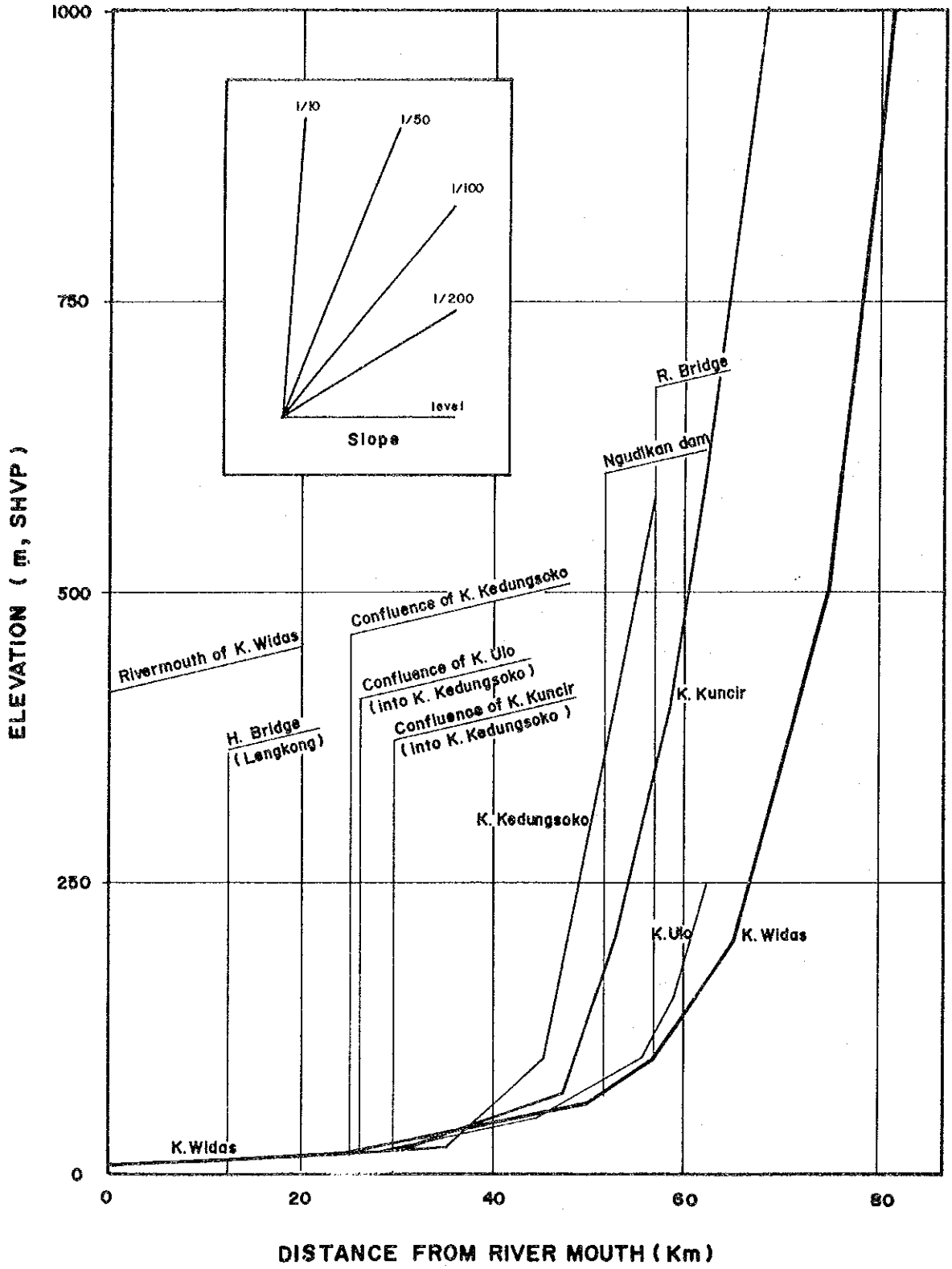


Fig. 2.5 PROFILES OF MAJOR RIVERS

LEGEND ;

- : Boundary of Kab
- : Boundary of Kecamatan
- : Boundary of desa
- : Boundary of Basin

Fig. 2.6 ADMINISTRATIVE DEVISION OF THE WIDAS RIVER BASIN

CHAPTER 3 AVAILABLE DATA

LIST OF TABLES

LIST OF FIGURE

3. AVAILABLE DATA

In this Chapter, data used for this study are summarily described.

3.1 Topographic Data

The entire Widas river basin is covered by topographic maps of 1 to 250,000, 1 to 100,000 and 1 to 50,000 scales, respectively. For study such as hydrology on the entire basin, the topographic maps of 1 to 50,000 are used.

The project area of the flood control works and the dam and irrigation development, are covered by topographic maps of 1 to 2,500 scale prepared by BRBDEO based on the aero photoes of 1 to 10,000 scale.

Along the Widas river and its major tributaries, a network of leveling was established during the Part I Study. Cross sections of the river channel were surveyed at an interval of 500 m on an average.

3.2 Meteo-hydrological Data

3.2.1 Meteorological data

Within the Widas basin, the meteorological observation has been carried out at Bulakmojo in the Nganjuk town from 1973. Observation is made on temperature, relative humidity, evaporation, sunshine hours and wind velocity, as shown in Table 2.1.

3.2.2 Rainfall data

There are 37 rain gauging stations in and around the basin as shown on Fig. 3.1 and availability of daily rainfall records is summarized in Table 3.1.

Hourly rainfall observation at 16 stations in Fig. 3.1 had started in 1970's. The availability of records is shown in Table 3.2.

3.2.3 Water level and discharge data

The location of water level observation stations are shown on Fig. 3.1. Table 3.3 shows the availability of the water level records. Discharge measurement has been carried out periodically to construct rating curves for converting water level to discharge.

3.2.4 Sediment discharge data

Sediment load is usually divided into three; suspended load, bed load and wash load. Out of them, suspended load sampling has been carried out at Lengkong water level gauging station since 1973.

3.3 Geological and Material Data

Geological and material investigation has been carried out by BRBDEO in 1984 and 1985. The results of investigation in 1985 as well as some of the 1984 investigation results are presented in ANNEX 3.

3.4 Unit Price Data

The unit prices used for estimation of unit costs of various works are presented in ANNEX 8.

Table 3.1 LIST OF RAINFALL STATION AND AVAILABLE PERIOD OF RAINFALL DATA IN THE WIDAS BASIN

No.	Name of Station	Number	Years	Recording Period	Non available Period
1.	Kedung Pinggit	1	34	1950 - 1983	July - Dec. 1979
2.	Tempuran	3	34	"	"
3.	Matokan	4	34	"	"
4.	Bangle	5	34	"	Jan. - May 1980
					July - Dec. 1979
5.	Sumber Kepuh	6	34	"	"
6.	Tretes	7	34	"	July - Dec. 1979
7.	Gondang	8	34	"	"
8.	Rejoso	9	34	"	"
9.	Nganjuk	11	34	"	Jan. - Mar. 1950
					Jul. - Dec. 1979
					Jun. - Jul. 1980
10.	Tunglur	12	34	"	Jul. - Dec. 1979
11.	Kacangan	13a	34	"	"
12.	Jati	13	34	"	Jun. - Sep. 1980
					Feb. - Dec. 1982
					Apr. - Nov. 1983
					Jun. - Dec. 1979
13.	Sawahan	16	34	"	Jun. - Apr. 1980
14.	Klodan	17	34	"	Jan. - Mar. 1969
					Jul. - Dec. 1979
15.	Mrican	189	34	"	July - Dec. 1979
16.	Logawe	57	34	"	July - Dec. 1979
17.	Sumbersono	58	34	"	Julu - Dec. 1979
18.	Lengkong	59	34	"	"
19.	Kedungrejo	62	34	"	"
20.	Baron	65	34	"	Jan. - Sep. 1980
					May - Dec. 1982
					"
					July - Dec. 1979
21.	Kertosono	64	34	"	July - Dec. 1979
22.	Warujayeng	68	34	"	July - Dec. 1979
23.	Prambon	75	34	"	"
24.	Dingin (Ngronggot)	73	34	"	"
25.	Prayungan	170	34	"	"
26.	Ngasem	171	34	"	"
27.	Sumber kemiri	172	34	"	"
28.	Pace	-	34	"	"
29.	Mlilir	-	34	"	"
30.	Ngudikan	-	34	1950 - 1983	July - Dec. 1983
					July - Dec. 1979
31.	Ngrambek	-	22	1962 - 1983	Jan. - Apr. 1962
					July - Dec. 1979
32.	Glatik	-	20	1964 - 1983	July - Dec. 1979
33.	Kedungsoko	-	14	1970 - 1983	July - Dec. 1979
34.	Patihan	-	14	1970 - 1983	June - Dec. 1972
					July - Dec. 1979
35.	Gemarang			-	All periods
36.	Genjeng	-	29	1955 - 1983	July - Dec. 1979
37.	Gading Parang	39	29	1955 - 1983	July - Dec. 1979

Gemarang station belongs to Kabupaten Madiun
Genjeng and Gading Parang belong to Kediri

Table 3.2 AVAILABLE PERIOD OF HOURLY RAINFALL DATA IN THE WIDAS BASIN

No.	Name of Station	Years	Recording Period	Non available Period
1.	Bulakmojo	12	1972 - 1984	Jan. - Mar. 1972 Jan. - Nov. 1973 Dec. 1976 Feb. - Mar. 1977 Nov. 1977 Jan. - Dec. 1980 Feb. - Apr. 1981 Aug. 1981 Feb. 1982 May - Dec. 1983
2.	Ngudikan	11	1974 - 1984	Jan. - Oct. 1974 April 1977 Jan. - Dec. 1980, 1981, 1982, 1983
3.	Gemarang	9	1976 - 1984	Jan. 1979 Jan. - Dec. 1980 Jan. - Mar. 1981 Jan. - Dec. 1983
4.	Kali Bening	9	1976 - 1984	Dec. 1978 Apr. - May 1979 Dec. 1982
5.	Kertosono	6	1979 - 1984	Jan. - Feb. 1979 Jan. - Dec. 1980
6.	Pace	4	1981 - 1984	Jan. - Jun. 1981 Dec. 1982 Nov. - Dec. 1983
7.	Jati / Loceret	4	1981 - 1984	Jan. - Sep. 1981
8.	Semantok	4	1981 - 1983	Jan. - Jun. 1981 Dec. 1981 Mar. - Jun. 1982
9.	Ngluyu	3	1981 - 1984	Jan. - Jun. 1981
10.	Kali Mati	3	1981 - 1984	Jan. - Jun. 1981 Aug. - Nov. 1981 Jan. 1983
11.	Tunglur	3	1981 - 1984	Jan. - Aug. 1981 Dec. 1981 Jan. - Mar. 1983
12.	Ngliman	2	1981 - 1982	Oct. - Dec. 1981 Nov. - Dec. 1982
13.	Lengkong (Kertosono)	3	1981 - 1984	Jan. - Mar. 1983
14.	Sawahan	3	1979 - 1984	Jan. - Dec. 1980
15.	Ngrambek	1	1981	Jan. - Jun. 1981
16.	Prambon (Kediri)	1	1983	