3. GEOTECHNICAL CONSIDERATION

3.1 General

Structural measures for the flood mitigation plans include dams in the mid-stream reaches and river improvement such as levee, revetment and enlargement of the river channel in the downstream reaches. Geological investigation for the dam scheme was performed concentrating mainly on the conceivable damsites, i.e. Lebir in the Lebir River, Dabong and Kemubu in the Galas River, Lower Pergau in the Pergau River and Nenggiri in the Nenggiri River. In this Section, geotechnical consideration is described for the conceivable dams and river improvement works on the basis of geological data collected from DID and GSD as well as the result of field survey and interpretation of aerial photographs.

In downstream reaches, some hydrogeological investigation was carried out for estimating the groundwater potential of alluvial plain, but data for engineering geology are not available.

3.2 Conceivable Damsites in the Mid-stream Reaches

3.2.1 Lebir damsite

The Lebir dam project, for which the feasibility study is under way by JICA, is developed as the multi-purpose project with the objectives of hydropower generation, flood mitigation and irrigation water supply. The main structures for this dam project comprise a 77 m high rockfill type dam, two saddle dams, spillway and so on as shown in Fig. III.3.1.

The Lebir damsite is located at about 3 km upstream from existing Tualang Bridge. The Lebir River forms an incised meander around the damsite, turning its direction from north to south and then returning to north. The geotechnical conditions reviewed for the feasibility study and also based on this field survey are as follows:

(1) Geological condition

Main dam

The river bed at the damsite is about 150 m wide and El.26 m high. There exist rapids in the reaches where the dam sits.

River terraces are developed on both banks, the top of which is El.45 m. The terrace on the left bank is narrow, behind which decomposed rocks rise at the gradient of about 16 to 18°. On the right bank, the river terrace is approximately 50 m wide, and the slope above it rises at the gradient of 20°.

Bedrocks underlying the damsite consist mainly of green tuffs, purple tuffs, green tuffaceous sandstones and shales with thin layers of tuffaceous conglomerates. These bedrocks, which are slightly metamorphosed and non-foliated, are hard and massive. Bedding is monoclinic with fairly consistent strike and dip of N40°E/34°SE on an average.

Irregular joints having main strike and dip of NW-SE/40°-70°NE or SW occur in the bedrocks of damsite. It is, however, found by field survey of core drilling and seismic explanation that there is little possibility of the existence of large-scale faults at the main damsite.

Intensive weathering develops on both banks of the damsite. The decomposed zones are 5 to 7 m thick on both slopes, and show high permeability of more than 20 Lugeon. To reach the fresh rocks, it will be necessary to excavate by 5 m at the river bed, 10 m at the left bank and about 20 m at the right bank. While, the pervious rock zones, indicating more than 20 Lugeon, are 20 m deep in the river bed, 15 m in the left bank and 25 m in the right bank.

It is considered from review result and site survey that JICA study result to adopt a 77 m high rockfill type dam is acceptable.

It is judged that a large scale landslide does not occur in the reservoir area since the bank slope of the reservoir area is fairly gentle.

Saddle dams

Two saddle dams have been proposed to keep the reservoir water level higher than El. 60 m. They are located on the right bank of the river; 1.8 and 2.0 km north-east from the proposed main dam, respectively. Both saddle dams with a rockfill type are about 70 and 45 m in height.

The bedrocks underlying saddle dam I consist mainly of tuffaceous conglomerates and tuffaceous sandstones with consistent strikes and dips of NNW-SSE/70-90°S. Heavily and deeply weathered zones are developed on both banks. Decomposed rocks with high permeability of more than 30 Lugeon are 5 to 10 m thick in the bottom, 25 to 30 m in the left bank and 5 to 20 m in the right bank. To reach the fresh rocks, it will be necessary to excavate 15 m in the bottom, more than 30 m in the left bank and 10 to 30 m in the right bank. The zones showing high permeability correspond to the weathered zones exceeding 30 Lugeon.

The bedrocks underlying saddle dam II are comprised mainly of tuffs, tuffaceous sandstones and intruded meta-dacites. Tuffs and tuffaceous sandstones alternate closely and strike generally NNW-SSE. Hard meta-dacites probably with some dozen metres in width are distributed on the right bank of the damsite. Weathering will be as shallow as about 7 m at most. The left bank

of this damsite which corresponds to the right bank of the saddle dam I is weathered by around 25 m in depth.

It is concluded from the review result and site survey that JICA study result to adopt the rockfill type dam for two saddle dams is acceptable.

(2) Construction materials

Rock materials and concrete aggregates

River deposits suitable for concrete aggregates and rock materials are insufficient in volume.

A proposed quarry site is located 1.5 km north of the proposed main damsite. It consists of tuffs, tuffaceous breccias and rounded conglomerates. However, its surface layer with 10 to 15 m in depth is weathered and not suitable for rock materials and concrete aggregate. The available amount beneath the weathered zone is enough for dam construction, and suitability of quality as rock materials and concrete aggregates has been confirmed by the laboratory test.

Core materials

The borrow site for core materials is situated in the granite area near the boundary with the Mesozoic sedimentary rocks, 4 km east-northeast from the proposed main damsite. The granite mass is heavily weathered by 15 to 20 m in depth. This weathered granite is adequate for core materials in quality since the material tests show that the materials contain the natural water content of 15 to 20% and are well graded. A sufficient amount of the core material is supposed to obtain from the proposed borrow area.

It is considered that the JICA study result for rock materials, concrete aggregate and core material is reasonable.

Filter materials

There are no descriptions for filter material in the feasibility study report. The result of field survey in this time clarified that the suitable filter materials have not been found around the proposed damsite, and then it is proposed to obtain them by crushing the rock material at the proposed quarry site.

3.2.2 Dabong damsite

The geological survey for conceivable damsite was performed in up and downstream river stretches from the proposed Dabong damsite aiming at finding out the alternatives for the Dabong damsite. The result of the survey clarified that the side slope of the both river banks becomes gentle in about 10 km long river

stretch downstream of the Dabong damsite, while several river terraces continue in about 5 km long stretch upstream from the Dabong damsite, and consequently the site superior to the Dabong site could not be found.

The Dabong damsite is located about 5 km downstream from the confluence of the Pergau River as shown in Fig. III.3.2. At the damsite, the Galas River passes through a narrow gorge created by a 300 m high ridge running from north to south.

The East Coast Railways passes through a tunnel (No. 5) at the right abutment. The submergence of the tunnel will be unavoidable after the completion of the dam. A saddle dam will be required at the left bank, if the main dam is higher than El.45 m.

Geotechnical investigation for the damsite and construction materials was carried out in 1975 by ENEX. The investigation report proposes an approximately 50 m high concrete dam.

(1) Geological conditions

Main dam

The river bed at the damsite is approximately 50 m wide and El.30 m high. The slope on the left bank, which consists of massive and sound rocks, rises at the gradient of about 45°. On the other hand, the slope on the right bank rises at a gradient of 30° up to 20 m in height from the river bed and becomes as steep as 50 to 55° above it.

The bedrock consists mainly of fine grained schist apparently derived from the regional metamorphism of argillaceous or arenaceous sedimentary rocks. The rocks with generally greenish or pinkish white colour are fairly hard, even considerably foliated. Quartz, muscovite and chlorite are dominant in the rocks. The hardness of the rock is probably due to high quartz content.

Schistosity strikes and dips NS/55-70°W. Since the river channel directs north-northeast at the site, the above schistosity dips toward the river on the right bank. The dip of the schistosity being steeper than the right bank slope, it will hardly result in any serious instability of the slope.

Some of the joints run nearly parallel to schistosity, but others strike and dip N40°W/50°NW and N80°E/90°. No evidence of significant faulting was observed.

The thickness of river deposit seems to be rather thin. Overburdens are generally thin, because bedrocks are exposed widely around the site. However, the debris with sub-angle rocks of 0.5 to 1 m in diameter exists up to 20 m in height from the river bed on the right bank, and its thickness is estimated to be 1 to 3 m.

Weathering develops presumably within a few metres in depth. The schists which form the foundation and abutments are relatively impermeable, because their foliations and folds are firmly closed.

It is considered from the topographic and geological view point that the site will allow the construction of about 50 m high concrete gravity dam.

The geotechnical points to be taken into account for the construction of dam are as follows:

(i) Slope stability at the damsite shall be taken into consideration, particularly on the right bank where the schists steeply dip into the river. Shallow rock slides parallel with the schistocity planes are possible during excavation. However, there does not appear to be any danger of large scale slides at the damsite.

(ii) It is evaluated that no possibility of occurence of excessive deformation in the schist foundation on the damsite because of massive and sound rock conditions.

(iii) Since the railway tunnel located at the right bank of the damsite will be submerged after the completion of the dam, the tunnel will have to be plugged by concrete. Besides, an adequate treatment by grouting will be needed for stopping leakage.

According to the geological interpretation based on the available data and field reconnaissance for the reservoir area, possible landslide areas are not found.

Saddle dam

A saddle dam will be needed at the col located approximately 6 km north of the main dam when the reservoir water level keeps higher than El.60 m. The bed rocks underlying the saddle dam consist mainly of schist. Weathered and pervious zones are estimated to be deep.

(2) Construction materials

Concrete aggregates and rock materials

The schists exposed at the damsite are considered unsuitable for concrete aggregates due to the flakiness of rock fragments. A quartz porphry dyke crops out near Kg. Kuala Teku, 6 km upstream of the damsite, extending south from the Galas River. Being moderately weathered, the rocks from this area will be suitable for concrete aggregates and rock materials, if the rock becomes less jointed and fresher with depth.

An aplite intruded into the sedimentary rock is distributed at the opposite side of Dabong. The outcropped rock is massive and sound, being only slightly weathered. If ample amount is

available, this aplite may be suitable for a quarry site of concrete aggregates and rock materials.

Pinnacles of limestones which may also yield concrete aggregates and rock materials in good quality are available at 4 km south of the damsite and at Kemubu, about 15 km upstream of Dabong. The limestones will be one of alternative sources for aggregate, since the rocks are exposed and the quarried rocks can be hauled by the existing railway which passes through the Dabong damsite.

Sand

Large sand deposits distributed 2 to 3 km upstream of the Galas River will be suitable for concrete aggregates, but amount is limited.

Filter materials

Sand and gravel deposits suitable for filter materials exist along the Pergau River. The deposits are composed mainly of granitic rocks, quartzose rocks and sedimentary rocks, the size of which is generally upto 100 mm in diameter.

Core materials

Residual soils and decomposed rocks distributed around 1 to 2 km east of the damsite are considered to be suitable for core materials.

3.2.3 Lower Pergau damsite

The survey to find out the conceivable damsite was performed for about 20 km long Pergau River stretch upstream from the Galas confluence. However, there was no suitable damsite superior to the proposed Lower Pergau site. It is considered that the envisaged Lower Pergau site is not always suitable for dam construction and its height will be topographically limited less than 20 m.

The Lower Pergau damsite is located near Batu Lembu village on the Pergau River, approximately 10 km east-northeast of Dabong located at the confluence of the Pergau and Galas rivers as shown in Fig. III.3.3. Geotechnical investigation of the damsite and construction materials was carried out in 1975 by ENEX.

(1) Geological condition

Main dam

The valley at the site is widely open. The river bed is 65 m wide and El. 33 m high. The slope on the right bank rises at the

gradient of 25° upto 10 m in height from the river bed and becomes steeper above it with the gradient of 35°. There is a 400 m wide area on the left bank, in which several gullies run through the small undulating hills.

Bedrocks are sporadically exposed only on the river brinks. The rocks in the vicinity of the damsite consist mainly of shale interbedded with coarser grained, indurated tuffs, striking and dipping NS-N25°W/30°-50°NE. Since joints are developed parallel to the bedding, the shales are fissile to this direction.

The rocks, especially coarse grained rocks, in this area appear to be slightly metamorphosed even with the granite mass in a short distance to west. No major faulting seems to exist at the damsite.

Weathering on both banks is estimated to be considerably deep, but the outcrops on the river brinks are observed to be moderately or slightly weathered.

Due to this topographic condition, an about 20 m high dam will be constructed. Considering this dam height and geological conditions at the site, an earthfill type dam is considered to be adopted. It is presumed that there are no possibilities of landslide at the damsite and in the reservoir area because the slope of river banks is relatively gentle.

(2) Construction materials

Concrete aggregates and rock materials

Massive and sound granites are found in a 4 km distance to west from the damsite. These granites will be suitable for rock materials and concrete aggregates.

Sand and gravel are available in the river bed of 5 km downstream from the damsite. Amount is limited, so that concrete aggregates will be obtained from the crushed rocks.

Earth materials

Residual soils thickly decomposed appear to be suitable for impervious materials. Two sites with ample residual soils are proposed as the borrow areas. One is located within 1.5 km distance from the dam on the right bank, while the other is 2 km on the left bank.

3.2.4 Kemubu damsite

The survey to find out the conceivable damsite was carried out for the Galas River upstream of the existing railway bridge. The result of the survey clarified that there are three conceivable damsites, i.e. at about 1.5 km (ENEX No.3), 12 km (ENEX No.15) and 18 km (ENEX No.17) upstream from the existing

railway bridge. Among them, three large-scale saddle dams for the lowermost site are needed for the col located at the right river bank. While the site located in the middle is not considered to be suitable for the damsite due to its weak rock foundation. At the uppermost site as shown in Fig. III.3.4, massive and comparatively sound rocks are found around the both river brinks, and the slope conditions of both abutments are steep and stable. Consequently, the uppermost site is conceived to be superior to the other sites.

(1) Geological conditions

Main dam

The river bed at the damsite is about 100 m wide and around El.60 m high. The slopes of the both bank are steep.

Bedrocks consist mainly of schist and volcanics moderately foliated due to metamorphism. These rocks are exposed along the river brinks and slopes of the both banks up to 15-20 m above the river bed.

Schistosity strikes and dips, being not clear, probably NW-N30°W/60°W-60°E. Joints are approximately parallel to schistosity.

The thickness of the river deposit seems to be rather thin, and its thickness is estimated to be 1 to 3 m.

Since the schist exposes on both banks at the proposed damsite, it is considered that there are no problems for slope stability during the excavation period and after submergence in the reservoir.

The shearing strength of the bedrocks is evaluated to be comparatively strong because of their massive and sound conditions.

It is considered from topographic and geological viewpoints that it will be possible to construct a concrete gravity type dam or rockfill type dam with a height of about 50 m.

According to the result of the interpretation of aerial photograph and field investigation, possible landslide sites are not found around and upstream of the damsite.

(2) Construction materials

Rock materials and concrete aggregates

Large pinnacles of limestones located 6 km northwest of the damsite are suitable for rock materials and concrete aggregates.

Filter materials

Sand and gravel of the river deposits will be used as filter materials. However, since they are insufficient in volume, the filter materials will be secured by crushing limestone at the quarry site.

Core materials

Residual soils and decomposed rocks distributed around 1 to 2 km west of the damsite are considered to be suitable for core materials.

3.2.5 Nenggiri damsite

The feasibility study on the Nenggiri dam project was carried out in 1986 by ELC. According to this study, the Nenggiri damsite is located near Batu Baloh, about 30 km upstream from the Galas confluence as shown in Fig. III.3.5. In this vicinity, the Nenggiri River forms a meander and flows down northwardly. A high limestone ridge ranges from north to south on the left bank. The report proposes a 115 m high rockfill type dam and two saddle dams with 50 m and 30 m high respectively at the col of the right bank.

The geological conditions reviewed for the feasibility study and also based on field survey are as follows:

(1) Geological condition

Main dam

The river bed at the damsite is about 80 m wide and El. 60 m high. The slope of the left bank rises gently at the gradient of 15^{o}. On the right bank, the slope gradient is 25^{o} to 30^{o} upto 150 m in height above the river bed. Massive limestone makes a vertical cliff higher than 200 m above it.

The geology in the vicinity of damsite is fairly complicated. Several kinds of rocks expose along the river. The bed rocks exposed at the damsite are interbedded meta-sedimentary and meta-pyroclastic rocks, consisting of quartzites, hornfels, schists and altered tuffs.

The meta-sedimentary and pyroclastic rocks distributed at the damsite are massive and hard, even considerably foliated. The schistosity strikes and dips $N60^{o}E$ - $70^{o}E/40^{o}S$ - $50^{o}S$ at the river bed of damsite.

Joints developed at the site are closed. No evidence of major faults is found.

Weathering condition varies locally with its depth from a few metres to more than 15 m. Especially, weathering is deeply

developed at the left bank of the damsite, the slope of which may not be stable. The bed rocks, except weathered zones, are evaluated to be impervious according to the result of the permeability test.

It is considered from review result and field survey that ELC study result to adopt a 115 m high rockfill type dam is acceptable. Geotechnical points to be considered for the construction of dam are as follows:

(i) The zones thickly weathered are developed at both banks of the main dam. A special caution should be given for slope stability during dam construction.

(ii) Natural water content of the earth material for the proposed borrow pit ranges from 30 to 40% which is 5% higher than the optimum water content. An adequate quality control will be needed for embankment of the core materials.

(iii)No leakage around damsite is considered because the limestone is found at higher place than the dam crest of the right abutment. However, there may be a possibility of leakage through limestone developed between the main and saddle dams. An adequate treatment such as curtain grout or soil blanket for leakage will be required.

The result of the field reconnaissance for the reservoir area clarifies that the land slide may occur at unstable slope areas with deep weathering and colluvial zones, but its scale is considered to be relatively small.

Saddle dams

Saddle dams have been proposed about 6 km southwest-south of the main dam where the reservoir water level keeps higher than El.140 m.

The right bank of the saddle dam I forms a vertical cliff up to about El.400 m, while the left bank rises gently up to El.200 m, where the saddle dam I is separated from the saddle dam II. The river bed is flat with about 300 m in width.

The bedrocks underlying the damsite consist of massive and sound marble on the right bank and river bed, and of weathered metamorphic rocks on the left bank. Residual soils and intensively weathered rocks are 20 to 30 m deep on the left bank and around 10 m in the river bed.

The saddle dam II is located in a small gorge, where both banks have gentle slopes. The damsite is covered with thick residual soils and weathered schists of deeper than 50 m.

It is considered from these geological conditions that ELC study result to adopt the rockfill type dam for two saddle dams is reasonable.

(2) Construction materials

Rock materials and concrete aggregates

Two quarry sites have been proposed for rock materials and concrete aggregates: A quarry site comprising meta-agglomerate is located about 1 km upstream of the damsite and the other comprising marble or limestone is located about 2 km upstream of the damsite.

Filter materials

River deposits comprising mainly sand located 3 km to 6 km upstream of the damsite have been proposed as the borrow sites of filter materials. However, since a sufficient amount is not expected, the filter materials should be obtained by crushing rock materials at the quarry site.

Core materials

Residual soils available at the left bank of dam have been proposed as the core material, but natural water content is higher than 5% from the optimum water content. On the other hand, the construction materials for the saddle dams are found to be obtainable near the damsites.

3.3 Downstream Reaches

3.3.1 Low hilly area

Low hilly areas, from Kuala Krai to Kg. Gondang, consist mainly of the Permian sedimentary rocks covered with river terrace deposits.

(1) Distribution

Terrace deposits on both banks of the river are composed mainly of sand and silt, occasionally gravel and clay. Thickness is estimated to be less than 5 m. The Permian sedimentary rocks deeply weathered expose on the brinks of the river sporadically.

(2) Foundation condition

It is judged that both terrace deposits and sedimentary rocks are suitable for the foundation of embankment less than 5 m. In case of concrete structures, a spread foundation is recommended to place on sedimentary rocks by stripping terrace deposits which is estimated to be thin.

(3) Embankment materials

Residual soils and decomposed rocks available in the flood plain of the Kelantan River will be suitable for levee embankment materials.

3.3.2 Alluvial plain

The alluvial plain forming flat areas consists of fluvial and marine deposits. The fluvial deposits are composed mainly of sand, silt, clay, gravel and their alternation. On the other hand, marine deposits consist of medium-coarse sand and organic clayey soil behind rised beaches and dunes.

(1) Distribution

Both banks of the Kelantan River are mainly covered with silt, clay and their alternation of 5 m to 10 m deep, being soft and loose. Medium-coarse sands with gravels transported by floods remain on the river bed, river bar and some parts of the riverside.

Marine deposits comprising coastal medium-coarse sand and organic clayey soil are distributed at and around the river mouth. Especially, the organic clayey soil such as peat is anticipated to form soft foundation.

(2) Foundation condition

It is estimated that both fluvial and marine deposits are suitable for the foundation of embankment with a height lower than 5 m except for organic clayey soil. If organic clayey soil indicates 0 to 4 in N-value of the standard penetration test, foundation improvement will be necessary for consolidation settlement and sliding.

In case of concrete structures, a spread foundation or pile foundation will be selected according to the foundation condition of respective sites.

Regarding the levee embankment material, clayey soil at the river banks is considered to be available in the river stretch upstream from Kota Bharu. However, since the river bank in the stretch downstream from Kota Bharu consists mainly of coarse sand, residual soil and decomposed rocks around Machang on the right bank and Tanah Merah on the left bank is considered to be adopted for levee embankment material.

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19. Geological Map (Scale: 1/63,360), Sheet 22

20. Geological map (Scale: 1/63,360), Sheet 33

21. Geological Map (Scale: 1/63,360), Sheet 34

22. Geological Map (Scale: 1/63,360), Sheet 44

23. Geological Map (Scale: 1/63,360), Sheet 45

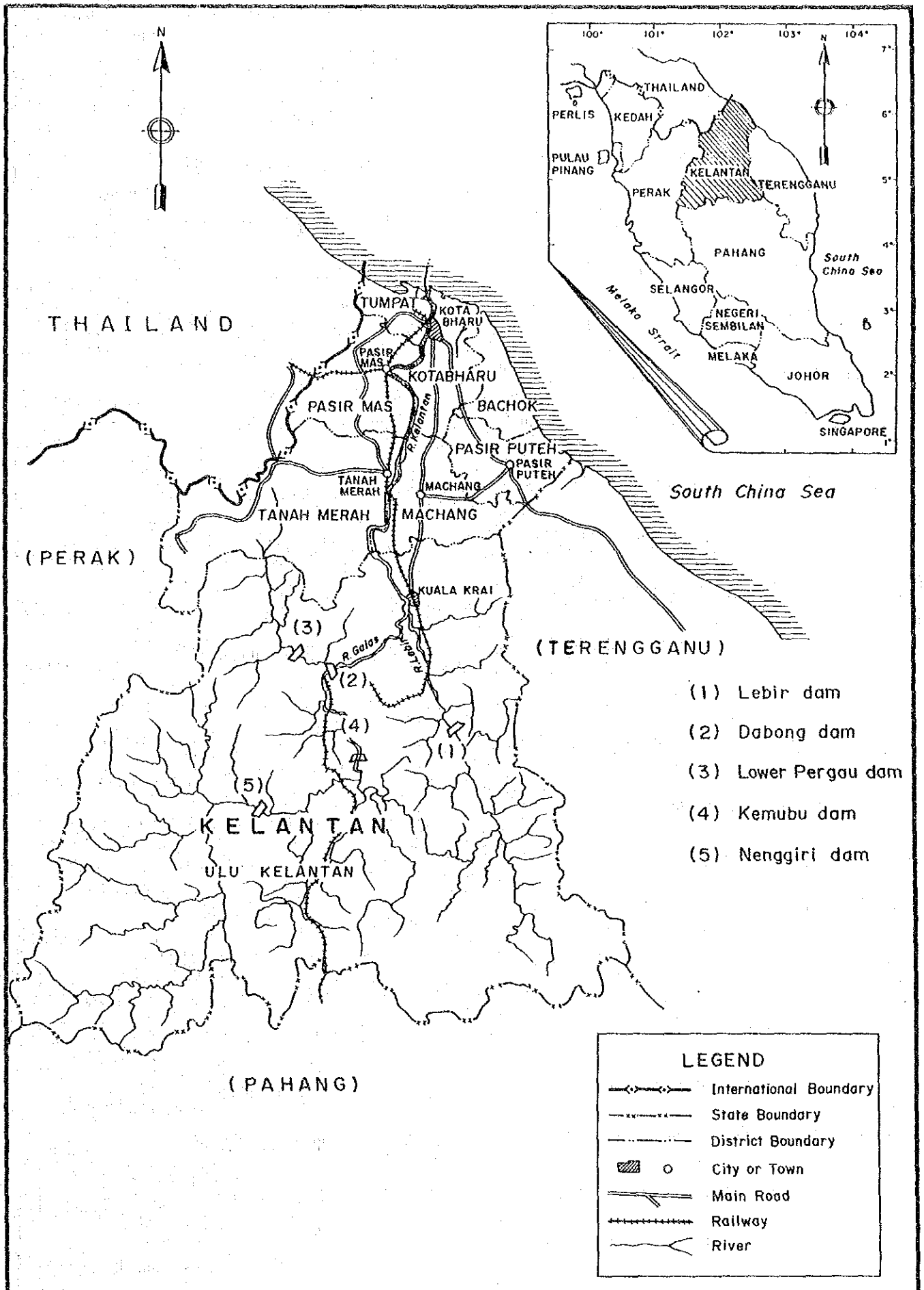

Fig. III. 2. 1 Location Map of Project Area

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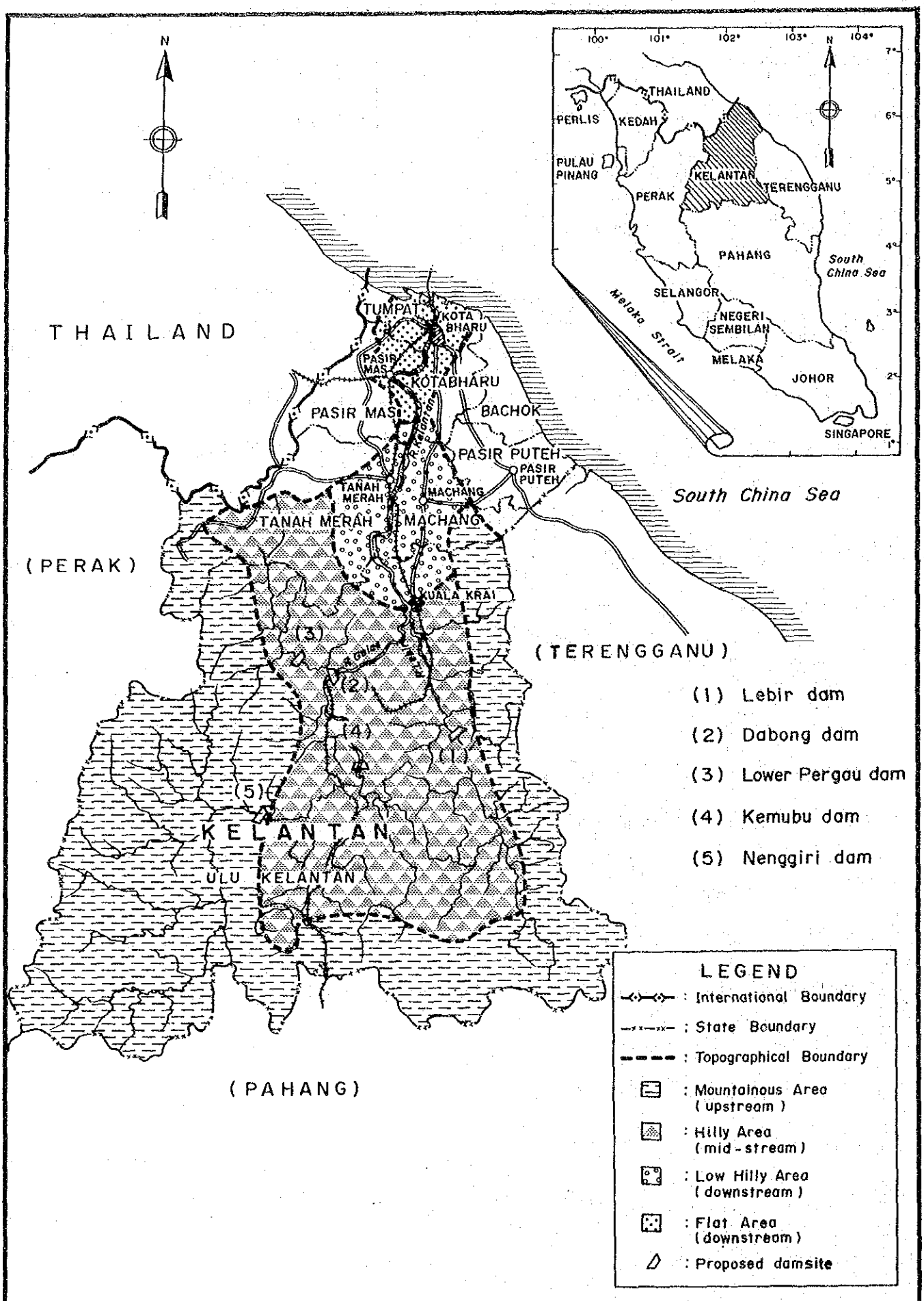

Fig.III.2.2 Topographic Map of the Kelantan River Basin

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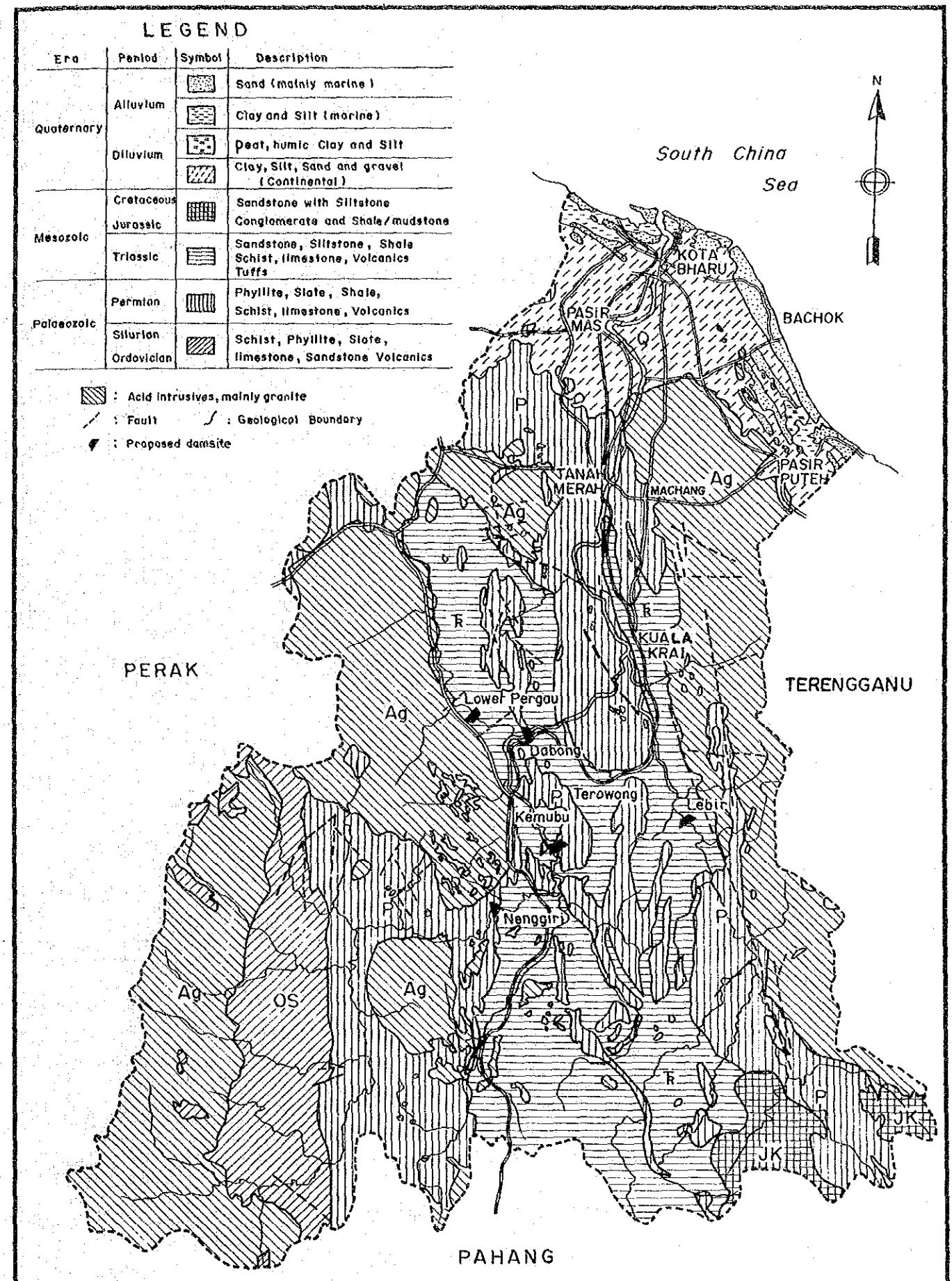

Fig. III.2.3 Geological Map of the Kelantan River Basin

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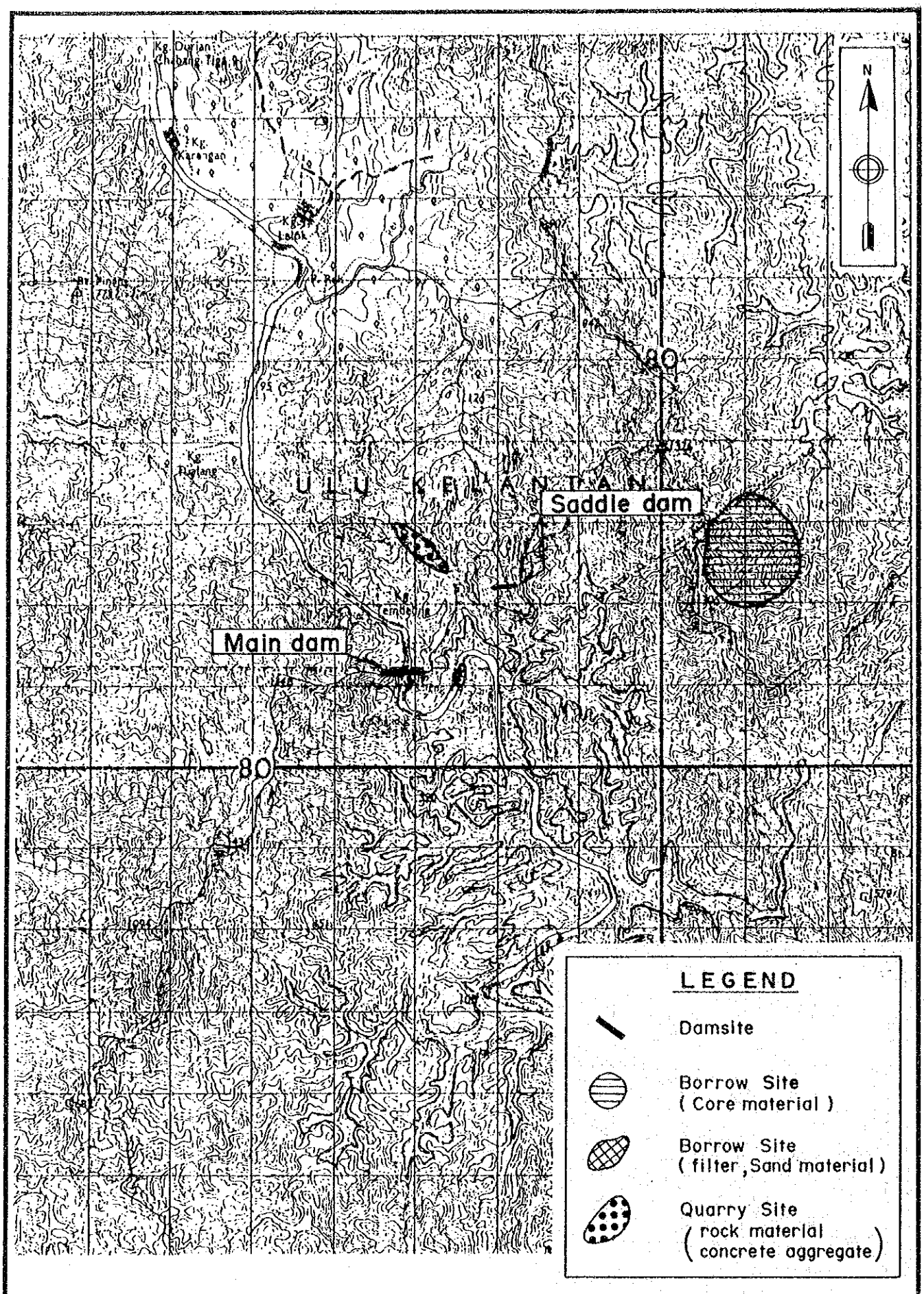

Fig. III. 3. 1 Location Map of Lebir Dam

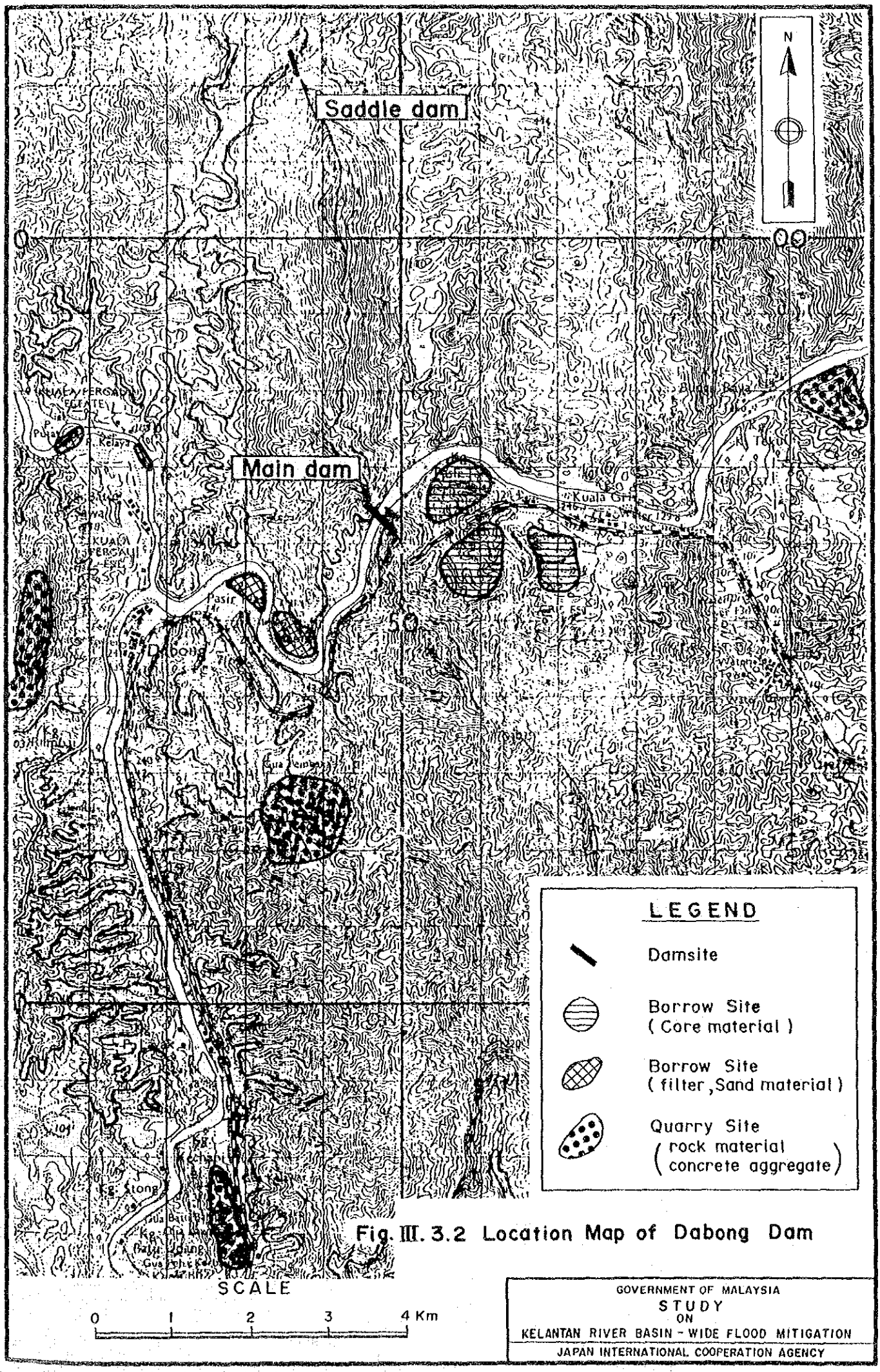

Fig. III. 3.2 Location Map of Dabong Dam

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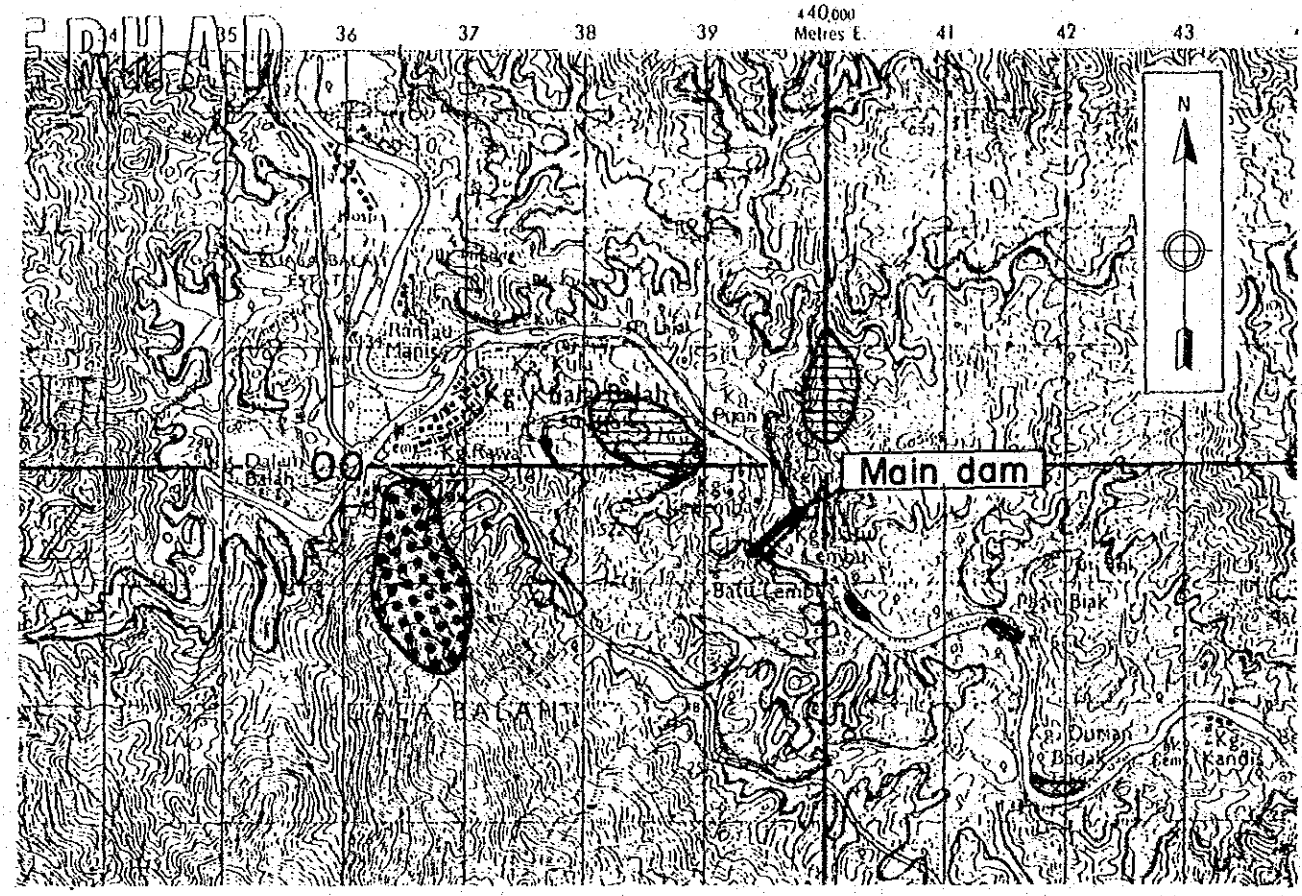

LEGEND

- Damsite
- Borrow Site (Core material)
- Borrow Site (filter, Sand material)
- Quarry Site (rock material concrete aggregate)

Fig. III.3.3 Location Map of Lower Pergau Dam

SCALE

0 1 2 3 4 Km

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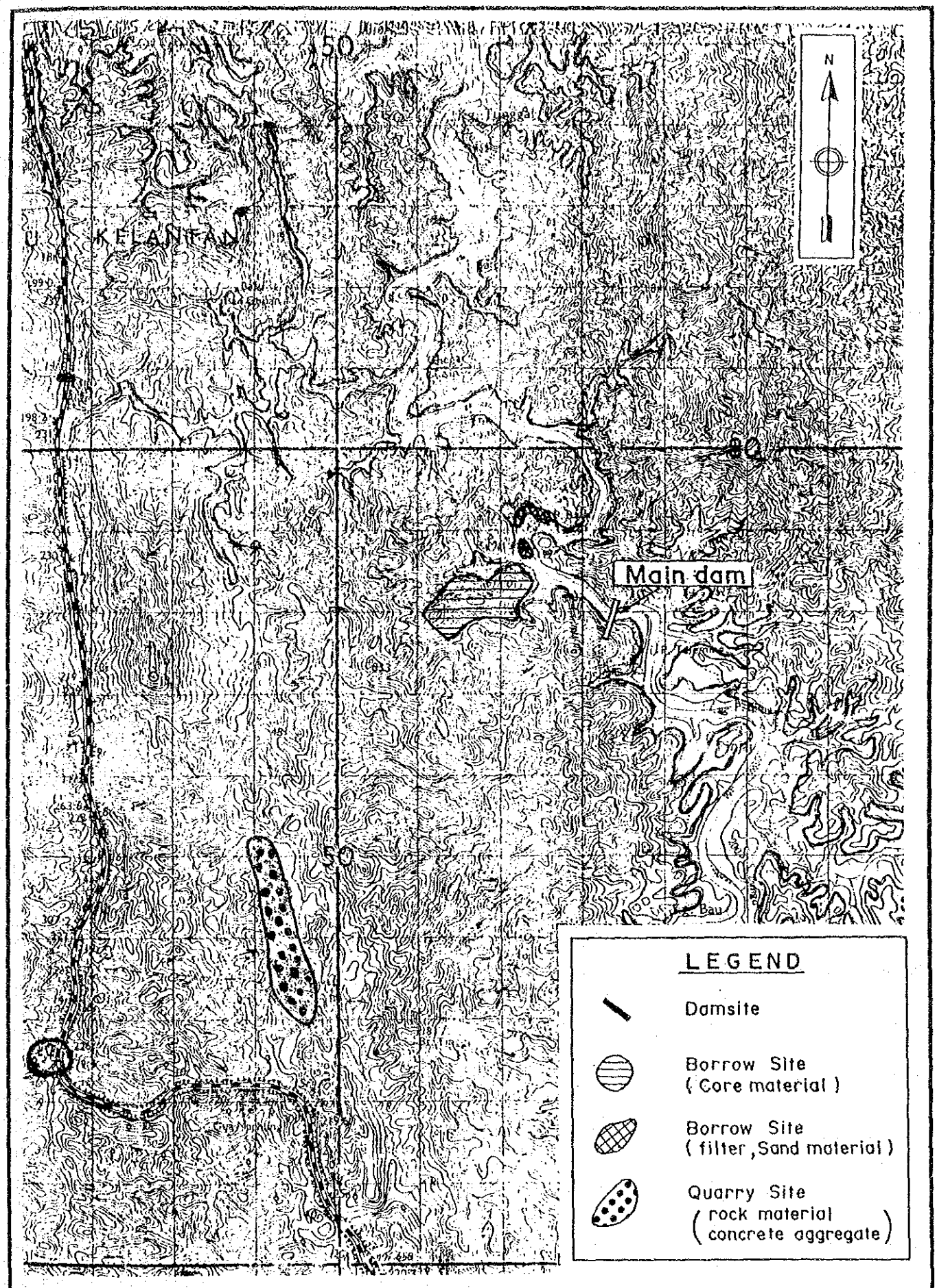

Fig. III. 3.4 Location Map of Kemubu Dam

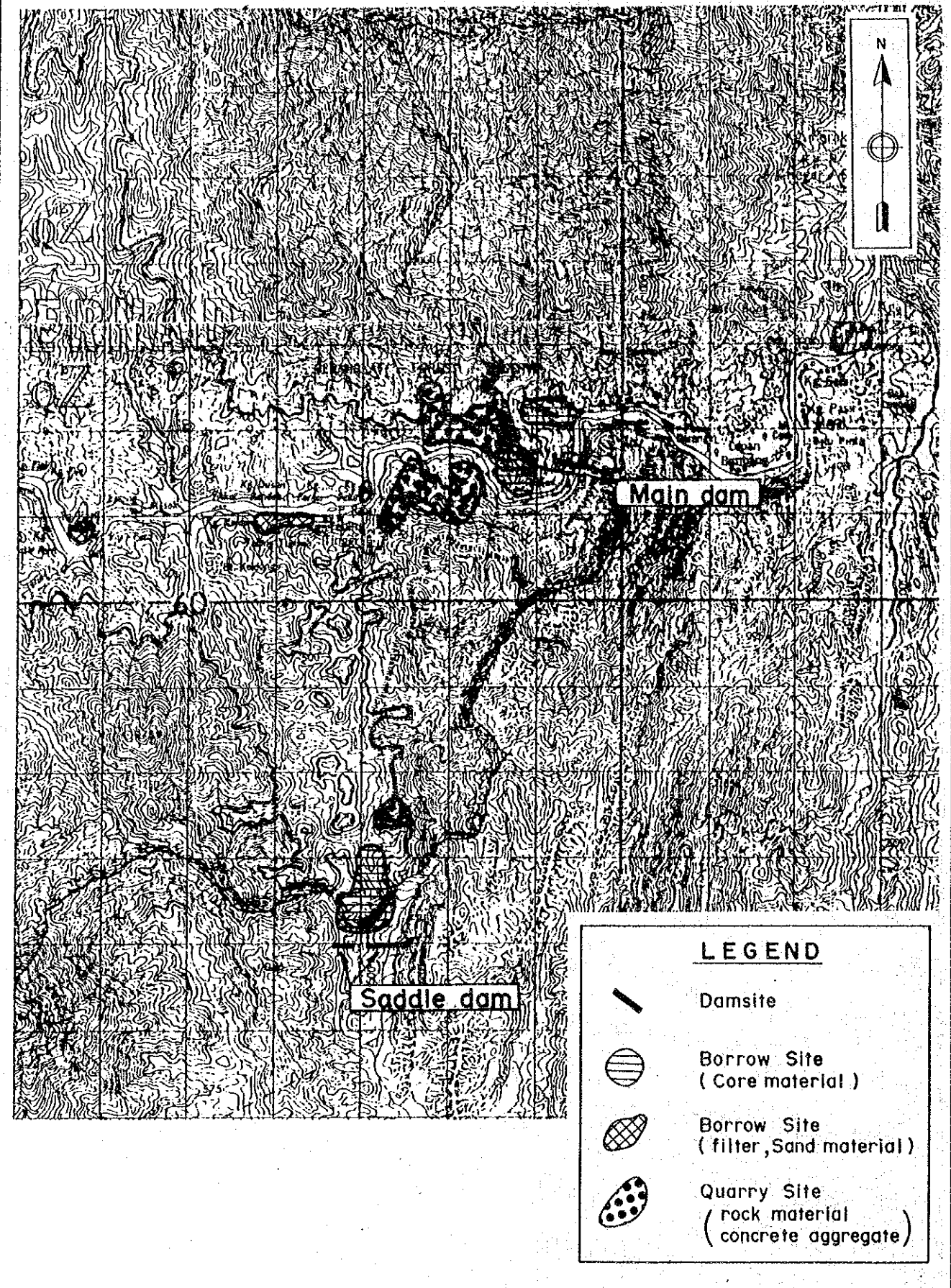

Fig. III. 3.5 Location Map of Nenggiri Dam

SCALE

0 1 2 3 4 Km

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JAPAN INTERNATIONAL COOPERATION AGENCY

ANNEX IV

SOCIO-ECONOMY

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IV. SOCIO-ECONOMY

1. INTRODUCTION

The State of Kelantan lies at an eastern part of Peninsular Malaysia with a land area of 14,943 km^2, accounting for 4.5% of the total land area of Malaysia.

The State has an estimated population of 1,091,756 as of 1988, out of which 78.8% live in the northern sub-region occupying 16.4% of the total land area in the State. On the other hand, the southern sub-region with 83.6% of the State area is the abode of 21.2% of the State people. The population of the State corresponds to 6.4% of the national population.

The State economy is dominated by agriculture with 70% of population, 50% of work force and 30% of GDP. The area of 65% in North Kelantan is used as agricultural land, while 86% of South Kelantan is covered with forests.

One difficulty that the economy of the State confronts is low productivity of the agricultural sector due to an adherence to the traditional farming practices. Another bottleneck is the narrow base of the manufacturing sector; that is, this sector shares 7.3% and 4.5% of State employment and GDP, respectively.

The GDP of the State is estimated at M$2,684.4 million in 1988 at market prices, accounting for 3.4% of the national GDP. Per capita GDP works out at M$2,459 or US$983. This living standard might be equal or higher than per capita GDP's in most of ASEAN countries, but it is only a half compared with the national average, resulting from a backwardness of the productive sectors as mentioned above.

The majority of the Kelantan people reside on both sides of the Kelantan River practising agriculture. The Kelantan River can bring enormous benefits to the people as a source of water supply, irrigation and power generation.

On the contrary, the Kelantan River annually brings extensive economic losses and human sufferings by flooding. Furthermore, the threat of floods contributes to such negative psychological attitudes that farmers tend to be reluctant to adopt modern agricultural technology, and industrialists would refrain from investing in flood prone areas.

The harnessing of the Kelantan River for flood mitigation as well as for other purposes is therefore the prerequisite to develop the State into a modern economy.

2. PROJECT BACKGROUND

2.1 Administrative Conditions

Malaysia with a land area of 329,745 km^2 is composed of Peninsular Malaysia and the two Regions of Sabah and Sarawak. Peninsular Malaysia is divided into Northern, Central, Eastern and Southern Regions. The State of Kelantan belongs to Eastern Region and is one of eleven States in Peninsular Malaysia.

2.1.1 Administrative divisions

The State of Kelantan normally divided into North and South Kelantan is composed of ten Districts as shown in Fig.IV.2.1; Bachok, Kota Bharu, Machang, Pasir Mas, Pasir Puteh and Tumpat in North Kelantan and Tanah Merah, Jeli, Gua Musang and Kuala Krai in South Kelantan. Each District comprises several Daerahs, the number of which reaches 67 in the whole State. Under each Daerah there are several Mukims.

There is a District Office in each District. Kota Bharu is the capital of Kelantan as well as the development centre of North Kelantan. Gua Musang is on the other hand the development centre of South Kelantan. Other major towns are Bachok, Machang, Pasir Mas, Pasir Puteh, Tanah Merah, Rantau Panjang, Jeli, Tumpat, Kuala Krai, Chiku, etc. Six Daerahs including Bandar Kota Bharu in Kota Bharu District are under the jurisdiction of MPKB (Majlis Perbandaran Kota Bharu) or Kota Bharu Municipal Council.

The State Government consists of 15 departments and offices as shown below:

Departments and offices of Kelantan State

(1) Office of Chief Minister (Menteri Besar) and State Secretary
(2) State Assembly Office
(3) Land and Mine Office
(4) Ten-District Office
(5) Forestry Department
(6) Drainage and Irrigation Department
(7) Agriculture Department
(8) Public Works Department
(9) Islamic Affairs Department
(10) Welfare Department
(11) Public Service Commission
(12) Town and Country Planning Department
(13) State Treasury Department
(14) Veterinary Department
(15) State Development Office

The State Goverment is headed by Chief Minister (Menteri Besar). Chief Minister's office is responsible for overall planning, administration and financing for the State of Kelantan. The State Government considers that the future of Kelantan hinges

on the development of agriculture, infrastructure and human resources.

2.1.2 Institutions concerned

The institutions/organizations in the local government which are directly and indirectly related to flood mitigation projects are SEPU, DID, Agriculture Department, Town and Country Planning Department, Public Works Department, KESEDAR and Forestry Department, while National Electricity Board, Geological Survey Department and Department of Environment as well as EPU and DID headquarters are directly and indirectly related in the federal level. Out of them, SEPU and DID are two major institutions directly connected with flood mitigation projects.

SEPU is an organization under State Secretary Office. Under Director SEPU there are two Principal Assistant Directors: One is in charge of economy and the other is responsible for sector. Under Principal Assistant Director (Economy) three Assistant Directors are assigned; Assistant Director (Statistics), Assistant Director (Regional Development) and Assistant Director (Manpower). Also, under Principal Assistant Director (Sector) four Assistant Directors are assigned, i.e. Assistant Director (Agriculture), Assistant Director (Infrastructure), Assistant Director (Industry) and Assistant Director (Community Development).

Basic/principal functions of SEPU are co-ordination of planning processes for project implementation to determine priorities of programmes and projects towards distribution of financial allocations, to prepare economic, technical and financial analysis in project implementation and to review State development requirements in co-operation with the relevant authorities at Federal Level.

DID is a department belonging to the federal and local governments. In the federal level, DID is placed under the Ministry of Agriculture, while six sections are organized under Director in the local level; Administration, Mechanical Unit, Planning, Federal Unit, and East and West Regions of the Kelantan River.

Federal Unit implements Federal development projects. Planning Section consists of Planning and Design, Surveys and Investigations, Analysis and Monitoring Progress of Projects and Hydrology. Main functions of Planning Section are planning and designing of proposed irrigation and drainage projects, carrying out surveys and investigations for proposed projects, updating progress of projects, collection/processing of hydrological data, flood forecasting and investigation of water resources. The sections in charge of East and West Regions of the Kelantan River have several District Offices under their jurisdiction. Their main functions are operation and maintenance of completed projects, implementation of development projects and river conservation works.

2.2 Social Conditions

2.2.1 Population

The population of Kelantan is estimated at 1,091,756 in 1988 as shown in Table IV.2.1. District-wise, Kota Bharu District has the biggest population of 357,995, accounting for 32.8% or almost one third of the State population. The population of Pasir Mas District is 142,867, which is placed second and accounts for 13.1%. The third place is occupied by Tumpat District, whose population of 104,492 accounts for 9.6% of the State population. Gua Musang District has the smallest population of 28,198, corresponding to 2.8% of the total population in Kelantan. The population of Jeli District is 37,120, which is the second smallest, sharing 3.4% of the State population.

Kota Bharu is the capital of Kelantan. It consists of six Daerahs; Badang, Kemumin, Kota, Lundang, Panji and Bandar Kota Bharu. The population under the jurisdiction of Kota Bharu town council, MPKB, is estimated at 224,719 in 1988, constituting 20.6% or one fifth of the population of Kelantan.

North Kelantan has the land use area of 246,364 ha, accounting for 16.4% of the total land use area in Kelantan. This sub-region occupying a fraction of the State area accommodates the population reaching 859,369, or 78.7% of the State population. Conversely, South Kelantan commands the land use area of 1,257,645 ha, covering 83.6% of the total land use area in the State. This bigger sub-region is however inhabited by a fewer people of 232,387, accounting for only 21.3% of the State population.

The population of Kelantan grew during the last inter-censal period of 1970 to 1980 at the average annual rate of 2.6% (refer to Table IV.2.1). It is estimated that population is growing at the average annual rate of 2.5% since 1980.

There is a difference in the pace of population growth among Districts. The population of Jeli District is growing at the fastest average annual rate of 5.4% since 1980. The population of Gua Musang District is also growing fast at the annual rate of 4.8%. Population growths in all Districts in South Kelantan are greater than the State average. Thus, the average annual growth rate in the whole of South Kelantan works out at 3.8% from 1980 to 1988. In contrast, population of all Districts in North Kelantan except Kota Bharu District is growing at a lesser rate than the State average. Especially low growths of population are witnessed for Machang and Pasir Puteh Districts in these two decades: Average annual growth rates are 1.5% and 1.6% respectively. The population in the whole of North Kelantan is growing at the average annual rate of 2.2% since 1980. The population of Kota Bharu District has grown from 1980 to 1988 at an average annual rate of 2.8%, while a slightly higher rate of 2.9% for the area under MPKB.

It can be said from the above that there are two major streams of intra-State migration; in-migration to the city of Kota Bharu from other parts of the State and migration from North Kelantan to South Kelantan. This phenomenon is in line with the Government policy that farmers in the North are transferred to rubber and oil palm plantations in the South, thereby lifting their standard of living and at the same time lessening the imbalance existing between the two sub-regions. Also the Government is developing Kota Bharu and other major towns to provide employment opportunities to rural workforce.

The average density of population in Kelantan is estimated at 72 per km^2 in 1988 as shown in Table IV.2.2. District-wise, Kota Bharu District has the highest population density of 889 per km^2, followed by Tumpat District of 576 per km^2 and Bachok District of 324 per km^2. Gua Musang District has the lowest population density of 3 per km^2. The second and third lowest are 28 per km^2 in Jeli District and 38 per km^2 in Kuala Krai District. The average density of population in North Kelantan works out at 84 per km^2, while 16 per km^2 in South Kelantan. There is a clear contrast in the density of population between the two sub-regions. Population density of MPKB is 1,782 per km^2, which is by far higher than that of any District or Daerah.

According to Population Census 1980, population at age groups 0 to 14, 15 to 64 and 65 and over accounted for 42.6%, 53.3% and 4.1% of the total population in Kelantan respectively as shown in Table IV.2.3; that is, population of productive age is a little greater than dependent population. Male-female distribution is 48.9% for male and 51.1% for female. Ethnically, 93% of the State population is Malays, followed by 5% of Chinese, 1% of Indians and 1% of Others. The ethnical composition of the State population is markedly different from that of the national population. At the national level 58% of population is Malays, followed by 32% of Chinese, 9% of Indians and 1% of Others.

During the last inter-censal period of 1970 to 1980 there were 30,000 in-migrants and 62,800 out-migrants in Kelantan, working out at the net migrants of minus 32,200. It means that there was an average annual net out-flow of 3,220 people from the State during that period.

The population of the whole of Malaysia in 1988 is estimated at 16,968,000, of which the population of Kelantan accounts for 6.4%.

Both crude birth and death rates of Kelantan are higher than those of the national average. Urban-rural distribution of the State population was 28% and 72% in 1980, while that of the national population was 34% and 66% in the same year. The average number of members per household was 5.08 and the average number of households per house was 1.04 according to Housing Census 1980.

2.2.2 Labour force

The total number of employees in Kelantan is estimated at 327,659, in 1988, occupying 30.0% of the total population as shown in Table IV.2.4. Out of it, 158,329 or 48.3% fall under the agricultural, forestry and fishery sectors; this is, a half of the workforce in the State relies on a living to a single biggest sector. The government services sector is the second biggest sector employing 57,545 persons or 17.6% of the workforce.

The wholesale and retail sector is placed third with the employment of 32,402 and the share of 9.9%. The fourth and fifth places are occupied by the construction sector and the manufacturing sector respectively. The former has the employment of 26,607 or 8.1% of the workforce, and the latter has the employment of 23,954 or 7.3% of the workforce.

Summing up, the estimated employment structure of Kelantan in 1988 is 48.3% for the primary industry, 15.5% for the secondary industry and 36.2% for the tertiary industry. The estimated employment structure of Malaysia in the same year is 35.3% for the primary industry, 21.6% for the secondary industry and 43.1% for the tertiary industry. It can be said from the above that the proportion of the employment in the primary industry in the State is markedly higher than that in the nation, while the proportion of the employment in the secondary industry in the State is substantially lower than that in the nation.

The employment in the agricultural, forestry and fishery sectors in the State is declining at an average annual rate of 0.1% since 1980. Whereas, the employment in the construction sector has grown at an average annual rate of 11.0%. There is a wide difference in the growths of employment among sectors. The employment in Kelantan is as a whole estimated to have grown for these eight years at an average annual rate of 1.8%. This rate is 0.7% lower than the estimated growth rate of the State population in the same period, resulting in a rise of unemployment. The unemployment rate of the State was 8.1% in 1985, while that of the nation was 7.6% in the same year.

2.2.3 Health and education

The number of beds in hospitals increased from 789 in 1970 to 1,574 in 1986 at an average annual rate of 4.4% in Kelantan. Also, the number of health facilities (hospitals and health centres) in the State increased from 21 to 46 at an average annual rate of 5.0% during the same period. Comparing with an average annual growth rate of the State population in the corresponding period, 2.6%, the physical aspect of health services per capita is improving at a remarkably high pace.

Nevertheless, some gaps still remain in overall health environment between Kelantan and Malaysia. For instance, the infant mortality rate was 22.9 in Kelantan in 1983, while 20.3 in Malaysia in the same year. The incidence of typhoid and

dysentery in the State was 50.3 and 13.8 per 100,000 population respectively in 1984, while the incidence of the two infectious diseases in the nation was 13.1 and 10.1 per 100,000 population respectively in the same year. The number of doctors per 10,000 population in 1985 was 1.6 in the State compared with 3.2 in the nation. Population served with piped water in the same year was 32.8% in the State compared with 69.9% in the nation.

The number of students in Kelantan increased from 92,872 in 1966 to 251,404 in 1986 at an average annual rate of 5.1%. Also, the number of teachers in the State increased during the same period from 3,994 to 11,495 at an average annual rate of 5.4%. These rates are just twice as high as the average annual growth rate of the State population in the same period. Thus, it can be said that educational standard and environment in the State are rapidly improving.

However, some gaps still remain in education between Kelantan and Malaysia. For instance, an illiteracy rate was 36.8% in Kelantan in 1980, while 24.5% in Malaysia in the same year. Also, population with no schooling was 45.5% in the State in 1980, while 35.5% in the nation in the same year.

2.3 Economic Conditions

2.3.1 Gross domestic product

The Gross Domestic Product (GDP) of Kelantan for 1988 is estimated at M$2,684.4 million at market prices as shown in Table IV.2.5, while GDP of Malaysia is estimated at M$78,458 million at market prices for the same year. Therefore, the State GDP as percentage of the national GDP is 3.4%. This ratio is much smaller than the populational ratio of 6.4% as well as the areal ratio of 4.5%. Kelantan is implied to be economically a "developing" State in Malaysia.

Sector-wise, the agricultural, forestry and fishery sectors will produce an amount of M$772.3 million in 1988, accounting for 28.8% of the State GDP. This sector is the single biggest contributor to the economy of the State. The government services sector is placed second, producing M$677.9 million and sharing 25.2% of the State GDP. The third and fourth places are occupied by the banks, insurance and real estates sector and the transport, restaurants and storage sector, respectively. The added value of the former will be M$334.0 million, accounting for 12.4% of the State GDP. And that of the latter will be M$273.3 million, accounting for 10.2% of the State GDP. The manufacturing sector's contribution to the economy of Kelantan is confined to 4.5%.

Summing up, the industrial structure of Kelantan is estimated at 28.8% for the primary industry, 11.0% for the secondary industry and 60.2% for the tertiary industry in 1988, while 21% for the primary industry, 37% for the secondary industry and 42% for the tertiary industry in the nation in the same year. One striking feature of the State economy is that the

secondary sector is in the low level compared with the primary sector.

The primary industry's contribution to the State employment is 48.3%, while the same sector's contribution to the State economy is 28.8%. It means that the labour productivity of the primary industry in the State is in a great degree lower than the State average. Also, the secondary industry's share in the State employment is 15.5%, while the same sector's share in the State GDP is 11.0%. It implies that labour productivity of the secondary industry in the State is markedly lower than the State average. The tertiary industry is estimated to produce the added value corresponding to 60.2% of the State GDP with an employment constituting 36.2% of the State workforce.

In a nutshell, the economy of Kelantan is characterized by two aspects; that is, a primary industry which is given a priority in the State economy as well as a secondary industry which is not given a proper place in the State economy suffers from low productivity.

Economy of Kelantan is estimated to have grown from 1980 up to 1988 at an average annual rate of 6.1%. Sector-wise, the construction sector is growing at the fastest average rate of 12.2% per annum. The transport, restaurants and storage sector is also growing fast at an average annual rate of 11.9%. The government services sector and the banks, insurance and real estates sector occupy the third and fourth places, growing at an average annual rates of 9.1% and 7.3%, respectively. However, two productive sectors which form the nuclei of the State economy, i.e. the agricultural, forestry and fishery sector and the manufacturing sector, are growing at lower rates than the State average; the former at a rate of 2.9% per annum on an average and the latter at a rate of 5.7%. It means that the shares of two sectors in the State economy are shrinking.

2.3.2 Living standard

The per capita GDP of Kelantan is estimated at M$2,459 (refer to Table IV.2.5) at market prices in 1988, which is equivalent to US$983 at an exchange rate of M$2.50 to US$1.00. This standard of living might be equal or higher than per capita GDP's in most of the ASEAN countries. But, the per capita GDP of Malaysia in 1988 is estimated at M$4,624 and the living standard of the State is therefore only a half compared with that of the nation.

The per capita GDP of the State is estimated to have grown at an average annual rate of 3.5% since 1980. In 1982 the average monthly household income per capita was M$92 in Kelantan compared with M$128 in Peninsular Malaysia. In 1984 the incidence of poverty (ratio of the number of households whose monthly income is below M$330) was 39.2% in Kelantan compared with 18.4% in Peninsular Malaysia.

2.3.3 Prices

The movements of prices in Malaysia for the last decade were characterized by remarkable stability. In 1985 and 1986 the international prices of the major export items of Malaysia such as crude oil, tin, rubber and sawlogs plunged sharply. As a result GDP deflator recorded a negative rise and consumer prices rose less than one percent during that period as shown in Table IV.2.6.

The average annual rate of rise for GDP deflator during the period of 1980 to 1988 was 1.6%. Also, the average annual rate of rise for consumer prices was 4% during the same period.

2.3.4 Development budget

The Malaysia Plan (1986-1990) allocations for Kelantan stand at M$1,807 million as of May 1988, corresponding to 13.5% of the estimated cumulative GDP of Kelantan during the same period. Looking back over the past, the Third Plan (1976-1980) allocations for Kelantan were M$1,744 million, accounting for 5.4% of the entire allocations for Malaysia. Also, the Fourth Plan (1981-1985) allocations for the State were M$2,653 million, accounting for 5.4% of the national allocations. The Fifth Plan (1986-1990) allocations for the State as of 1987 accounted for 6.5% of the national allocations as shown in Table IV.2.7. This budgetary share for Kelantan matches with the populational share for the State. It is noted regarding the Fifth Plan allocations that they are by far small compared with the immediate predecessor. This situation is in line with the Government policy of privatization, where the role of the private sector is stressed and pushed as the leader in the management of the economy, while the government is put in a position of the coordinator.

The average share of the allocations to the economic sector during the last three plan periods reaches 74% for Kelantan. Whereas, it is 63% for Malaysia. This fact clarifies the extent of emphasis that the government of Kelantan places on the economic development of the State. Also, the State government has given the average allocation share of 17% to the social sector.

Most of the allocations to the economic sector in the State are spent on agriculture and infrastructure. And most of the allocations to the social sector are spent on education. A clear picture emerges from the above that the development strategy of the State Government centres on the development of agriculture, human resources and infrastructure.

As regards to the sources of the budgetary funds, about 20% come from the State's own coffer and the rest are provided by the Federal Government in the form of grants or soft loans.

2.4 Sectoral Profile

2.4.1 Agriculture

Supporting 70% of population, employing 50% of workforce, producing 30% of GDP and using 20% of land area, the agricultural sector plays and will continue to play a major role for the socio-economy of the State.

There are four main crops, i.e. paddy, tobacco, rubber and oil palm. Paddy is the most important crop in the State with the annual planted area of around 70,000 ha and the annual production of about 200,000 tons. The State's share to national paddy production with around 1.5 million tons a year is therefore as much as 13.5%. Paddy is not only consumed within the State, but also exported to other States.

Tobacco is grown under the Federal guidance to lift the economic status of the farmers concerned. Green tobacco leaves of 7 to 9 million tons are annually produced with the planted area of around 10,000 ha. National quota is more or less 10 million tons, resulting in the Kelantan's share of 80% or so to the total production of tobacco.

Rubber is one of traditional crops in the State. Now replanting of the crop is in progress, and 60% out of 130,000 ha has been replaced with young plants. The State shares about 30% to the total production of rubber with the annual average production of 45,000 tons.

Oil palm is grown like rubber mainly for export. For the past 20 years the planted area of oil palm has grown to 60,000 ha at an average annual rate of 24%. In 1988, Kelantan is estimated to produce 84,000 tons of palm oil, which will correspond to 1.7% of the total production in Malaysia.

Paddy and tobacco are mostly grown in North Kelantan. Whereas major plantations of rubber and especially oil palm are found in South Kelantan. Other important crops are coconut, cocoa, groundnut, vegetables, fruits and so on.

Livestocks, a non-crop product belonging to the primary industry, are important as a supplementary income source to the farmers in Kelantan. In 1988, the State is estimated to have cattle and buffalo population of around 130,000, which will correspond to 15% of the said population over the whole Malaysia. Up to 1988, grazing reserves of 4,178 ha have been developed.

2.4.2 Industry, commerce and service

In 1988 the manufacturing industry in Kelantan is expected to produce the added value of M$121 million and to employ workforce of 23,954. GDP and employment of the manufacturing industry are estimated to be 4.5% and 7.3% for the State total respectively.

Most of the manufacturing industries in the State fall under the category of the so-called agro-industry or the like, i.e wood, rubber, food and tobacco industries. Undergoing only a primary processing, the resultant products are not high in terms of the added value.

The number of registered industrial establishments in the State is estimated at 624 for 1988 and the average number of workers per such an establishment is 25. Actually, it is estimated that there exist about 5,000 establishments when the so-called cottage industries are taken into account. Then, the average number of workers per establishment is reduced to 5.

In 1988 commerce and service industries in Kelantan are expected to produce the added value of M$825 million with the total employment of 50,537. The industries comprise wholesale, retail, transport, restaurant, storage, banks, insurance and real estate. GDP and employment are estimated to be 30.7% and 15.4% for the State total respectively. The estimated number of establishments under this sector is 8,854 and the number of workers per establishment works out at 6.

2.4.3 Infrastructure

Infrastructural deficiency in both quantity and quality has been habitually cited as one of major factors retarding the economic growth of the State. It is said that isolation of the State is confined to the traditional agriculture-based self-sufficient economy. The Government has persistently placed the highest priority on infrastructural development against such background.

Road length in 1987 is 2,004 km, out of which 1,225 km is State roads and 749 km is Federal roads. Noteworthy events for the last a few years are the development of the Kuala Krai-Gua Musang-Kuala Lipis Highway, Jeli-Dabong-Gua Musang road and East-West Highway. The Kuala Krai-Gua Musang-Kuala Lipis Highway links the northern sub-region with the southern sub-region as well as with other States. The construction of the Jeli-Dabong-Gua Musang road connects the Sg. Pergau - Sg. Galas Valley with the new growth centre of Gua Musang, and the opening of the East-West Highway links not only Kelantan but also the East Coast with the northern West Coast of Peninsular Malaysia.

Railway runs in parallel with the Kelantan River starting from Tumput down to Gua Musang and beyond. The total length within the State is 207 km. Besides the highway and railway networks, there is a air system, which connects Kota Bharu with major cities in Malaysia with several daily flights.

Out of the urban population of 216,000 in the State, 140,887 or 65.2% were served with urban water supply in 1985. Likewise, out of the rural population of 789,480, 189,392 or 24.0% were served. The total average service ratio works out at 32.8%. Per capita daily consumption was 137 litres. The existing water sources are groundwater and the Kelantan River water.

An electricity supply network is linked to the National Grid. The ratio of households with electricity supply in Kelantan was 62.8% in 1985. The number of electricity consumers as of 1987 was 186,110.

2.4.4 Housing conditions

It is estimated that there exist 203,057 houses now in Kelantan. According to Housing Census 1980, 95.3% were detached houses and 94.3% were owned by individuals. Also, the average number of persons per household was 5.08 and the average number of households per house was 1.04.

Regarding to the condition of housing units, 81.9% were seen as sound, 14.2% as deteriorating and 3.9% as dilapidated. As for toilet facilities, 48.2% has no toilet, followed by 35.0% of pour flush, 9.3% of pit and 5.2% of flush system.

The average purchase price of a plank house with the floor space of 217 m^2 is M$42,098. The price of a brick & plank house with the same floor space as above is M$58,373 and that of a brick/concrete house with the floor space of 235 m^2 is M$71,675. There is a movement in the government quarters to supply so-called low cost housing with the average purchase price of around M$20,000 to the economically disadvantaged classes.

2.5 Present Land Use

2.5.1 General

74.4% of the State, 1,504,009 ha, is covered with forest, and another 21.3% is planted with agricultural crops in 1988 as shown in Table IV.2.8 and Fig. IV.2.2.; that is, 95.7% of the State areas are occupied by forest and agricultural lands.

When Kelantan is divided into the northern and southern sub-regions, another aspect emerges. North Kelantan has the land areas of 246,364 ha, accounting for 16.4% of the total State area. Out of it, 160,379 ha or 65.1% is agricultural land, and 49,434 ha or 20.1% is forest and related land. South Kelantan commands a land area reaching 1,257,645 ha, accounting for 83.6% of the total State area. Out of it, 1,086,088 ha or 86.4% is forest and related land, and 160,204 ha or 12.7% is agricultural land. North Kelantan is said to be dominated by agriculture, while virtually a forest land in South Kelantan.

2.5.2 Present land use

Urban and associated areas composed of urban, estate buildings, mining and power line and other associated areas are estimated at 5,365 ha as of 1988, accounting for 0.4% of the total State land area. They have grown at an average annual rate of 2.2% from 1966 to 1981. It is assumed that the same rate

can be applied since 1981. The rate is a little lower than 2.5%, which is the estimated average annual growth rate of the State population during the same period. Population density in the urban areas may be rising. District-wise, Kota Bharu with 2,381 ha occupies 44.4% of the total State urban and associated area.

Out of 320,583 ha of agricultural land areas in 1988, 129,413 ha or 40.4% is the rubber plantation area, followed by 71,248 ha or 22.2% of paddy fields and 61,261 ha or 19.1% of oil palm plantations. The combined acreage of these three major crops works out at 261,922 ha, accounting for 81.7% of the total State agricultural land area.

During the period of 1966 to 1981, rubber acreage grew from 91,285 ha to 142,209 ha at an average annual growth rate of 3.0%. Since 1981, however, the outward expansion of rubber land has stopped. And now an emphasis is upon the intensive utilization of the existing rubber areas by replanting. Now 60% of the total State rubber area has been replanted with young trees. Even distributed all over Kelantan, rubber areas are especially concentrated in the three southern Districts of Kuala Krai, Tanah Merah and Gua Musang. 65% of the total State rubber area is located in South Kelantan.

During 22 years from 1966 to 1988, oil palm plantations have multiplied 123 times from 497 ha to 61,261 ha. This trend will be kept up into future. District-wise, 74.6% of the total oil palm areas in the State are only shared by Gua Musang District. South Kelantan's share of oil palm acreage reaches 96.9%.

Paddy as well as timber and livestocks has an important role in the agricultural economy of the nation. Paddy area is rather on the decrease in statistics, because agricultural policy towards paddy has revolved around intensive use of the existing areas through modern agricultural technology such as irrigation, fertilizers, pesticide and improved variety of seeds. Paddy fields are distributed all over Kelantan, but three Districts of Pasir Mas, Kota Bharu and Pasir Puteh distinguish themselves with more than 10,000 ha of paddy areas. North Kelantan shares 89.5% of total paddy areas in the State.

Tobacco is normally grown in paddy areas. The acreage of tobacco for 1988 is 8,219 ha. Although there are fluctuations in the yearly acreage of tobacco, a trend is rather upward. District-wise, Bachok, Pasir Puteh and Pasir Mas have the acreage of more than 1,000 ha. North Kelantan dominates in tobacco planting areas with the share of 95.8%.

The Government is making a great effort to develop grazing reserves considering the important place of Kelantan in livestock farming. As of 1988, 4,178 ha has been developed, of which 2,385 ha or 57.1% belongs to Pasir Mas District. North Kelantan shares 89.9% of pasture reserves.

The rather even distribution of agricultural land as a whole over the ten Districts is striking. Also, it is noteworthy that agricultural land is almost evenly shared by North and South

Kelantan, although the comparative position of agriculture between two sub-regions is different. The area for agricultural land has grown at an average annual rate of 1.9% during the period of 22 years from 1966 to 1988.

Forest is decreasing along with grasslands and swamps at an average annual rate of 0.4% since 1966. The trend will be maintained or intensified in future as the economic development of Kelantan progresses. As of 1988, South Kelantan possesses 95.6% of the total forest and related area in the State, most of which falls under Gua-Musang District.