VI. ENERGY/POWER

A. Present Situation and Development Potential

1. Present Situation

297. The total commercial energy consumption in the Region in 1985, was estimated of 20,587 KBOE[1], consisting of:

(i) petroleum products 17,665 KBOE,

(ii) natural gas 366 KBOE,

(iii) coal 1,911 KBOE, and

(iv) electricity 64 KBOE (1,051 GWh).[2]

Although we have no relevant data other than the above-mentioned commercial energy at this time, it is suspected that the traditional energy products, mainly fuel woods and charcoal, are in wide use. The total traditional energy use in the Region is estimated at 16,005 KBOE, based on the outcome of the study done by the Ministry of Mines and Energy. The total energy consumption in the Region, therefore, would be 36,592 KBOE, of which the share is estimated at 48 per cent for petroleum product, 44 per cent for traditional energy, 5 per cent for coal, 2 per cent for electricity and 1 per cent for natural gas.

298. The region's share of electricity and petroleum production to the national total was 8.3% and 10.9%, respectively in 1985. Per capita energy consumption in the Region is close to that of national average, but much smaller than that of Jakarta. Per capita electric consumption in the Region was 56 KWh against the national average of 76 KWh and Jakarta's 537 KWh. Per capita petroleum consumption in the Region was 142 litters compared to 149 litters of the national average and 842 litters of Jakarta. If these per capita energy consumption in the Region are compared with 289 KWh and 271 litters of per capita consumption in Thailand national average, the significant energy demand growth are apparent.

299. During the period between 1980 and 1985, when the data for the Region were available, the petroleum consumption grew at 12.4% per annum, while Jakarts's gross consumption of petroleum products recorded 6.1% per annum. An annual average growth rate of electricity consumption in Indonesia as a whole recorded 13% during 1981/85 while the Region showed higher growth rate of 15%.

300. As for the traditional energy, with the outcomes of field survey during "the Integrated Regional Development Plan for the Northern Part of Sumatra" and the available traditional energy studies, the followings are revealed:

(i) The per capita consumption of fuel wood is estimated as 0.36m^3/year.

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1 KBOE: Thousand Barrels of Oil Equivalent

2 The Electricity consumption here is from the PLN Data. In considering the share of captive power generators in the nation (40%), it is suspected large amount of electricity consumption is supplied by the self generation.

(ii) Over 75% of the total population in the Region are depending on this energy and occupies 85% of the total fuel wood use against industrial use of 15%.

(iii) The biomass, mainly fuel wood contributes 44% of the total regional energy consumption (about 16,000 BOE).

301. The petroleum product consumption pattern in the Region remained the same during that period. There is no significant difference between petroleum consumption pattern in the Region and that of the national average, except diesel oil and fuel oil. The share of diesel oil and fuel oil consumption in total petroleum consumption in the Region was 46% and 6%, respectively, while those of national level was 36% and 15% respectively. In view of a major consumer of such oil products (i.e., PLN), it is suspected that the Region are equipped with relatively expensive electricity generation system, namely, diesel power stations.

302. With the newly available information, the total commercial energy consumption and supply volume in 1988 are derived as 24.67 MMBOE (Million Barrels of oil Equivalent), and the average annual growth rate is calculated as 6.2% during 1985 and 1988. The commercial energy consumption and supply structure in the Region in 1988 is shown on Table 5.8, where the dominant role of petroleum products over the Regional energy structure remains unchanged with 87% contribution.

2. Development Potential

303. A number of promising hydropower schemes have been identified in the Region since the land offers topographically favorable sites and is abundant in rainfall. The total capacity so far identified as economically viable is approximated at 1,500 MW to 3,000 MW. These schemes should be developed most effectively in view of the long-term perspective and under the overall power development program, taking the advantages of renewable and non-polluting nature, high flexible performance to load, much less operating risk which other wise may occur in procurement of fuel and possible multiple faces in the rural development, even though some of them require longer lead time and larger capital cost for implementation. For the other primary energy resources potential, please refer to the Mining section. Coal, lignite, natural gas seems promising energy resources in addition to the biomass resources from agricultural residuals.

304. It should be noted, however, that the Region plays a significant role in the country's oil and gas production. The Region shares over 50% of the national total production of both oil and gas and holds 63.7% of remaining oil recoverable reserve with 55% of that of gas. In this regard the newly discovered natural gas field off-shore Pangkalan Brandan and the Natuna field (remaining reserve of 35 TSCF: Trillion Standard Cubic feet which occupies 33% of national total),which is the untouched and the largest natural gas reserve in the whole of Indonesia, also add the energy advantage in the Region.

B. Energy Intensity and the Future Energy Consumption Outlook

1. Energy Intensity

305. The energy and economic growth have a certain relationship. One of the variables to link such relationship is the energy intensity. The energy intensity indicates the amounts of energy required to produce per unit of GDP/GRDP. In exploring the economic theory a

little further, elasticity of energy to GDP (in view of GDP production function) is divided into two parts as the marginal productivity of energy and the energy intensity. Thus even having assumed the same energy elasticity of GDP, there exists two movements. One is declining marginal energy productivity with increasing energy intensity, and vice versa. These point should be carefully considered when utilizing energy intensity for projection purpose. In looking at the energy intensities along the phase of development, one can see that the energy intensity starts to increase at a significantly low level and increases and then decreases and in further, an upraise of the energy intensity is manifested and followed by a declining trend in the latter part of development process. Stated differently, this movement of the energy intensity has a characteristic of decelerating trigonometric curve.

306. This decelerating cyclical movement of energy intensity implies the followings. At first the initial investment spurt results in increased volume of energy consumption without achieving efficiency in energy use. At the stage of completing the first import substitution oriented industrialization, the efficiency in energy use is realized within this particular structure of the economy. The filtration of the investment spurt in conjunction with passage into the next stage of economic development is characterized by secondary import/export substitutions, with resulting increases in energy demand and energy intensity. Finally, in the latter part of the development process energy efficiency in all sectors is about to be achieved.

307. These historical experiences proved by scientific analysis has been utilized in deriving the future energy consumption outlook for the Region. In planning development for the Region, the readily existing energy resources to support energy intensive regional production structure should be capitalized in view of future industrialization of the Region.

308. The average gross commercial energy intensity of non-oil GDP for the whole Indonesia is about 2.54 BOE (BOE; Barrels of Oil equivalent) per million rupiah in 1985 and that of the Region is estimated as 2.34 BOE per million rupiah. This 9% lower gross commercial energy intensity of the Region than the national level does not necessarily suggest the existence of energy efficient economic production system in the Region.

309. For the electricity intensity, the Region shows 0.07 BOE per million rupiah non-oil GRDP (119.3 KWh/million rupiah) in 1985, which is far below the national average.

2. Future Energy Consumption Outlook

310. Based on the past experience of the country and the Region, experience of NIE's and Japan and simultaneously with regional development envisaged for the Region, Tables 58 and 59 are prepared for the future energy consumption outlook for the Region utilizing energy intensity.

311. Incidentally Tables 58 and 59 differ only for their supply structure (i.e., energy resource mix), under the same forecasted consumption volume. The table is structured from top to bottom as follows:

(i) The top part illustrates the total commercial final energy consumption (excluding, energy exported and traditional energy).

(ii) The second part from the top explains the relationship between electricity consumption and direct fuel consumption fr the above total commercial final energy consumption outlook.

(iii) The third part from the top shows the energy product mix for the direct fuel consumption outlook.

(iv) The fourth part from the top provides the energy products volume for direct fuel use in their original units.

(v) The bottom part illustrates the power generation structure by primary energy resources in terms of final energy thermal equivalent.

312. Toward the year 2008, the total final commercial energy consumption is estimated to increase by 4.6 times from 1988's consumption volume of 24.7 MMBOE, while the total nation increases by 3.6 times during the same period. The Region's energy intensive nature will be apparent in 2008 since the total energy intensity for the Region is assumed to increase faster than the national average. In projecting these consumption outlook however , energy efficiency toward the latter part of development period has been reflected in the growth of energy intensity. In other words, the Region is the energy intensive nature but envisaged to achieve efficient energy consumption structure within its economic structure. In looking the projected spatial consumption pattern, the economic structure of each province is reflected in the energy consumption outlook. This has resulted in the picture where the industrialization in North Sumatra province leads the overall energy consumption of the Region.

313. For the electricity, the consumption is projected to grow by 11.8 times bigger. The speed of the growth is calculated as 13.7% per annum average during 1988 to 2008 and the elasticity of electricity consumption is derived as 1.65. (See Tables 60 and 61). This rather enormous growth of energy consumption is the results of analysis of electricity intensity, rate of electrification, and the electricity requirements by provinces. (See Tables 62 to 65). This speed of electricity consumption does not seem too fast in considering the current system of very limited power supply in the Region. Thus the power sector is expected to be the one of the biggest consumer of the primary energy. In looking spatial distribution of the electricity consumption, North Sumatra Province is estimated also as the largest consumer reflecting faster commercial and industrial sectoral growth.

314. Electrification rate in terms of households in 2008 is assumed at 85% for Wilayah I of Aceh, 96% for Wilaya II of North Sumatra, and 82% for Wilayah III of West Sumatra and Riau. These electricity consumption projections are somewhat similar to those by PLN Wilayah except Wilayah I. This exception of stems from rather ambiguous projection of Wilayah I after Repelita V (see Tables 60 and 61).

C. Development Strategies

1. Issues and Strategic Element for Energy Sector Planning

315. The magnitude of total final commercial energy requirement in the Region in 2008 is envisaged enormous though, this projected consumption volume amounts to 50% of the current crude oil production volume within the Region. Thus even if the current (1988) petroleum dependent energy supply /consumption structure continues, there

wouldn't be any problem in terms of volume balance within the Region, where regional consumption is satisfied by less oil export from the Region. However in view of the total future national energy consumption, and the role of oil as means of foreign exchange earnings, it gets increasingly important to satisfy the projected energy consumption with diversified energy resources. Thus the critical issue is how to develop the energy replenishment system as plainly stated in the national energy policy. Energy consumption especially electricity shows the rapid growth. In considering the endowed primary energy resources for electricity generation such as coal, lignite, peat and natural gas reserves with hydro and geothermal potential, it is possible to achieve the maximum utilization of such energy resources. Priority of those resource development in view of spatial distribution of the energy consumption growth should carefully be considered. Given the known reserve of fossil fuels at this time for the energy requirements, it is envisaged that the natural gas and coal will play significant roles in the future primary energy supply and demand structure in the Region with hydro resource contributing the same degree. Combining the above two schemes, the Region has a great potential to be developed with energy sufficiency and with diversified energy resources. By taking advantage of short distance to those energy resources not like Java, the Region provides ample opportunities for energy intense development in the national energy system. Actualization of this direction of development will largely depends on the spatial pricing structure for energy products against the current practice of uniform pricing for electricity and petroleum products.

316. There exist large potential for the alternative energy resources to be developed, if the economic benefits of such developments are calculated from the international price of petroleum products. Energy pricing is the one of the strongest energy policy implementation measure. Effective pricing for energy products is set between the economic price (international market price) and the price determined by production cost with depletion allowance for the concerned energy resources. The financial price set nearer to the either side depends on the national interest whether the nation concerns more economic returns for the producer of energy or more to the consumer side in view of rippled effects of such pricing policy. It is possible to set the financial price attractive to user so that the rippled or multiplier effects of user industries bring more to the total economy than the price set attractive for energy producers. In further this consideration also has to be given over the above said alternative energy resource development.

2. Energy Policy at National Level and Its Implication to the Energy Planning in the Region

317. Since the slowing down of the country economy along with glut of international oil market, Indonesia is launching forth a rapid industrialization, which requires increasing energy. With this industrialization Indonesian government has undergone structural change of its economy. However, it is not desirable to limit the energy consumption to the extent that the industrialization is choked off. In order to overcome the dilemma of oil exporting country and increasing domestic energy demand, a long term energy policy has been laid down. To increase energy efficiency in energy use, the cost effectiveness of domestic energy source development, and to achieve supply mix of relevant energy sources to meet different pattern of energy consumption are stressed on the policy. The demand supply pattern of energy will be influenced largely by increasing cost of energy with a result where the energy conservation and change in the composition of energy will occur. In this process, sources of energy suitable to different area or different consumption purposes need to be

identified from the viewpoint of stableness, cost efficiency and security in energy supply.

318. After this identification procedure with demand forecast, it is possible to define roles and position of energy resources. Succeedingly, policy issues of whether the oil still remains the basic dependable energy resources or to what extent the diversification is possible can be answered. In this context with precedent energy issues of the Region and also recognizing the implicit energy policy for national framework, the planning goal is set as to achieve stable supply and cost effective energy system for the Region in view of increased security by diversifying national energy system with less expensive energy for promoting regional development.

3. Development strategies

3.1. Power Sector Development Strategies

(1) Power development

319. In order to satisfy the growing power demand, a power development plan should be established for each load center with future interconnected grids in view, for the full utilization of indigenously endowed energy sources. For the projected annual energy requirement of 25,000 GWh in 2008, the required installed capacity is approximated at 5,800 MW, which is about 6 times the aggregate capacity of existing capacity (967 MW in 1988). Since the plan which is already or almost committed for installation in the near future is 1,490 MW of hydropower, 350 MW of coal-fired plant and 217MW of gas turbine and gasifired, being 2,057 MW in total, about 3,700 MW of new plants should be additionally developed for the coming period of 20 years. With these power sector development plan is laid down as seen on Tables 66 to 68.

320. In the short-range development program, a pressing demand for electricity which currently occurs in Wilayah II and III should be properly met, aiming at more sufficient and stable supply for the welfare of people and economic development in the Region. In this regard, it is recommended to proceed at the earliest time with the installation of an additional thermal power capacity as planned under Repelita V for those Wilayah. In this regard especially expansion of thermal capacity by 217 MW in Belawan should gather due attention. The development of the natural gas field off shore Pangkalan Brandan is a prerequisite for this expansion. If the gas development should occur after Repelita V, it is strongly recommended to go for development of Asahan No.1 hydro project at full capacity.

321. For mid- and long-range program it is recommended to adopt the following strategy, in view of cost effective endowed resource utilization in relation to the scale of consumption. Next ten years after Repelita V (i.e., during Repelita VI and VII) , the hydro potential should be focused and developed at the fullest extent. After 2003, the thermal power development should be refocussed in view of thermal base load requirement for the total regional power grid. Natural gas and coal availability will be the decisive factor for this scenario. Although preliminary indicative reserve figures for coal in the Region make the coal fired power plant option attractive, the detailed exploratory survey for fossil fuel resource deposits or reserves is a prerequisite for formulating any long-range power development plan. The level of the electricity consumption after the year 2000 within each IDEP grows sufficiently large so that the hydro power developments within or nearby IDEP's will increase their

viability. In theses instance, in addition to the above large scale thermal power development, the hydro potentials left over during Repelita VI and VII should be developed.

322. Since development of coal resources is in view in Riau, it is conceivable, though subject to its technical feasibility, to use the coal not only for the secondary oil recovery in the Duri field but also for power generation, that is, steam passing through the turbines for power generation is reused for steam flooding of the oil layers. As for the primary energy for steam flooding for Duri field, natural gas from Natuna also exists as an option to the coal. The choice among these options is subject to the further study beyond this regional study scope. However from the point of view of regional development effects, the power development plan here envisages the utilization of coal in Cerenti, Riau.

323. These power development strategies with due attention on total power supply cost, are transformed into the development plan with individual projects as seen on Tables 66 to 68. Environment assessment should be conducted prior to the development of any type of power plant, hydro or thermal, and necessary countermeasures should be incorporated into every scheme. Land acquisition for the development should also be made in a well prepared manner, including establishment of a definitive resettlement plan if necessary for a reservoir type development.

(2) Interconnection

324. Another major strategy for the power sector development is the interconnection of the each Wilayah system. It is strongly recommended to interconnect load centers in view of fuller and effective utilization of regionally endowed energy resources. There exist large hydro potential in Aceh. However Aceh's projected electricity consumption level alone does not make development of such hydoro potential feasible. In considering the combined volume of electricity consumption in Aceh and in North Sumatra,the unfeasible project may turn out to be feasible and may provide electric power at less cost than isolated supply system at the same time. Therefore it is necessary to seize the future spatial consumption structure of the Region as a whole not by each Wilayah, when planning the power development. In addition interconnection increases reliability of power supply in the future when the both sides of the interconnecting line hold power generation system. Interconnection of the power grid systems thus plays a strategic role in the power sector development in the Region.

325. It is recommended to interconnect Wilayah I and II by 1993 and then with Wilayah III by 2008. Toward the final year of the study time horizon of the year 2008, not only the linear interconnection but also circular interconnection should be planned in view of reliable and stable power supply. Interconnection between Wilayah I and II is suggested so as to take advantage of power development in Aceh to improve electricity supply situation Aceh in addition to supplying less expensive electricity to Medan. The delayed interconnection lessens such benefits. Toward the year 2008, power developments within the Region of interconnected Wilayah I and II to satisfy the projected consumption for that Region is getting costly. Thus the interconnecting with Wilayah III should be implemented in view of binary use of coal at Duri field so as to achieve least cost power supply system over the whole of the Region.

(3) Rural Electrification[3]

326. The strategy for rural electrification (RE) in the Region is to utilize current institutional set up for rural electrification with introduction of decentralized system based on locally endowed resources for RE at first and in the later stage of development period, those systems are to be connected in view of scale of economy in satisfying the increased demand within each decentralized system. In this way PLN can concentrate on the grid extension electrification with adequate financial returns.

327. Promoting RE by other than PLN with locally endowed new and renewable energy resources such as palm, coconut, paddy and wood product associated biomass including mini and micro hydro in the isolated rural area is possible and can accelerate the RE. The proliferation of unregulated non PLN operation is the evidence of organizational skills and technical capabilities that could be channelled into higher quality services. Thus the required is the comprehensive strategy to connect and coordinate those potentially available resources not only energy resources but also human, institutional and financial resources for the challenging task of RE in the Region. In this instance the study recommends the "Guideline for Implementation for Accelerating Rural Electrification" as seen in Volume IV.

328. Challenge task of RE in the national context should be reminded here by the following statements.

(i) Currently in 1988 total household connected to electricity is estimated as 17%. 21 million households are left for electrification. 78% of those reside in rural area in scattered way. Thus the electrification target was set at less than half of the population ten years hence now, which is far lower than those of neighboring countries, such as Malaysia 72% in 1983 and Thailand 60% in 1986.

(ii) RE is always difficult to achieve adequate financial return, especially in its initial stage. PLN's operating expenses has been exceeding its revenue. The main cause of this stems from PLN's RE program. In addition to the financial drain on PLN, capital expenditure for RE is growing so large that it occupied 23% of total PLN investments for Repelita IV and estimated RE absorbed 4% of public investment outlay at the same period.

(iii) The source of power for these RE are mainly by diesel. In view of long term petroleum out look of this nation, it is difficult to project RE by current system of scattered diesel. In this regard the expanded use of new and renewable energy resources utilization has to be seriously considered.

(iv) Currently RE consists of three types of electrification set up. The foremost is the PLN serving 4 million households. Ministry of Cooperative and provincial governments also carry RE but serves mere 40,000 households and the third type is the informal RE operators at village level, which is said to serve same number of villages as PLN. These institutional set up does not seem adequately functioning. Thus to formulate a strategy to manage and coordinate comprehensive set of actions required to take advantage of available options for RE is increasingly important.

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[3] Current rural electrification status is compiled into Table 69.

3.2. Fossil Fuel Energy Development Strategies

329. The maximum utilization of alternative energy resources with the sound structure of such energy supply system is the main energy development strategy for the Region as mentioned earlier. Precedently it has been suggested that this diversified energy system should be pursued in the power sector in view of increasing demand for electricity and easiness to utilize such alternative energy resources. Simultaneously for outer areas from the main transmission line, the decentralized system development has been recommended to accelerate the RE as well as to lessen the dependency on oil. The contribution of such energy resources (new and renewable energy) for decentralized system is fairly limited in view of contribution to the overall diversified energy structure in the Region though, nevertheless this decentralized system should be pursued in view of synergistic effects of such systems. In view of developing the above diversified energy supply system, it is increasingly important for natural gas, coal and hydro-power to play significant roles in the Region. Especially as fossil fuel, development of natural gas and coal is a key to achieve such diversified system.

(1) Natural Gas/Petroleum Product Distribution

330. Currently available natural gas for the regional use is estimated as 156 MMSCFD[4], (66 MMSCFD from Arun, 54 MMSCFD from Rantau, and 46 MMSCFD from Pangkalan Brandan). Arun's 66 MMECFD volume of natural gas is open for new utilization scheme. 54 MMSCFD of Rantau is currently consumed as second recovery sources. Scenario I of Table 58 is formulated with this assumption.

331. With the discovery of natural gas at offshore of Pangkalan Brandan, natural gas development is in view and it becomes possible to replace a part of projected petroleum product consumption. Scenario II of Table 59 is formulated with the assumption of this natural gas development. The above newly discovered field still needs a few more years to reach the proven reserve figure however, it is expected to start the production in the end of Repelita V.

332. Under Scenario II the amount of natural gas supply and demand is estimated at 356 MMSCFD in 2003 and that in 2008 as 425 MMSCFD. These volume enable to construct a natural gas separation plant which can provide an ample opportunity to develop down stream petro-chemical industries as well as LPG production . In further, CNG for automobile use also provides the opportunity for domestic utilization of natural gas. Therefore this study recommends to carry out the natural gas utilization study right after obtaining proven reserve figure of the newly discovered field. With this natural gas development and diversified energy system, the supply and demand volume of petroleum products in the Region in 2008 under Scenario II could be possible to be curved to a mere doubling amount of 1988 level.

333. As for the replenishment system for increasing petroleum consumption, the current plan to expand depots capacities, opening up new depots and distribution center in Telukbayur should be carried out as planned. In the mid- to long-term, in view of efficient petroleum product distribution not only for the Region but also the west coast of whole Sumatra, the petroleum product pipeline system should be considered, which connects Dumai and Telukbayur.

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[4] MMSCFD: Million Standard Cubic Feet per Day

(2) Coal

334. For coal development strategy in the Region, it is recommended to develop Ombilin to the fullest extent to satisfy the regional growing demand and to develop the new coal deposits to answer the export demand after the year 2003. Currently Ombilin produces coal for domestic cement industries and for export at production level of 680,000 tons per year. It is planned to boost coal production to 2.1 million tons per year toward the year 2000 where 1 million tons for domestic and export use and 1.1 million tons for Ombilin coal fired thermal power plants which reach total generation capacity of 330 MW. However, it is viewed that the maximum production level at Ombilin may stay at 1.5 million tons .

335. If the export market to be kept, the other coal depots have to be developed to replace Ombilin coal use in the Region so that the replaced volume will be supplied for the export market. In this instance, development of coal deposit in Meulaboh comes in, it is recommended to develop Meulaboh during Repelita VI so as to replace the coal from Ombilin to PT Andaras cement. If the detailed exploratory survey for Meulaboh turns out that quality of coal there makes unfeasible for transportation of Meulaboh coal, it is suggested to transfer 100 MW capacity at Ombilin to Meulaboh. In order to formulate the definite plan for coal development strategy considering the above options, it is a must to carry out detailed exploratory survey for known coal deposits.

336. Subject to the international price for crude oil and benefit/cost comparison to the other options, the Study envisages coal in Riau represented by Cerenti as primary energy for secondary recovery of Duri oil field. Preliminary consideration in adopting this option is the direct investment effect of this option to the Region as well as indirect domestic economic effects.

3.3. Traditional Energy

337. Fuel wood characterizes the household energy supply/demand in the Region, where as commercial energy such as LPG , kerosene and natural gas are available for just a limited number of household in the urban population. This main source of household energy, fuelwood is also consumed in the brick, tile and food processing industries.

338. The supply and demand balance for the fuel wood at the provincial level in the Region presently seems adequate. However at the district level, it shows sign of potential shortage represented by increasing prices for fuel wood. Given the estimated population growth and the increase of the number of households with upward trend of household energy use along with rise of income level, the sustainability of the current fuel wood situation is questioned. In further in view of energy products availability with household income level, it is difficult to envisage that the transition from traditional to commercial energy will take place next 10 years.

339. In these instances, efforts should be directed to enhance the thermal efficiency in fuel wood use in the rural household. The currently wide used fuelwood stoves are the open fired type with extremely low energy efficiency. The related studies show the efficiency of such stoves is mere 5 - 8% , in comparison to 24% by the efficiency improved stove. With the dissemination of the improved stove, the current level of fuelwood consumption is possible to be reduced to 1/2 to 1/3. The dissemination of the improved stove could

also complement betterment of the life in the rural population especially for women and children. It is the work for women and children to collect the fuelwood and to cook. The result of the case study for West Sumatra villages in 1983 shows that the time spent in fuel wood collection is 6.6 man-hours/week and the time spent for cooking is 4.2 man-hours/day. With the introduction of the improved stove, the more time for other work or study would be available.

340. The above strategies are transformed into projects listed in the Long List, and Power Development Plan in Tables 66 to 68. More detailed discussion on some of the strategies discussed in the above is found in Vol. IV, "Priority Projects and Project Information" of this Report.

Table 58. Commercial Energy Projection (Scenario 1)

Energy Requirement by Province

(Unit:MMBOE)

	1988	1993	1998	2003	2008	AV.G.Rate(%) 1988/2008	Share(%) 2008
Aceh	3.6	5.0	7.1	10.3	15.0	7.5	
North Sumatra	15.8	22.0	32.1	49.3	75.7	8.2	
West Sumatra	3.1	4.3	6.1	8.8	12.7	7.2	
Riau	2.3	3.1	4.3	6.4	9.6	7.5	
Northern Sumatra	24.7	34.4	49.5	74.9	113.0	7.9	
INDONESIA	232.1	279.5	399.9	556.2	824.5	6.5	
N.Sumatra/INDONESIA (%)	10.6	12.3	12.4	13.5	13.7		

*Team projection except 1988. Figures, which are actual.
Figures for 1988 are based on data from PLN Wilayah I,II,III,Pertamina UPDN-I, PT Batubara Ombilin, and PN Gas
Thermal value equivalent
MMBOE=MIllion Barrels of Oil Equivalent

Energy Requiremont

(Unit:MMBOE)

	1988	1993	1998	2003	2008	AV.G.Rate(%) 1988/2008	Share(%) 2008
Total comm. energy	24.67	34.38	49.53	74.85	112.96	7.9	
Electricity	3.88	7.61	12.34	23.74	45.79	13.1	
Direct fuel	20.79	26.77	37.20	51.11	67.17	6.0	

Energy Requirement by Resource

(Unit:MMBOE)

	1988	1993	1998	2003	2008	AV.G.Rate(%) 1988/2008	Share(%) 2008
Oil Product	21.46	25.91	33.43	46.92	54.79	4.8	48.5
Coal	1.17	2.40	3.90	6.25	23.38	16.2	20.7
Natural Gas	1.48	4.17	6.22	7.62	9.64	9.8	8.5
Hydro	0.57	1.78	5.57	13.55	24.61	20.7	21.8
Mini - Hydro	0.01	0.10	0.22	0.28	0.28	16.8	0.2
Geothermal			0.03	0.06	0.06	7.2	0.0
New & Renewable		0.03	0.17	0.17	0.20	13.8	0.2
Total Ene Reqmt	24.67	34.38	49.53	74.85	112.96	7.9	100.0
Share of oil (%)	87	75	67	63	49		

Original Unit

	1988	1993	1998	2003	2008	AV.G.Rate(%) 1988/2008	Share(%) 2008
Oil Product (kbd)	65.0	78.5	101.3	142.2	166.0	4.8	
Coal (kton/y)	271.9	558.9	908.7	1,457.7	7,141.5	17.8	
Natural Gas (mmscfd)	25.5	72.0	107.2	131.5	166.3	9.8	

Energy Requirement for Power Sector by Resources

(Unit:MMBOE)

	1988	1993	1998	2003	2008	AV.G.Rate(%) 1988/2008	Share(%) 2008
Electricity Total	3.88	7.61	12.34	23.74	45.79	13.1	100.0
Oil Product	2.17	2.05	1.51	1.57	1.50	-1.8	3.3
Coal	1.10	2.88	3.64	5.81	7.83	10.3	17.1
Natural Gas		0.77	1.19	2.30	11.31	19.6	24.7
Geothermal			0.03	0.06	0.06	7.2	0.1
Mini - Hydro	0.01	0.10	0.22	0.28	0.28	16.8	0.6
Hydro	0.60	1.78	5.57	13.55	24.61	20.4	53.8
New & Renewable		0.03	0.17	0.17	0.20	13.8	0.4

Table 59. Commercial Energy Projection (Scenario 2)

Energy Requirement by Province

(Unit:MMBOE)

	1988	1993	1998	2003	2008	AV.G.RATE(%) 1988/2008	Share(%) 2008
Aceh	3.6	5.0	7.1	10.3	15.0	7.5	
North Sumatra	15.8	22.0	32.1	49.3	75.7	8.2	
West Sumatra	3.1	4.3	6.1	8.8	12.7	7.2	
Riau	2.3	3.1	4.3	6.4	9.6	7.5	
Northern Sumatra	24.7	34.4	49.5	74.9	113.0	7.9	
INDONESIA	232.1	279.5	399.9	556.2	824.5	6.5	
N.Sumatra/INDONESIA (%)	10.6	12.3	12.4	13.5	13.7		

*Team projection except 1988. Figures, which are actual.
Figures for 1988 are based on data from PLN Wilayah I,II,III,Pertamina UPDN-I, PT Batubara Ombilin, and PN Gas
Thermal value equivalent
MMBOE=MIllion Barrels of Oil Equivalent

Energy Requirement

(Unit:MMBOE)

	1988	1993	1998	2003	2008	AV.G.RATE(%) 1988/2008	Share(%) 2008
Total comm. energy	24.67	34.38	49.53	74.85	112.96	7.9	
Electricity	3.88	7.61	12.34	23.74	45.79	13.1	
Direct fuel	20.79	26.77	37.20	51.11	67.17	6.0	

Energy Requirement by Resources

(Unit:MMBOE)

	1988	1993	1998	2003	2008	AV.G.RATE(%) 1988/2008	Share(%) 2008
Oil Product	21.46	25.91	33.43	33.92	39.79	3.1	35.2
Coal	1.17	2.40	3.90	6.25	23.38	16.2	20.7
Natural Gas	1.48	4.17	6.22	20.62	24.64	15.1	21.8
Hydro	0.57	1.78	5.57	13.55	24.61	20.7	21.8
Mini - Hydro	0.01	0.10	0.22	0.28	0.28	16.8	0.2
Geothermal			0.03	0.06	0.06	7.2	0.0
New & Renewable		0.03	0.17	0.17	0.20	13.8	0.2
	24.67	34.38	49.53	74.85	112.96	7.9	100.0
Share of oil (%)	87	75	67	45	35		

Original Unit

		1988	1993	1998	2003	2008	AV.G.RATE(%) 1988/2008	Share(%) 2008
Oil Product	(kbd)	65.0	78.5	101.3	102.8	120.6	3.1	
Coal	(kton/y)	271.9	558.9	908.7	1,457.7	7,141.5	17.8	
Natural Gas	(mmscfd)	25.5	72.0	107.2	355.7	424.9	15.1	

Energy Requirement for Power Sector by Resources

(Unit:MMBOE)

	1988	1993	1998	2003	2008	AV.G.RATE(%) 1988/2008	Share(%) 2008
Electricity Total	3.88	7.61	12.34	23.74	45.79	13.1	100.0
Oil Product	2.17	2.05	1.51	1.57	1.50	-1.8	3.3
Natural Gas	1.10	2.88	3.64	5.81	7.83	10.3	17.1
Coal		0.77	1.19	2.30	11.31	19.6	24.7
Geothermal			0.03	0.06	0.06	7.2	0.1
Mini - Hydro	0.01	0.10	0.22	0.28	0.28	16.8	0.6
Hydro	0.60	1.78	5.57	13.55	24.61	20.4	53.8
New & Renewable		0.03	0.17	0.17	0.20	13.8	0.4
	3.88	6.91	11.79	21.17	45.79		

Table 60. Capacity Projection

(1) Required Capacity

(Based on Team Projection)

(Unit:MW)

Required Capacity*	1988	1993	1998	2003	2008	Av.G.Rate(%) 1988/2008
Aceh	150.0	208.9	262.8	396.4	778.1	8.6
North Sumatra	532.0	1,042.3	1,549.0	2,166.8	3,926.7	10.5
W.Sumatra/Riau	285.0	444.8	581.7	707.4	1,117.5	7.1
Northern Sumatra	967.0	1,696.0	2,393.5	3,270.7	5,822.3	9.4

(Based on PLN Projection)

(Unit:MW)

Required Capacity**	1988	1993	1998	2003	2008	Av.G.Rate(%) 1988/2008
Aceh	150.0	165.6	165.6	165.6	165.6	0.5
North Sumatra	532.0	1,012.0	1,468.0	2,149.5	3,776.9	10.3
W.Sumatra/Riau	285.0	470.8	650.8	983.4	1,486.1	8.6
Northern Sumatra	967.0	1,648.4	2,284.4	3,298.5	5,428.6	9.0

(2) Additional Capacity Required

(Based on Team Demand Projection)

(Unit:MW)

Required Capacity*	1989/93	1993/98	1998/2003	2003/08	Total Add. Capacity
Aceh	58.9	53.9	133.7	381.6	628.1
North Sumatra	510.3	506.7	617.8	1,759.9	3,394.7
W.Sumatra/Riau	159.8	136.9	125.7	410.0	832.5
Northern Sumatra	729.0	697.5	877.1	2,551.6	4,855.3

(Based on PLN Demand Projection)

(Unit:MW)

Required Capacity**	1989/93	1993/98	1998/2003	2003/08	Total Add. Capacity
Aceh	15.6	0.0	0.0	0.0	15.6
North Sumatra	480.0	456.0	681.5	1,627.4	3,244.9
W.Sumatra/Riau	185.8	180.0	332.6	502.7	1,201.1
Northern Sumatra	681.4	636.0	1,014.1	2,130.1	4,461.6

Notes : *Transmission/dis.losses are set at 16% during 1988/98 and 12% thereafter.
Based on Load factor:1993 40%, 1988 50%, 2003 60%, 2008 65% except Aceh's 30% in 1993.
Based on dependable capacity of 75% during 1993/98 and 85% thereafter.
**Based on each Wilayah system expansion plan.

Source : Team's estimate.

Table 61. Electricity Projection

(1) Total Energy Requirement

(Team Projection)

(Unit:GWh)

Energy Requirement	1988	1993	1998	2003	2008	Av.G.Rate(%) 1988/2008
Aceh	173.7	355.0	744.2	1,581.4	3,362.3	16.0
North Sumatra	1,327.3	2,361.4	4,386.7	8,643.2	16,968.8	13.6
W.Sumatra/Riau	632.4	1,007.8	1,647.3	2,821.8	4,828.9	10.7
Northern Sumatra	2,133.4	3,724.1	6,778.2	13,046.5	25,160.0	13.1
Indonesia	35,959.6	55,145.3	88,931.9	123,151.3	173,027.2	8.2
N.Sumatra/Indonesia(%)	5.9	6.8	7.6	10.6	14.5	

(PLN Projection)

(Unit:GWh)

Energy Requirement	1988	1993	1998	2003	2008	Av.G.Rate(%) 1988/2008
Aceh	173.7	333.2	421.5	504.4	603.6	6.4
North Sumatra	1,327.3	2,808.9	5,740.8	10,087.3	17,724.6	13.8
W.Sumatra/Riau	633.1	1,039.3	1,695.6	2,706.0	4,318.6	10.1
Northern Sumatra	2,133.4	4,181.4	7,857.9	13,297.7	22,646.9	12.5
Indonesia	35,959.6	55,145.3	88,931.9	123,151.3	173,027.2	8.2
N.Sumatra/Indonesia(%)	5.9	7.6	8.8	10.8	13.1	

(2) System Peak Load Projection

(Based on Team Projection)

(Unit:MW)

System Peak Load*	1988	1993	1998	2003	2008	Av.G.Rate(%) 1988/2008
Aceh	46.8	156.7	197.1	337.0	661.4	14.2
North Sumatra	280.2	781.7	1,161.8	1,841.8	3,337.7	13.2
W.Sumatra/Riau	133.2	333.6	436.3	601.3	949.8	10.3
Northern Sumatra	460.2	1,272.0	1,795.1	2,780.1	4,948.9	12.6

(Based on PLN Projection)

(Unit:MW)

System Peak Load*	1988	1993	1998	2003	2008**	Av.G.Rate(%) 1988/2008
Aceh	46.8	106.4	235.1	535.8	1,207.7	17.6
(Load Factor) (%)	42.0	36.0	20.0	11.0	6.0	
North Sumatra	280.2	663.0	1,468.0	2,210.4	4,400.2	14.8
(Load Factor) (%)	54.0	48.0	45.0	52.0	46.0	
W.Sumatra/Riau	133.2	200.0	301.2	576.6	939.8	10.3
(Load Factor) (%)	54.0	59.0	64.0	54.0	52.0	
Northern Sumatra	460.2	969.4	2,004.2	3,322.9	6,547.7	14.2
	53.0	49.0	45.0	46.0	39.0	

Notes : *Transmission/dis. losses are set at 16% during 1988/98 and 12% thereafter.
Based on Load factor: 1993 40%, 1998 50%, 2003 60%, 2008 65% except Aceh's 30% in 1993.
**Shows Wilayah time series trend.

Source : Team's estimate.

Table 62. Electrification Plan by Wilayah Area

Region	Category	Unit	1988	1993	1998	2003	2008	Av.G.Rate (%) 1988/2008
Wilayah I	Total Households	('000)	658.2	756.1	860.4	974.1	1,102.4	2.6
Aceh	Elec Households	('000)	116.7	253.6	450.9	701.4	937.0	11.0
	Elec Rate	(%)	17.7	33.5	52.4	72.0	85.0	8.2
	Energy Consum.	(GWh)	68.5	145.6	312.0	584.8	941.4	14.0
	Unit Energy Consum.	(kWh)	586.7	574.2	691.9	833.8	1,004.7	2.7
Wilayah II	Total Households	('000)	1,804.3	2,051.6	2,321.1	2,631.9	2,954.3	2.5
N.Sumatra	Elec Households	('000)	519.9	958.0	1,180.6	1,696.7	2,836.2	8.9
	Elec Rate	(%)	28.8	46.7	50.9	64.5	96.0	6.2
	Energy Consum.	(GWh)	323.2	550.1	975.6	1,592.7	3,101.4	12.0
	Unit Energy Consum.	(kWh)	621.7	574.2	826.4	938.7	1,093.5	2.9
Wilayah III	Total Households	('000)	1,332.0	1,478.9	1,634.4	1,808.6	2,004.9	2.1
W.Sumatra/	Elec Households	('000)	317.0	557.0	877.0	1,193.7	1,644.0	8.6
Riau	Elec Rate	(%)	23.8	37.7	53.7	66.0	82.0	6.4
	Energy Consum.	(GWh)	203.2	360.3	604.7	991.8	1,645.9	11.0
	Unit Energy Consum.	(kWh)	641.0	646.9	689.5	830.9	1,001.2	2.3

Table 63. Relative Household Consumption Share in Each Wilayah

Region	Category	Unit	1988	1993	1998	2003	2008	Av.G.Rate (%) 1988/2008
Wilayah I	Total Consumption	(GWh)	173.7	355.0	744.2	1,581.4	3,362.3	16.0
Aceh	Households	(GWh)	68.5	145.6	312.0	584.8	941.4	14.0
	Other Sectors	(GWh)	105.2	209.4	432.3	996.6	2,420.9	17.0
	Households Share	(%)	39.4	41.0	41.9	37.0	28.0	
Wilayah II	Total Consumption	(GWh)	1,327.3	2,361.4	4,386.7	8,643.2	16,968.8	13.6
N.Sumatra	Households	(GWh)	323.2	550.1	975.6	1,592.7	3,101.4	12.0
	Other Sectors	(GWh)	1,004.1	1,811.3	3,411.1	7,050.5	13,867.4	14.0
	Households Share	(%)	24.4	23.3	22.2	18.4	18.3	
Wilayah III	Total Consumption	(GWh)	632.4	1,007.8	1,647.3	2,821.8	4,828.9	10.7
W.Sumatra/	Households	(GWh)	203.2	360.3	604.7	991.8	1,645.9	11.0
Riau	Other Sectors	(GWh)	429.2	647.5	1,042.6	1,830.0	3,183.0	10.5
	Households Share	(%)	32.1	35.8	36.7	35.1	34.1	
Nrn.Sumatra	*Total Consumption*	*(GWh)*	*2,133.4*	*3,724.1*	*6,778.2*	13,046.5	25,160.0	13.1
Total	Households	(GWh)	594.9	1,056.0	1,892.3	3,169.3	5,688.7	12.0
	Other Sectors	(GWh)	1,538.5	2,668.1	4,886.0	9,877.2	19,471.3	13.5
	Households Share	(%)	27.9	28.4	27.9	24.3	22.6	

Table 64. Peak/Required Power Projection by Development Area

(Unit:MW)

Wilayah (Province)	Area No.	Development area	1988	1993	1998	2003	2008	1988/ 1993	1993/ 1998	1998/ 2008
Wilayah I	1	Aceh Besar		27.6	33.7	55.4	104.5		6.1	70.8
Aceh	2	Northern Aceh		66.4	84.2	145.4	288.4		17.7	204.2
	3	East Aceh		28.4	37.1	65.2	131.6		8.7	94.6
	4	Southeast Aceh		8.3	10.1	16.7	31.7		1.7	21.7
	5	West Aceh		13.2	16.4	28.0	54.9		3.2	38.5
	6	South Aceh		12.8	15.8	26.3	50.3		2.9	34.5
	7	Aceh Islands*								
		Total	46.8	156.7	197.1	337.0	661.4	109.9	40.4	464.3
								58.9	*53.9*	*515.3*
Wilayah II	8	Medan		197.8	292.8	465.2	844.4		95.0	551.7
North Sumatra	9	East Coast		410.4	608.8	955.2	1,712.3		198.4	1,103.5
	10	Karo Highlands		38.3	56.9	90.3	163.5		18.6	106.6
	11	North Tapanuli		40.7	59.3	90.2	156.9		18.6	97.6
	12	Southern Tapanuli		73.5	111.5	185.8	353.8		38.0	242.3
	13	Nias		21.1	32.5	55.1	106.8		11.4	74.3
		Total	280.2	781.7	1,161.8	1,841.8	3,337.7	501.5	380.0	2,176.0
								510.3	*506.7*	*2,377.7*
Wilayah III	14	Central West Sumatra		104.5	139.4	191.1	299.7		34.9	160.4
West Sumatra	15	Pasaman		17.5	23.3	31.7	49.2		5.8	26.0
	16	Lima Puluh Kota		19.0	25.8	36.0	57.4		6.8	31.6
	17	Southeast West Sumatra		32.7	43.3	59.9	94.7		10.6	51.4
	18	Pesisir Selatan		14.3	18.5	25.5	40.0		4.2	21.5
	19	Mentawai Islands**								
		Total		187.9	250.2	344.1	541.0		62.3	290.8
Wilayah III	20	Kampar		41.2	52.8	73.3	116.9		11.6	64.1
Riau	21	Bengkalis		48.2	61.0	83.6	131.6		12.8	70.6
	22	Indragiri Hulu		10.5	13.2	18.8	30.7		2.7	17.4
	23	Indragiri Hilir		17.6	22.7	31.6	50.7		5.1	28.0
	24	Riau Islands		28.1	36.3	49.9	78.9		8.2	42.6
		Total		145.7	186.1	257.2	408.8		40.4	222.7
Wilayah III		Total	133.2	333.6	436.3	601.3	949.8	200.4	102.7	513.6
								159.8	*136.9*	*535.7*
Northern Sumatra		Total	460.2	1,272.0	1,795.1	2,780.1	4,948.9	811.8	523.1	3,153.8
								729.1	*697.5*	*3,428.7*

Notes : *is included in 5. West Aceh and 6. South Aceh.
** is included in 14. Central West Sumatra.
Because of rounding figures may not add up.
Italics figures express required capacity.

5.8 Times as much

Table 65. Electricity Consumption Forecast by Development Area

(Unit:GWh)

Wilayah (Province)	Area No.	Development area	1988	1993	1998	2003	2008
Wilayah I	1	Aceh Besar	30.9	62.5	127.3	260.0	531.2
Aceh	2	Northern Aceh	73.0	150.5	317.8	682.5	1,466.0
	3	East Aceh	30.7	64.2	139.9	306.0	669.1
	4	Southeast Aceh	9.6	18.8	38.0	78.3	161.4
	5	West Aceh	14.9	29.8	61.8	131.3	279.1
	6	South Aceh	14.6	29.1	59.5	123.3	255.5
	7	Aceh Islands*					
		Total	173.7	355.0	744.2	1,581.4	3,362.3
Wilayah II	8	Medan	338.5	597.4	1,105.4	2,183.0	4,293.1
North Sumatra	9	East Coast	694.2	1,239.7	2,298.6	4,482.4	8,705.0
	10	Karo Highlands	65.0	115.7	214.9	423.6	831.5
	11	North Tapanuli	70.3	122.8	223.7	423.3	797.5
	12	Southern Tapanuli	123.4	222.0	421.1	872.1	1,798.7
	13	Nias	35.8	63.8	122.8	258.8	543.0
		Total	1,327.3	2,361.4	4,386.7	8,643.2	16,968.8
Wilayah III	14	Central West Sumatra	194.0	315.6	526.2	896.9	1,523.9
West Sumatra	15	Pasaman	32.2	52.8	87.9	148.5	250.3
	16	Lima Puluh Kota	35.7	57.3	97.3	168.7	291.6
	17	Southeast West Sumatra	60.8	98.8	163.4	280.9	481.4
	18	Pesisir Selatan	26.9	43.1	69.9	119.5	203.5
	19	Mentawai Islands**					
		Total	349.6	567.7	944.8	1,614.6	2,750.6
Wilayah III	20	Kampar	79.5	124.5	199.5	344.1	594.4
Riau	21	Bengkalis	93.3	145.7	230.4	392.3	669.2
	22	Indragiri Hulu	21.5	31.7	49.9	88.1	155.9
	23	Indragiri Hilir	34.8	53.3	85.7	148.5	257.7
	24	Riau Islands	53.7	84.9	137.0	234.2	401.1
		Total	282.8	440.1	702.5	1,207.2	2,078.3
Wilayah III		Total	632.4	1,007.8	1,647.3	2,821.8	4,828.9
Northern Sumatra		Total	2,133.4	3,724.1	6,778.2	13,046.5	25,160.0

Notes : *is included in 5. West Aceh and 6. South Aceh.
** is included in 14. Central West Sumatra.
Because of rounding figures may not add up.

Table 66. Power Development Plan (Wilayah I)

(UNIT: MW)

Region	Project		Type	1988	1993	1998	2003	2008	Completion Year	Status	Remarks
Wilayah I (Aceh)	*System Peak*	**P**		46.8	106.4	197.1	337.0	661.4			
	Required Cap.	**A**		150.1	208.9	262.8	396.4	778.1			
	Existing										
	Diesel			149.7	149.7	146.6	49.3	30.6			
	Mini hydro			0.4	0.4	0.4	0.4	0.4			
	Total existing			150.1	150.1	147.0	49.7	31.0			
	Add.Required										
	Diesel		Diesel		15.2	15.2	15.2	15.2	1991		
	Banda Aceh		Hvy.oil		50.0	50.0	50.0	50.0	1992		
	Mini hydro		Hydro		1.2	5.8	5.8	5.8	92/95	F/S	
	New&Renewable		Biomass			6.3	6.6	9.6	1996		palm/husk
	Lawe Alas	4*	Hydro				322.0	322.0	2003	PRE F/S	Kutacane
	Peusangan	1*/2	Hydro			64.0	64.0	64.0	1995	F/S	Lhokseumawe
	Ramasan	2	Hydro					58.0	2006	-	
	Peusangan	4*	Hydro				31.0	31.0	1999	PRE F/S	Lhokseumawe
	Tampur	1*/2	Hydro				428.0	428.0	2001	F/S	Langsa
	Meulaboh	4	Hydro					70.3	2004	PRE F/S	Meulaboh
	Teunom	1*/2	Hydro					106.5	2004	F/S	Sigli/B.Aceh
	Ramasan	1	Hydro				64.0	64.0	64.0	1997	
	TOTAL CAP.	**B**		150.1	216.5	352.3	1,036.3	1,255.4			
	B-A			*0.0*	*7.6*	*89.5*	*639.9*	*477.3*			
	Available hydro										
	Jamboaye	8		160.0						F/S	Lhokseumawe
	Kr. Kluet	2		66.3						RECN.S	Tapak Tuan
	Teunom	1		24.0						PRE F/S	Sigli
										RECN.S	Meulaboh
	Meulaboh	1		35.0						RECN.S	Meulaboh
				285.3							
	Available hydro	(Wilayah I+II)									
	Wanpu	1		115.0							
				400.3							

Table 67. Power Development Plan (Wilayah II)

(UNIT: MW)

Region	Project		Type	1988	1993	1998	2003	2008	Completion Year	Status	Remarks
Wilayah II	*System Peak*	P		280.2	663.0	1,161.8	1,841.8	3,337.7			
(N.Sumatra)	*Required Cap.*	A		532.0	1,012.0	1,549.0	2,166.8	3,926.7			
	Existing										
	Base capacity			151.3	148.3	142.1	19.6	16.5			
	Scat.Diesel			11.1	11.1	11.1	7.9	7.9			
	Belawan	1	HVY O/G	65.0	65.0	65.0	65.0	65.0			
	Belawan	2	HVY O/G	65.0	65.0	65.0	65.0	65.0			
	Belawan	3	HVY O/G	65.0	65.0	65.0	65.0	65.0			
	Belawan		COMCYC	117.0	117.0	117.0	117.0	117.0			
	Asahan	2	PURCHS	50.0	50.0						
	Mini hydro		Hydro	7.6	7.6	7.6	7.6	7.6			
	Add.Required										
	Belawan	4	HVY O/G		65.0	65.0	65.0	65.0	1989		
	Belawan		COM/NG		117.0	117.0	117.0	117.0	1993		
	Belawan		COM/NG		100.0	100.0	100.0	100.0	1993		
	P. Brandan		N.G					150.0	2005		
	Mini hydro		Hydro		0.6	3.8	3.8	3.8	1991	U. const.	
	New&Renewable		New/Renew		3.0	6.0	6.0	6.0			palm/husk
	Asahan	1*	Hydro		220.0	270.0	270.0	270.0	1993	D/D	
	Asahan	3*	Hydro			300.0	300.0	400.0	1995	D/D	
	Asahan	4	Hydro				113.0	113.0	2000	F/S	
	Renun	1*	Hydro			82.0	82.0	82.0	1996	Pre F/S	
	Sipansi Haporas	*	Hydro			43.0	43.0	43.0	1995		
	Wanpu	1	Hydro					156.0	2006		
	Lau biang							62.0	2007		
	Sirahar		Hydro					21.0	2004		
	Gadis	2	Hydro					104.0	2005		
	Gadis	3	Hydro					70.0	2004		
	Lau Gunung	2	Hydro				15.0	15.0	2001		
	Toru		Hydro				65.0	125.0	2002		
	TOTAL CAP.	**B**		532.0	1,034.6	1,459.6	1,526.9	2,246.8			
	B-P			*251.8*	*371.6*	*297.8*	*-314.9*	*-1,090.9*			
	B-A			*0.0*	*22.6*	*-89.4*	*-639.9*	*-1,679.9*			
Wilayah I + II	**TOTAL CAP.**			682.1	1,251.1	1,811.9	2,563.2	3,502.2			
(Interconn by 1993)	**REQD-ADD CAP**			*0.0*	*30.2*	*0.0*	*0.0*	*-1,202.7*			

Table 68. Power Development Plan (Wilayah III)

(UNIT: MW)

Region	Project		Type	1988	1993	1998	2003	2008	Completion Year	Status	Remarks
Wilayah III (W.Sumatra/ Riau)	*System Peak*	**P**		133.2	333.6	436.3	601.3	*949.8*			
	Required Cap.	**A**		285.0	444.8	581.7	707.4	1,117.5			
	Existing										
	Total existing			285.0	285.0	125.0	118.5	108.5		Operation	
	Scat.Diesel		Diesel	206.5	206.5	40.5	34.0	24.0		Operation	
	Batang Agam	*	Hydro	10.5	10.5	10.5	10.5	10.5		Operation	
	Maninjau	*	Hydro	68.0	68.0	68.0	68.0	68.0		Operation	
	Mini hydro										
	Add.Required										
	Kerinci		Geo.ther			5.0	5.0	5.0	1997		
	Scat.Diesel		Diesel		34.4	44.4	42.7	42.7	1990		
	Ombilin 1		COAL		65.0	65.0	65.0	65.0	1992	U. const.	
	Ombilin 2		COAL		65.0	65.0	65.0	65.0	1993	U. const.	
	Ombilin 3		COAL				100.0	100.0	2004	PRE F/S	
	Ombilin 4		COAL					100.0	2005	PRE F/S	
	Bi-steam Duri							1,000.0	2006		
	Mini hydro				8.5	15.4	22.2	22.2	1993	F/S	
	New&Renewable					6.0	6.0	6.0	1995		palm/husk
	Kotapanjang	*	Hydro			114.0	114.0	114.0	1995	D/D	
	Singkarak	*	Hydro			175.0	175.0	175.0	1997	D/D	
	Sinamar	1	Hydro					89.0	2004	RECN.S	
	Kuantan	1	Hydro					109.0	2007	RECN.S	
	Merangin	2	Hydro					232.0	2008	RECN.S	
	Rokan Kiri	2	Hydro					65.0	2005	RECN.S	
	Rokan Kiri	1						67.0	2004	RECN.S	
	TOTAL CAP.	**B**		285.0	458.0	608.8	707.5	2,359.5			
	B-A			*0.0*	*13.2*	*27.1*	*0.0*	*1,242.0*			
W I+II+III (Interconn by 2003)	**GRAND TL CAP.**			967.1			3,270.6	5,861.6			
	G. TOTAL-REQD			*0.0*			*0.0*	*39.3*			
	TOTAL PEAK			460.2			2,780.1	4,948.9			
	Available hydro										
	Sangir		Hydro	27.0							
	Bajang	1		29.0							
	Bajang	2		48.0							
	Bajang	3		22.0							
	Merangin	1		41.0							
	Merangin	3		57.0	224.0						

Table 69. Status of the Electrification for Selected Kabpaten (IDEP Sites)

Kecamatan	PLN June 1989	Non PLN 1983	Total Elec Rate(%)	PLN Elec Rate(%) 1989	PLN Total Sales kWh 1989	kWh/ Customer 1989	Reak kW 1989	Peak(kW)/ Customer 1989
Aceh Barat								
Beutong	0	93	4.5	0.0				
Darul Makmur	362	286	10.3	5.8				
Jaya	237	0	4.6	4.6				
Johan Pahlawan	4,286	56	71.5	70.6				
Kanai Xvi	185	79	3.1	2.2				
Krueng Sabee	326	176	19.0	12.3				
Kuala	178	75	3.1	2.2				
Sama Tiga	0	56	0.9	0.0				
Sampoiniet	79	146	10.2	3.6				
Setia Bakti	0	87	6.6	0.0				
Seunagan	678	47	14.0	13.1				
Sunagi Mas	0	45	6.7	0.0				
Teunon	447	295	16.7	10.1				
Woyla	0	35	0.9	0.0				
Total	6,778	1,476	13.2	10.8				
Nias								
Gunung Sitoli	3,340	1,573	34.2	23.2	226,369	67.8	900	0.269
Tuhemberuwa	18	0	0.2	0.2	356	19.8	4	0.222
Lahewa	223	1,111	20.3	3.4	9,778	43.8	56	0.251
Alasa		0	0.0	0.0	0		0	
Gido	66	0	0.6	0.6	1,250	18.9	11	0.167
Idang Gawo		0	0.0	0.0				
Lahusa		0	0.0	0.0				
Gomo		0	0.0	0.0				
Teluk Dalam	331	0	2.7	2.7	3,154	9.5	78	0.236
Lolowau	20	0	0.3	0.3	515	25.8	5	0.250
Mandrehe	29	0	0.5	0.5	359	12.4	6	0.207
Sirombio	30	0	1.0	1.0	701	23.4	10	0.333
Pp Batu	112	0	2.5	2.5	6,006	53.6	40	0.357
Total	4,169	2,684	6.9	4.2	248,488	59.6	1,110	0.266
Tapanuli Selatan								
Natal	242	463	9.1	3.1	10,336	42.7	52	0.215
Batang Natal	297	231	6.1	3.4	12,686	42.7	55	0.185
Kotanopan	1,965	220	17.7	15.9	72,439	36.9	340	0.173
Muara Sipongi	182	118	12.0	7.3	7,439	40.9	49	0.269
Panyabungan	4,069	1,024	25.9	20.7	193,542	47.6		
Siabu	2,469	298	21.9	19.5	73,319	29.7		
Sosa	145	209	4.3	1.7	6,721	46.4	29	0.200
Barumun	1,866	508	21.9	17.2	74,192	39.8	315	0.169
Barumun Tonga	240	192	6.2	3.4	5,547	23.1	40	0.167
Sosopan	108	136	6.8	3.0	3,169	29.3	18	0.167
Batang Angkola	3,606	246	28.6	26.7	102,604	28.5		
Padang Sidempuan	11,765	0	30.8	30.8	724,381	61.6	3,948	0.336
Batang Toru	544	172	9.7	7.3	18,601	34.2	83	0.153
Sipirok	2,048	0	27.3	27.3	29,822	14.6	295	0.144
Padang Bolak	927	124	6.6	5.8	52,024	56.1	174	0.188
Dolok	153	0	3.1	3.1	3,156	20.6	34	0.222
Saipar Dolokhole	126	0	3.2	3.2	3,293	26.1	18	0.143
Tapanuli Tengah								
Barus	1,451	342	13.9	11.2	669,260	461.2	248	0.171
Sorkam	802	0	12.6	12.6	37,728	47.0	128	0.160
Sibolga	249	139	3.7	2.4	6,923	27.8	35	0.141
Lumut	1,330	100	17.9	16.6	47,409	35.6		
Sibolga Kota	9,993	0	87.9	87.9	1,190,486	119.1	3,320	0.332
Total	44,577	4,522	21.0	19.1	3,345,077	75.0	9,181	0.206
Sawahlunto								
Kota Baru	391	10,356	83.3	3.0	22,493	57.5	98	0.251
Pulau punjung	802	6,765	89.8	9.5	37,484	46.7	147	0.183
Tanjung Gadang	212	6,076	83.0	2.8	10,174	48.0	44	0.208
Total	1,405	23,197	85.1	4.9	70,151	49.9	289	0.206

Table 69. Continued.

Kecamatan	PLN June 1989	Non PLN 1983	Total Elec Rate(%)	PLN Elec Rate(%) 1989	PLN Total Sales kWh 1989	kWh/ Customer 1989	Reak kW 1989	Peak(kW)/ Customer 1989
Indragiri Hulu								
Kuantan Mudik	246	29	4.1	3.6	15,621	63.5	53	0.215
Kuantan Tengah/Hilir	2,377	2,115	25.4	13.4	143,998	60.6	559	0.235
Singingi	186	743	62.5	12.5	6,321	34.0	28	0.151
Cerenti	155	150	8.0	4.0	11,715	75.6	46	0.297
Peranap	347	175	17.4	11.6	22,317	64.3	90	0.259
Pasir Penyu	1,633	0	17.1	17.1	114,760	70.3	490	0.300
Seberida	55	225	4.0	0.8	3,575	65.0	13	0.236
Rengat	3,164	52	77.9	76.6	328,577	103.8	1,082	0.342
Indragiri Hilir								
Reteh	189	3,067	25.7	1.5	11,410	60.4	50	0.265
Enok	168	875	15.4	2.5	7,421	44.2	38	0.226
Kuala Indragiri		752	11.2	0.0				
Tembilahan	3,848	47	32.2	31.8	409,970	106.5	1,310	0.340
Tempuling		217	2.6	0.0				
Gaung Anak Serka		200	2.1	0.0				
Mandah		21	0.3	0.0				
Kateman	258	85	6.3	4.7	150,050	581.6	77	0.298
Keritang		997	8.4	0.0				
Tanah Merah		2,920	51.6	0.0				
Batang Rika		200	4.4	0.0				
Total	12,626	13,810	18.5	8.8	1,225,735	97.1	3,836	0.304

VII. TRANSPORTATION

A. Identification of Development Potential

1. Role of Transportation Sector

1.1. Introduction

341. Indonesia is composed of more than 13,000 islands and stretches over a length of 5,000 km, from Sumatra in the west to Irian Jaya in the east. Due to the archipelagic nature of the country, transportation and communication system among those islands are of vital importance for Indonesian national integration and economic development. Among those islands, Sumatra, its northern part particularly, has relatively well developed transportation infrastructure, compared to other islands of the nation.

342. But it could be pointed out when the existing transportation network in the study is reviewed from the stand-point of intra-regional interdependence that the transportation network, as a system, is not so made as to fully function to smoothen inter-provincial economic activities. Rather it could be said that each of the provinces in the study area seems to have persued their own way of development in transportation regardless of other provinces. It might not be exaggeration to say that each of the region has developed their transportation network centered around their provinces' major cities and their main intended linkages were not with other provinces in the area. In addition, due to geographical heterogeneity, the patterns of regional development even within a same province differ one another and they are not systematically linking each other. Especially, the development patterns and processes between the regions in the eastern and western coastal areas are different in essence, and they are not always coordinating systematically.

343. In sum, the main reasons for the above issues in transportation development seem to come from the following facts:

- The absolute amount of investment for transportation in the past has been inadequate.
- The investment in the past was biased rather to relatively developed areas in any province.
- Measures for comprehensive transportation planning, standing on integrated scope of view, which pays attention to the inter dependent relation among regional economies have not ever been taken.

1.2. Historical Review of Transportation Development

344. In this section, the historical development in transportation in the study area is briefly reviewed. For the description of economy in northern Sumatra as well as that of Indonesia as a whole, the structure of economy first founded under the colonial policy by foreign powers should not be ignored. Indonesia has long been put under colonial policy by Dutch since early 17th century until the independence of the nation in the 1940s. As is the case with most of the countries in Asia, economic system in Indonesia was reformed into that of raw material supply for the industrialization of this European nation.

345. Colonial economy under the foreign powers had introduced plantation system for the planting of such estate crops as oil palm, rubber and coconut for international market at the cost of planting of substantial food crops. Under the situation, socio-economic infrastructures, chiefly those for transportation, were provided mainly for the transportation of these products.

346. As the plantation economy in Indonesia was developed revolved around the island of Java, transportation system of this country was formed centered around the island. The sealines, for instance, were first introduced for the transportation of plantation products to Java and overseas. Railways as well, were constructed for the purpose of transportation of industrial raw material and mining products to the nearby ports for the shipment to the other parts of Indonesia.

347. Although, great efforts to correct this skewed structure of national economy were taken and a variety of transportational infrastructure development programs were initiated after the independence of the nation, homogeneous and internally balanced distribution of transportation facilities with satisfactory standard has not yet been realized.

348. After president Soeharto assumed the presidency in 1969, Nation's Five Year Plan (Repelita) was institutionized and development target was set up for the modernization of the nation. The historical process in development of transportation sector for each of the Repelita are described as shown in Table 70.

349. The most remarkable event in the transportation development in the study area might be the opening of the trans-Sumatra Highway in 1984. This event is deemed first achievement of combining of mutually independent local economies within the region. It is needless to say that wider scaled inter-industrial activities among different provinces have become possible owing to the opening of the road.

350. As seen above, not so many years have passed since the study area had received full-fledged scale of investment. Further it could be pointed out that most of the development plans have come up with for imminent need where most of the transportation development plan are conducted regardless of other plannings, due mainly to small amount of investment as against the vastness of land and hetergeneity of geography, and lack of enunciated concept for the incentive roles of transportation in the development of regional economy.

Table 70. Basic Stance for Transportation Development in Repelitas

	Target for Transportation Development	Target for Regional Economic Development	Remarks
Repelita I	• To vitalize neglected transportation facilities • Contribution to export increase	• Reconstruction of national economy • Stability in national economy • To arrest the process of economic deterioration	• Period of making investment inventory for the infrastructure abondoned during the preceeding period
Repelita II	• To revive the transportation facilities • Improvement in transportation efficiency • Establishment of transportation system	• Homogeneous development among sector • Stability in national economy • Equity in regional development	• Period of recovering self-confidence for the construction of the national economy
Repelita III	• Improvement in transportation efficiency • Construction and maintenance of transportation facilities	• Enhancement of living standard, technology and welfare standard in homogeneous manner. • Preparation of economic condition for coming development in the next stage	• Attainments of minimum substantial standard (self sufficiency of rice was first attained in this period) • Minimum level of infrastructure was going to be provided although it is not a satisfactory standard
Repelita IV	• Road development aimed at promotion of productive sector • Coordinated development among different transportation means • Airplane and ship service to the transportationally less developed area • Internationalization	• Economic growth to lead the national economy to the take-off stage • Social equity to ensure productive employment and renumerative income • Sustained stability from political, environmental and natural resources points of view	• Period of reviewing past Repelita with modest progress of society as achivable target

2. Existing Transportation System

2.1. Road Transportation

(1) General

351. In the northern part of Sumatra, road transportation is the dominant mode of land transportation. The existing road network is shown in Figure 34 by province. The total length of roads ranked over urban roads as of 1984 comes up with 41,357 km, of which the lengths of National roads, Provincial roads, Kabupaten roads and Urban roads are 2,078 km, 8,287 km, 27,798 km and 3,194 km respectively as shown in Table 71. The road lengths by functional classification per province are shown in Table 72. The pavement types and conditions of roads by length in the Region are summarized in Tables 73 and 74. About 99 percent of the national roads and 58 percent of provincial roads are paved. For provincial roads, the paved proportion varies from 32 percent for Riau to 86 percent for West Sumatra.

352. The Trans-Sumatra Highway forms a backbone in the road network of the Region. As this road passes the eastern coast of North Sumatra and Aceh provinces and the western coast of West Sumatra province, the other parts of the Region are said fairly inconvenient to use this road. Provincial and Kabupaten roads are provided in the manner of supplementant to the said Highway. By and large, however, these roads are at substandard levels in their road design and surface condition, and require improvement.

353. The road network in the Region is not so well organized that it falls to support sufficiently functional interdependence among sub-regions, regional industries and vital points of transportation such as ports. Generally, the transportation system in the Region needs an overall level-up to integrate industries and sub-regions as well as to provide good access to several important nodes of transportation. Its improvement through small-scale construction and rehabilitation works is one of the most urgent development issues.

(2) Characteristics and Issues in Road Transportation

354. Present traffic volumes on major roads in the Region are shown in Figures 35 and 36. The traffic volume on the Trans-Sumatra Highway is about 500 - 800 vehicles a day on the section between Bukittinggi in West Sumatra province and Tarutung in North Sumatra province. On the other hand, the traffic volume on the section between Tarutung and Banda Aceh is roughly in the range of 2,000 - 5,000 vehicles a day, except for a large amount of traffic in the urban area of Medan where more than 10,000 traffic is recorded. The traffic volume on this Highway near Padang is some 5,000 - 8,000 vehicles a day.

355. Strong road traffic concentrations can be seen around the cities of Medan and Padang, as shown in Figures 37 and 38. This fact suggests the dominant role of these cities in the two separate regional economic zones: one is formed by North Sumatra and Aceh provinces and the other by West Sumatra and Riau provinces.

356. Urban Areas, especially Medan and Padang, have many issues related to their urban traffic. As for Medan, a bypass construction and improvement of its urban transportation system are being proposed to alleviate traffic congestion in its downtown areas.

357. The north-west part and south-east part of the Region are particularly lacking adequate road networks. Construction of new

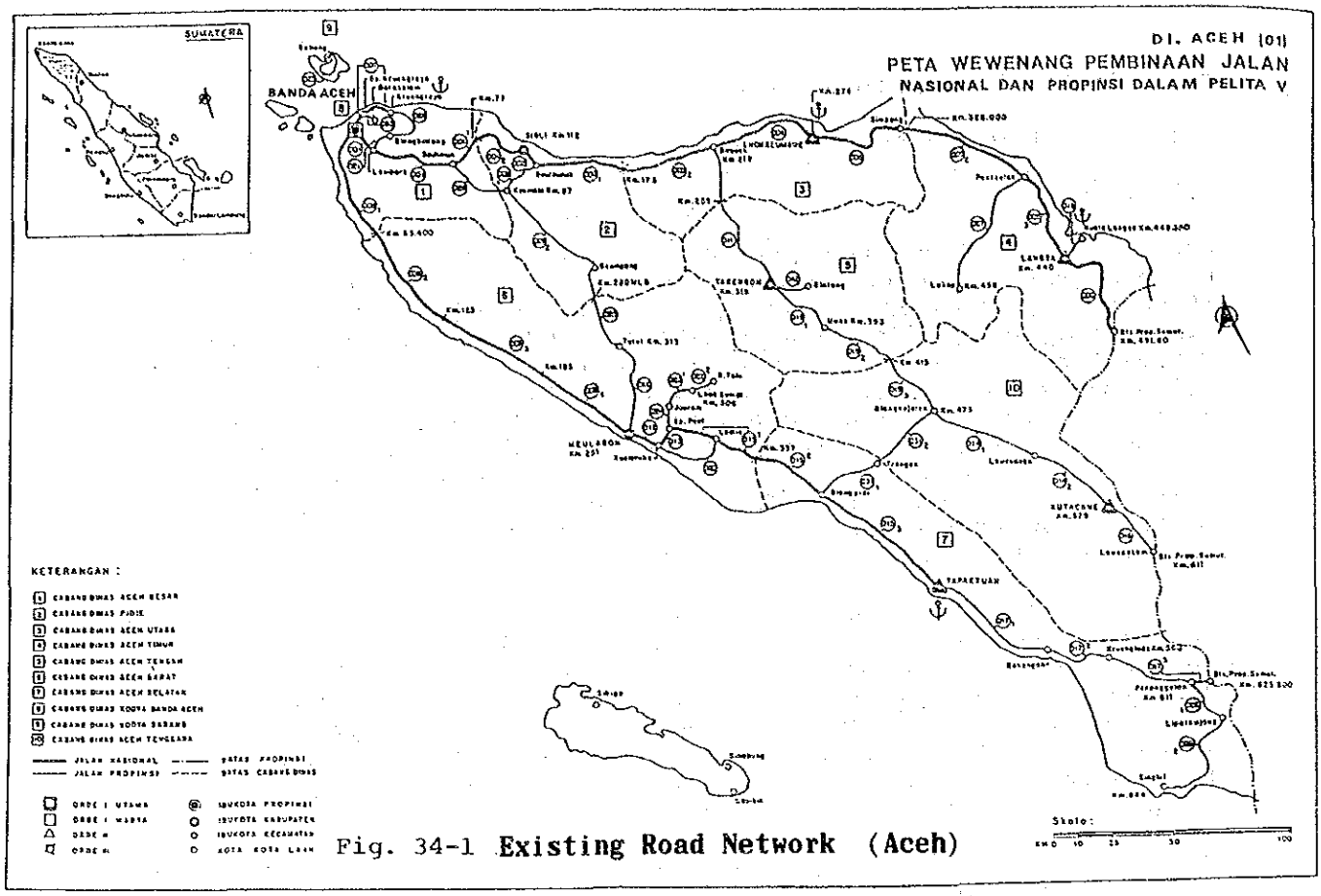


Fig. 34-1 **Existing Road Network (Aceh)**

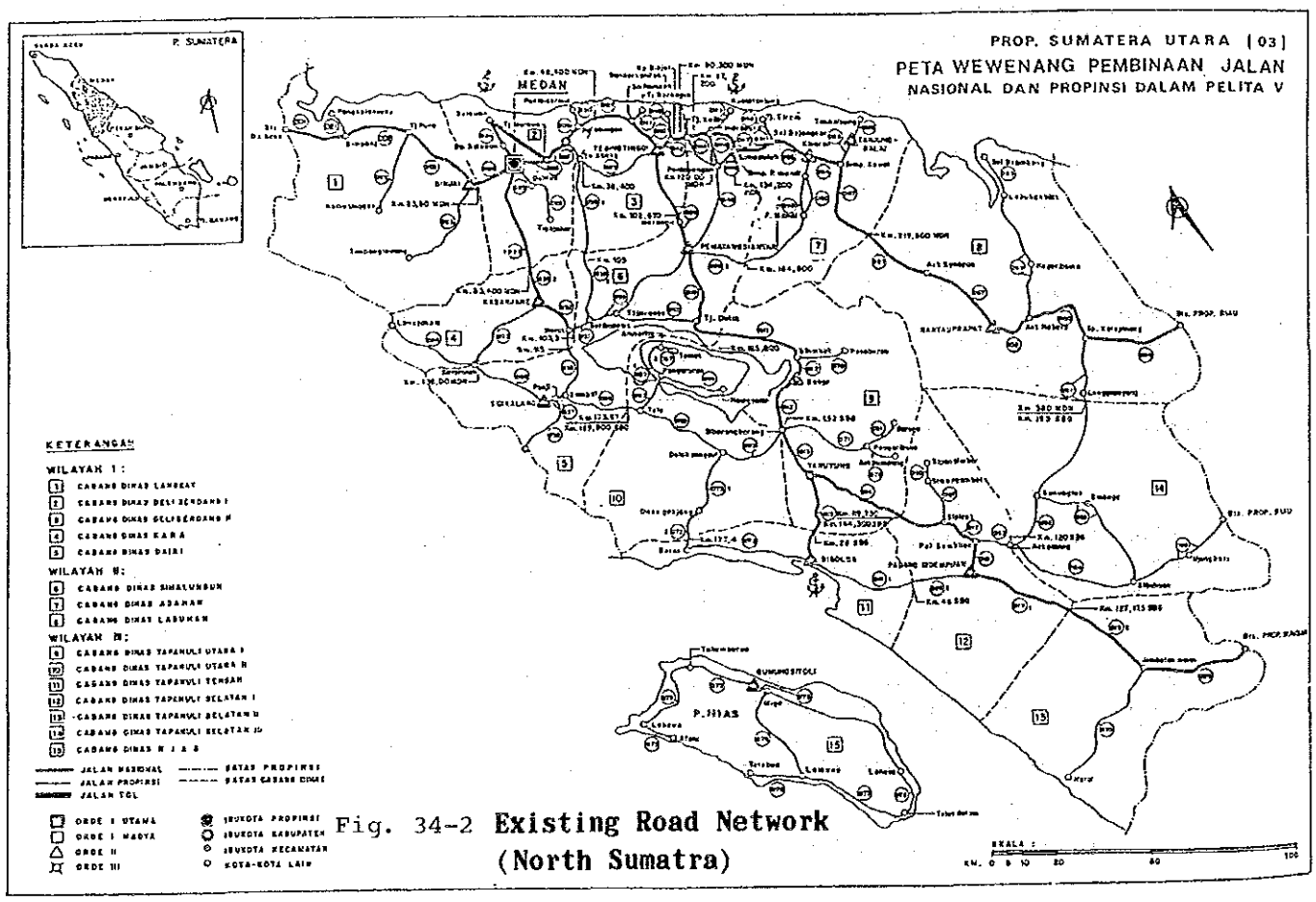


Fig. 34-2 **Existing Road Network (North Sumatra)**

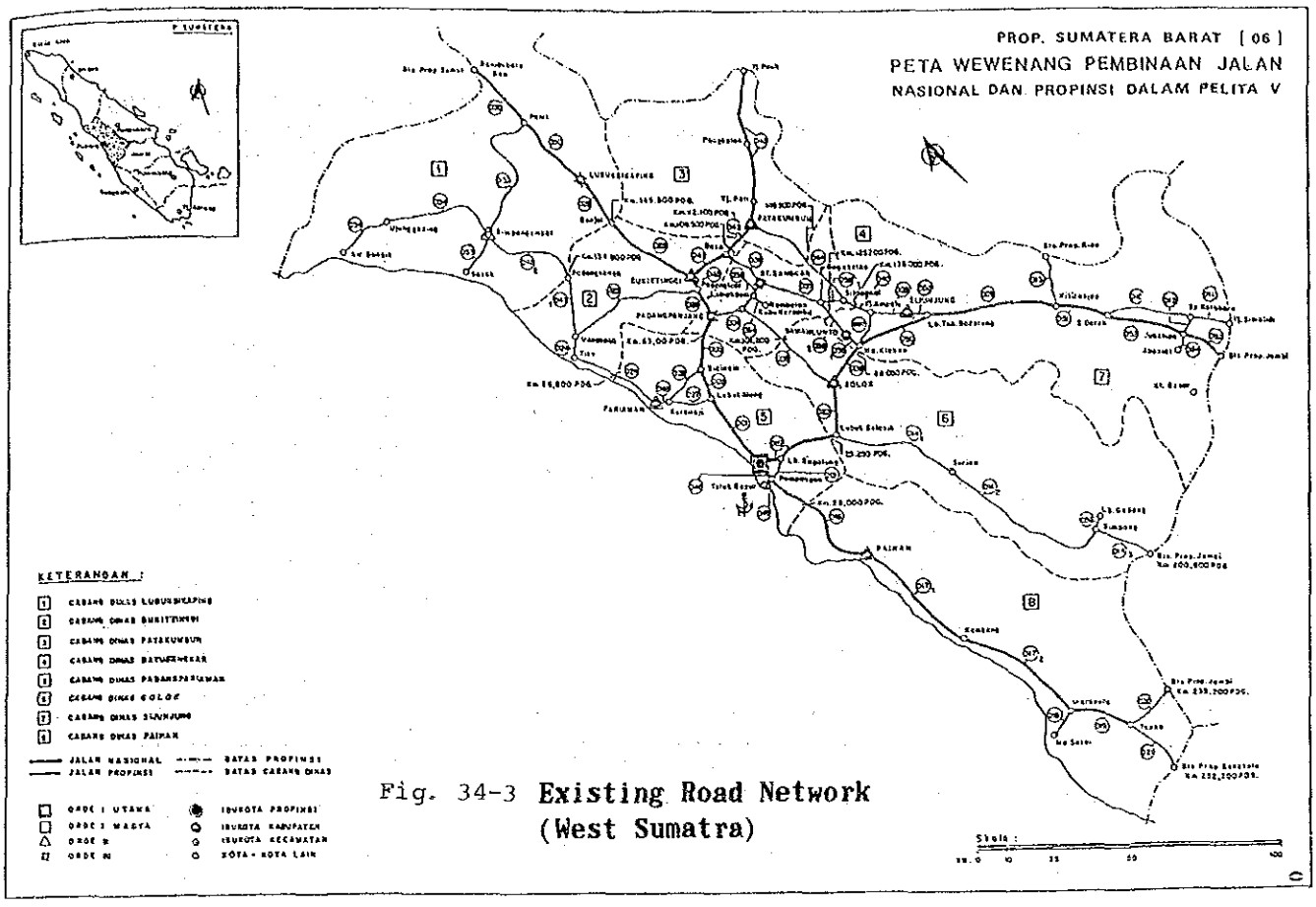


Fig. 34-3 **Existing Road Network (West Sumatra)**

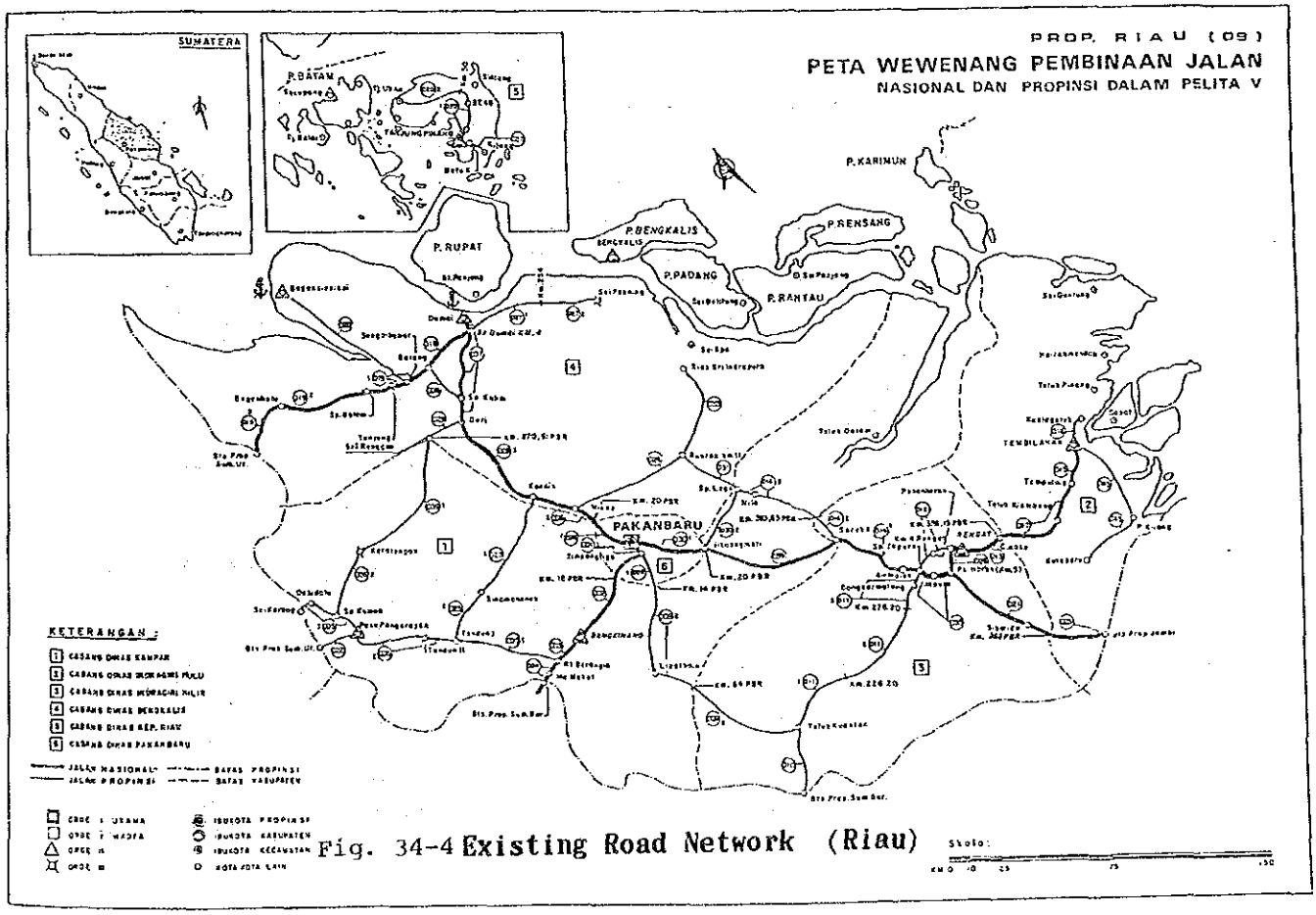


Fig. 34-4 **Existing Road Network (Riau)**

feeder roads which connect rural center and/or grade-up of existing feeder roads are considered necessary along with the improvement of trunk roads.

Table 71. Total Road Length by Province

(1) Road Length by Administrative Status

Length in Km. Year: 1984/1985

Province	Road Length	Road Status			
		National Road	Provincial Road	Kabupaten Road	Urban Road
Aceh	9,907	493	2,010	7,076	328
North Sumatra	15,070	793	2,544	9,944	1,789
West Sumatra	8,602	689	1,188	5,860	865
Riau	7,778	103	2,545	4,918	212
Total	41,357	2,078	8,287	27,798	3,194

(2) Road Length by Functional Classification

Length in Km. Year: 1984/1985

Province	Total Road Length	Road Function			
		Alterial Road	Collector Road	Local Road	Unspecified
Aceh	9,907	957	949	597	7,404
North Sumatra	15,070	1,046	2,109	302	11,613
West Sumatra	8,602	747	1,016	58	6,781
Riau	7,778	713	798	1,137	5,130
Total	41,357	3,463	4,872	2,094	30,928

Source: Bina Marga

Table 72. Road Length by Pavement Type by Province

(1) National Road

Length in Km. Year: 1984/1985

Province	Total Length	Pavement Type			
		Asphalt Road	Gravel Road	Earth Road	Unspecified
Aceh	493	493	0	0	0
North Sumatra	793	793	0	0	0
West Sumatra	689	660	29	0	0
Riau	103	103	0	0	0
Total	2,078	2,049	29	0	0

(2) Provincial Road

Length in Km. Year: 1984/1985

Province	Total Length	Pavement Type			
		Asphalt Road	Gravel Road	Earth Road	Unspecified
Aceh	2,010	942	688	380	0
North Sumatra	2,544	2,048	267	229	0
West Sumatra	1,188	1,018	170	0	0
Riau	2,545	808	587	1,150	0
Total	8,287	4,816	1,712	1,759	0

(3) District Road

Length in Km. Year: 1984/1985

Province	Total Length	Pavement Type			
		Asphalt Road	Gravel Road	Earth Road	Unspecified
Aceh	7,076	538	2,697	1,941	1,900
North Sumatra	9,944	2,731	2,127	4,918	168
West Sumatra	5,860	1,814	1,406	1,834	806
Riau	4,918	318	1,230	2,087	1,283
Total	27,798	5,401	7,460	10,780	4,157

(4) Municipality Road

Length in Km. Year: 1984/1985

Province	Total Length	Pavement Type			
		Asphalt Road	Gravel Road	Earth Road	Unspecified
Aceh	328	212	34	82	0
North Sumatra	1,789	976	142	40	631
West Sumatra	865	493	130	235	7
Riau	212	115	2	58	37
Total	3,194	1,796	308	415	675

Source: Bina Marga

Table 73. National and Provincial Road Condition

Length in Km. Year: 1984/1985

Province	National and Provincial Roads Length	Road Condition			
		Stable	Unstable	Critical	Unspecified
Aceh	2,503	1,109	1,108	286	0
North Sumatra	3,337	1,188	2,013	136	0
West Sumatra	1,877	788	1,028	0	61
Riau	2,648	856	1,552	240	0
Total	10,365	3,941	5,701	662	61

Source: Bina Marga

Table 74. Ratios of Road Length to Population, Land Area and Number of Vehicles by Province; 1984

Province	Road Length (Km)	Population (1,000)	Length to Pop. Ratio (km/1,000 pop.)	Land Area (Km^2)	Length to Area Ratio (km/km^2)	Vehicles (Bh)	Length to Vehicle Ratio (Km/Bh)
Aceh	7,045	2,920.5	2.412	55,392	0.127	119,198	0.059
North Sumatra	13,705	9,231.7	1.485	70,787	0.194	486,650	0.028
West Sumatra	7,901	3,705.5	2.132	49,778	0.159	133,542	0.059
Riau	5,540	2,442.8	2.268	94,562	0.059	122,322	0.045
Total	34,191	18,300.5	1.868	270,519	0.126	861,712	0.040

Source: Bina Marga

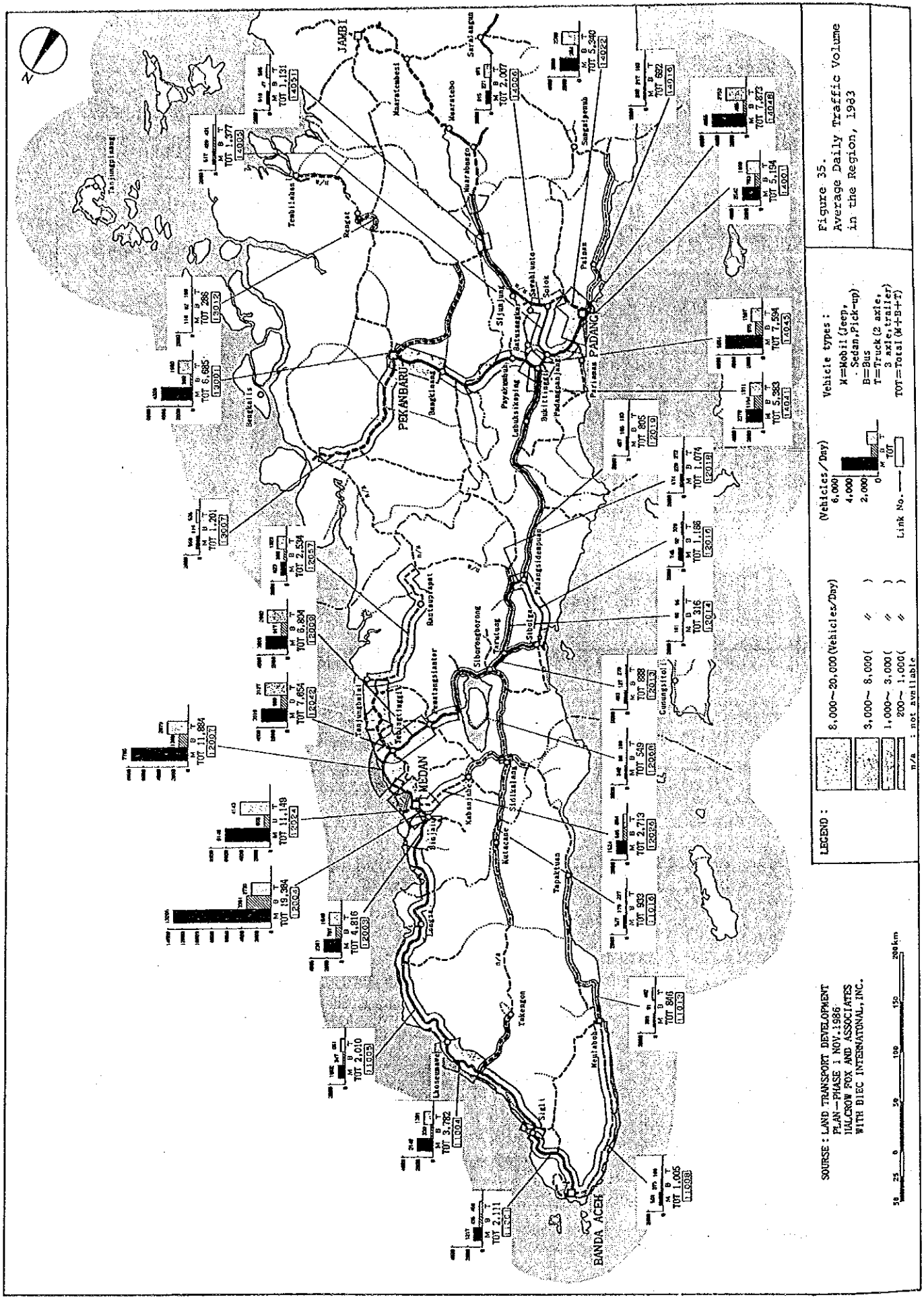
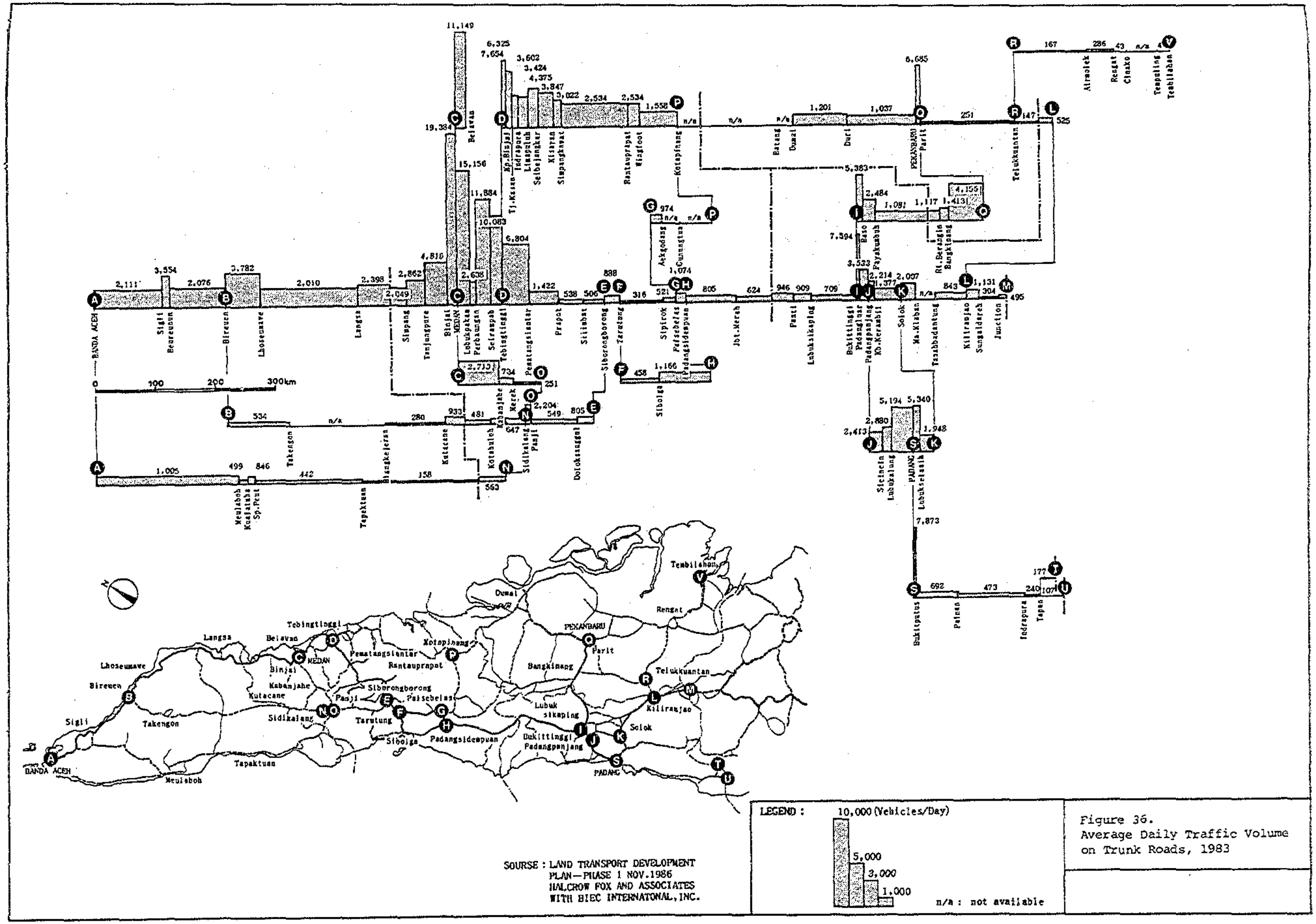
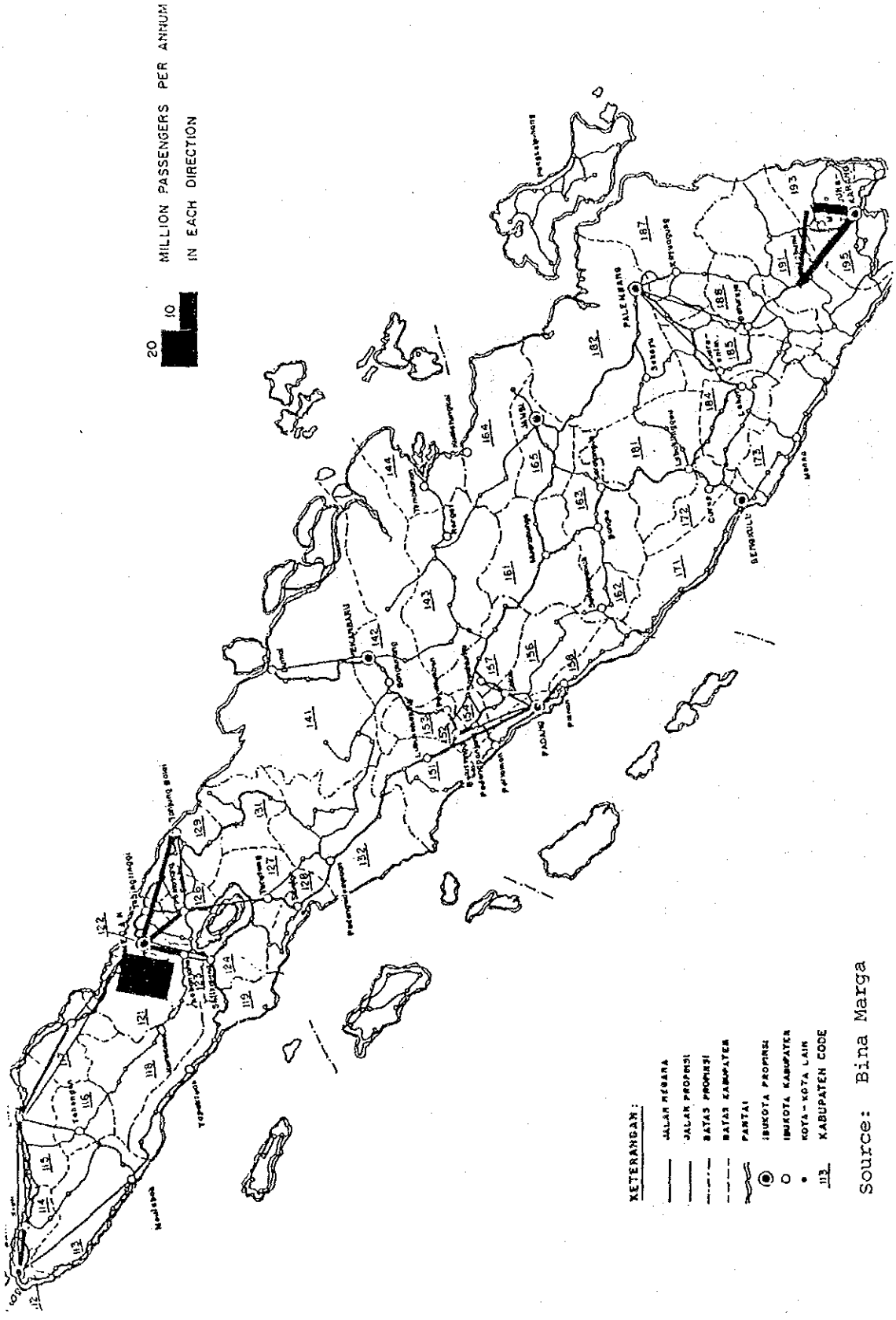


Figure 35.
Average Daily Traffic Volume in the Region, 1983



SOURSE : LAND TRANSPORT DEVELOPMENT PLAN—PHASE 1 NOV.1986 HALCROW FOX AND ASSOCIATES WITH BIEC INTERNATONAL, INC.

Figure 36.
Average Daily Traffic Volume
on Trunk Roads, 1983



Source: Bina Marga

Figure 37. Interregional Passenger Transportation by Road (1982)

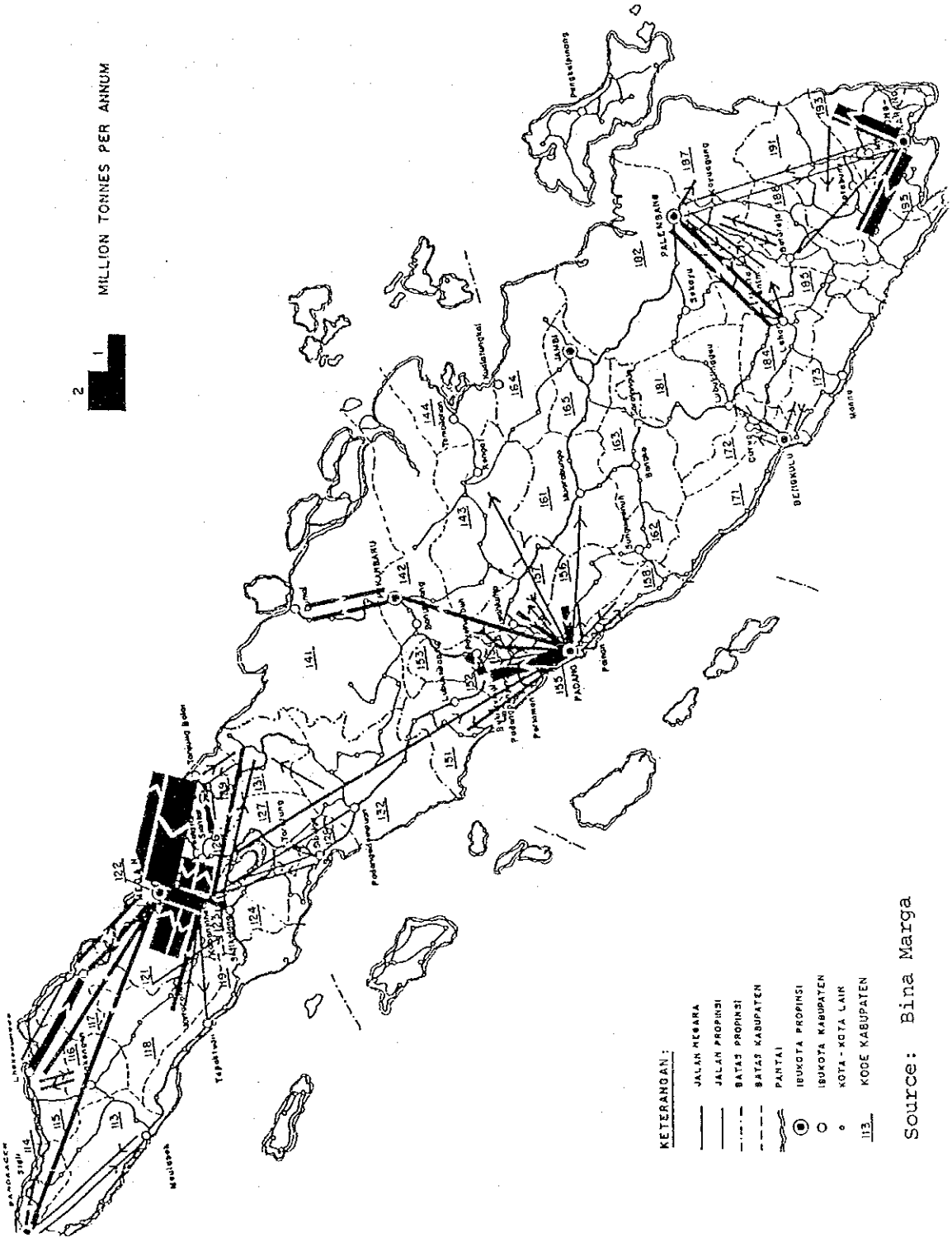


Figure 38. Interregional Cargoes Transportation by Road (1982)

Source: Bina Marga

2.2. Railway Transportation

(1) General

358. Railway systems in the northern part of Sumatra are operated by the Indonesian State Railways (PJKA). A network of 1,052 km exists in North Sumatra region and 284 km in West Sumatra region. The two systems are unlinked and operated in separate manner as shown in Figures 39 and 40. At present both of the railways are predominantly used for freight transportation. The amounts of freight transported by railways in 1984 were 101 million ton.km in North Sumatra region and 66 million ton.km in West Sumatra region, while the amounts of passenger transported by railway in the same year were 195 and 0.79 thousand person.km respectively, as shown in Table 75.

359. Transportation by railways in the Region have very limited use at present compared to that of roads, mainly due to sharp competition with road and overall inefficiency in operation of railway system itself. Railway transportation has become restricted to Suburban passenger transportation and bulky estate product such as palm oil and rubber in the North Sumatra region and coal and cement in the West Sumatra region.

Table 75. Indicators of Railway Transportation (1984)

	Item	North Sumatra Railway	West Sumatra Railway
1)	Length of track (km)	1,052	284
2)	Gauge of track (mm)	1,067	1,067
3)	Number of locomotives	74	40
	(of which more than 20 years of age)	(23)	(7)
4)	Number of freight cars	1,490 *	296
5)	Number of passenger cars	29	12
6)	Freight loaded (1,000 ton)	598	1,260
7)	Freight Ton-Km (mil ton-km)	101	66
8)	Average haul of freight (km)	168	52
9)	Passenger transported (1,000)	1,525	22
10)	Passenger person-km (1,000 km)	195	0.79
11)	Average length of travel (km)	128	37
12)	Number of operating station	77	130
13)*	Revenues (Rp. million)	2,695	1,690

Note: * includes cars owned jointly with non-railway enterprises.
Source: BPS, Railways Statistics 1984.

(2) Characteristics and Issues in Railway Transportation

360. All the railways in the Region are single tracked with dilapidated operation system. The gauge of railways is 1,067 mm with exception on some branch lines in North Sumatra. Trains are hauled by diesel locomotives. Steam locomotives are mainly used for shunting. The maximum nominal tractive capacity is about 800 ton for North and West Sumatra regions. But it is pointed out that most of the locomotives are out-dated model with more than 35 years old and absolute number of locomotives as well as rolling stock are not enough to cope with expected increase in transportation by railway.

361. In general, almost all the railway related facility and equipment are deteriorating and thus their renewal or modernization is inevitable. Rehabilitation and maintenance of the existing system, rather than constructing of new line; seems to be the shortest way to

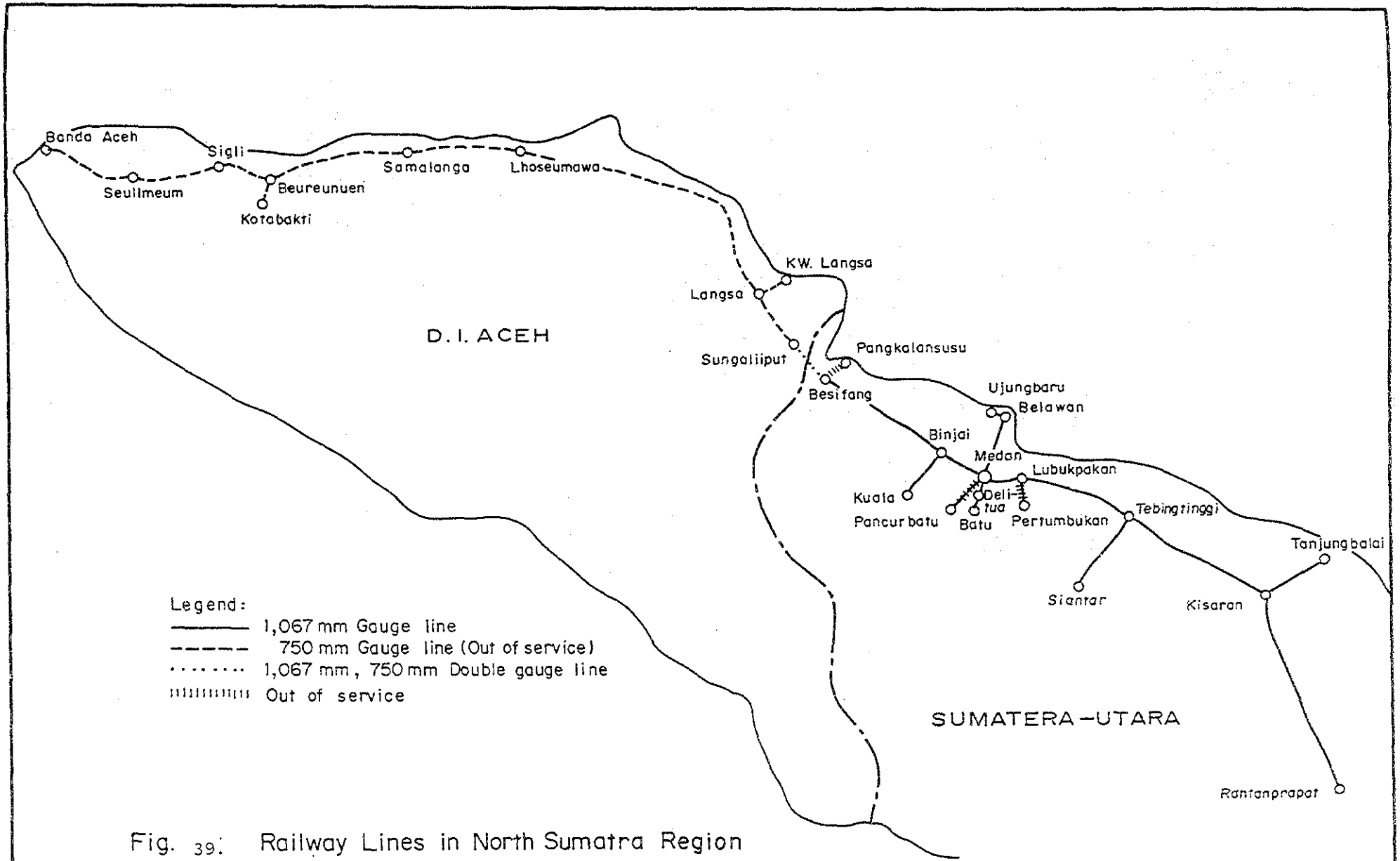


Fig. 39: Railway Lines in North Sumatra Region

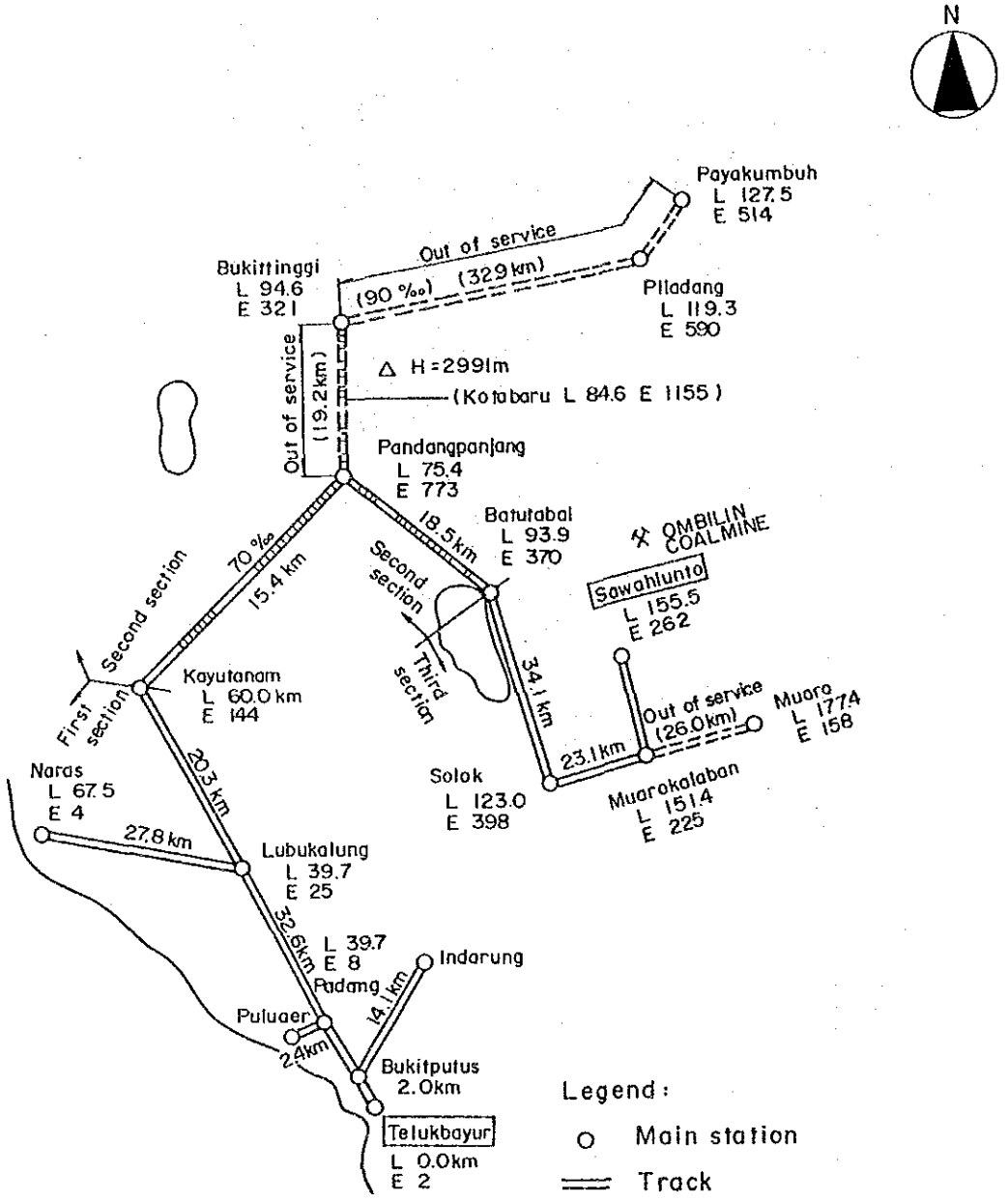


Fig. 40. Railway in West Sumatra Region

bring about the prospective future of railway in the Region. Among which rehabilitation of track and rolling stock seem to be urgent issue.

362. There also existed a narrow gauged railway with the width of 250 mm in Aceh region which run some 495 km long. This line is not functioning at present due mainly to the functional disadvantage compared with road transportation. But recently there is a strong request of revival of this line on the side of Aceh provincial government in junction with the industrial development in the areas along this railway.

363. Vast potential for estate development, in the Region compared to the relatively poor system in existing transportation sometimes requires the construction of new railway. The lines which connect Rantauprapat and Dumai, and extended line from Naras to the western coast of West Sumatra region are two of them still in their conceptual stage of planning. For these lines as well as for other existing lines, the regional developments in the surrounding areas are to be carefully monitored.

2.3. *Water Transportation*

(1) General

364. Since Indonesia is an archipelagic nation with total length of sea lane being more than 40,000 km, the vitalization of water transportation is one of the most urgent issues for the nation. This aims not only to encourage regional industries but also to enhance the level of consumption for local population by realizing a better system for freight distribution. The port of Belawan, which is one of the three major ports in Indonesia and located near Medan, plays a vital role both in international and in domestic trade. Dumai is the important port for the shipment of crude oil which is the primary product of Riau Province. Besides the above two ports, such ports as Telukbayur and Lhokseumawe play a very significant role in the water transportation in the Region.

365. Most of the sea lines originate from above-mentioned major ports and connect them with many small-scaled ports in the Region. With this regard, shipping services between the mainland and islands off the coast of Sumatra such as Weh (Sabang), Nias, Mentawai, Bintan and Batam are extremely important for socio-economic activities and integration of the Region.

366. On the other hand, inland water transportation plays an important role especially in Riau province, where vast swamp areas have historically restricted land transportation. As far as the foreseeable future is concerned, the importance of transportation through inland waterways will remain the same in the area. Location of major ports in the Region is illustrated in Figure 41.

367. Most of the area in the Region is covered with the hinterlands of main 10 ports as shown in Figure 42 schematically. As shown in the figure, Port of Belawan covers North Sumatra Province and Aceh Province. Ports of Telukbayur and Dumai cover West Sumatra Province and Riau Province respectively. At present, these three ports cover almost all areas in the Region. Port of Sibolga covers the west part of North Sumatra Province and plays important roles especially for Nias Island. In the meanwhile, other main ports cover rather small hinterlands around vicinities of the ports. In Riau Province, inland waterways are playing extremely important roles as mentioned above and

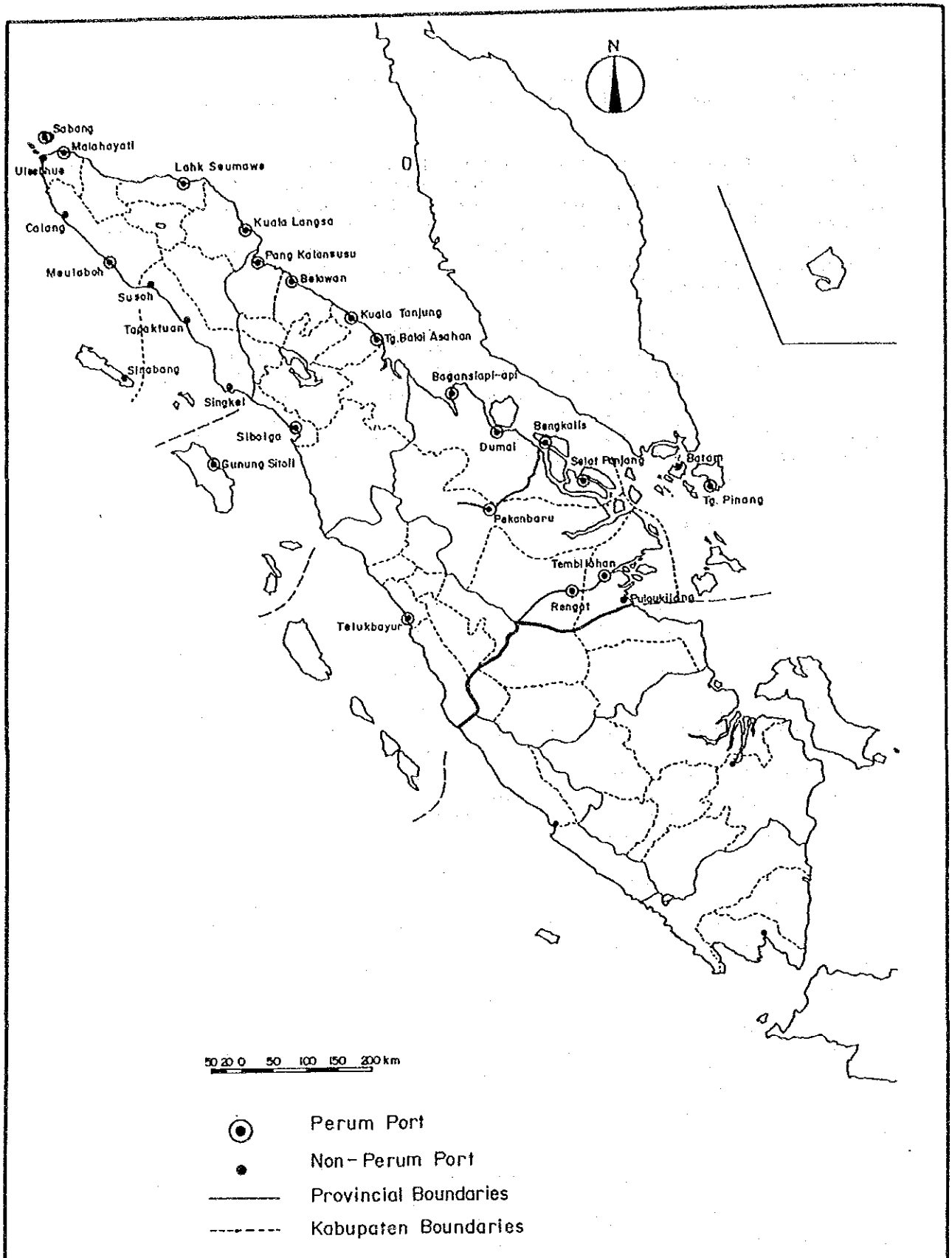


Fig. 41. Ports in the Northern Part of Sumatra

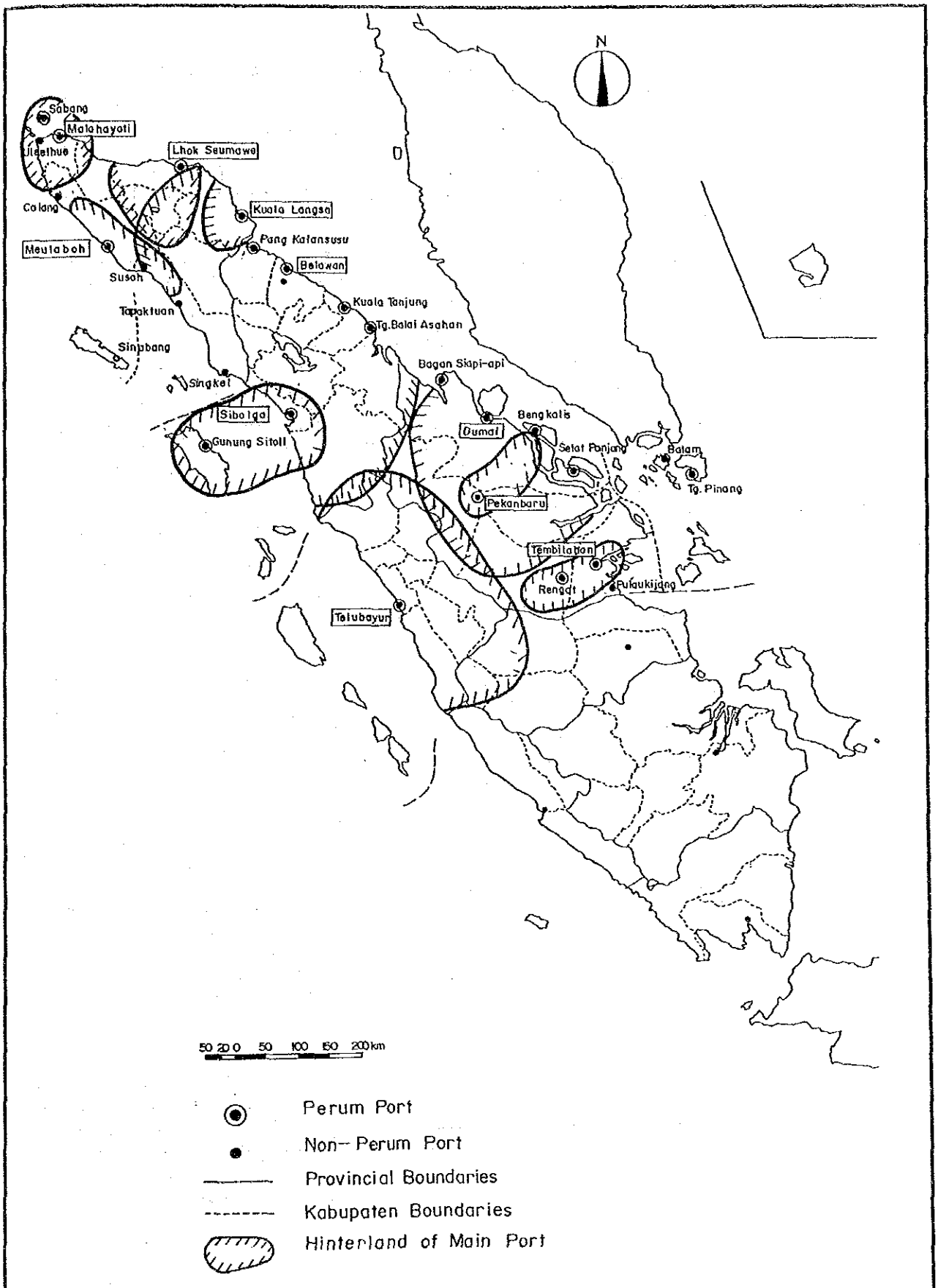


Fig. 42. Hinterlands of Main Ports

river basin areas for the Indragiri River and the Siak River are hinterlands of those river transportations.

(2) Characteristics and Issues in Water Transportation

368. Table 76 shows the statistics of calling ships for 10 main ports in the Region. From this table, several characteristics for calling ships are itemized as below:

- Number of calls is dominant in Ports of Belawan, Pekanbaru and Dumai. Liner foreign trade ships (Samudera) are also concentrated in these three ports.

- Average ship size of Port of Lhokseumawe is the largest among 10 ports due to large size of ships for gas and fertilizer transportation.

- Reflecting the sea transportation between small islands, number of small ships (Perahu) are dominant in Ports of Tembilahan, Sibolga, Pekanbaru and Dumai.

369. The amounts of cargoes for each of the ten major ports are illustrated in Figure 43, from which following characteristics in cargo handlings are pointed out:

- Concerning the amount of cargos, Port of Belawan is by far the largest and followed by Ports of Telukbayur, Lhokseumawe and Dumai.

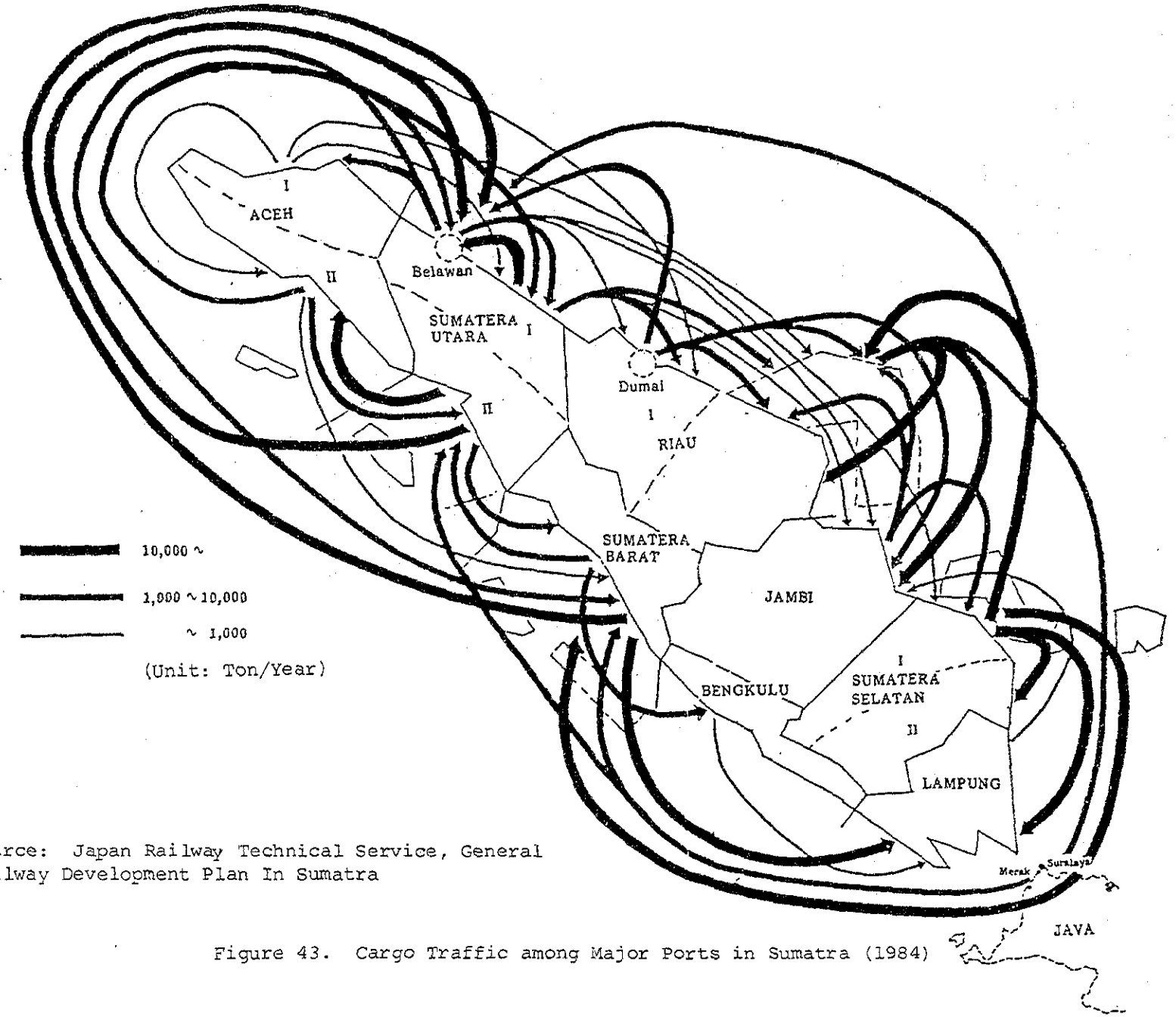
- Ports of Lhokseumawe and Dumai show very sharp increase in its handling amount of cargos reflecting the economic activities in the hinterlands. To the contrary, Port of Malahayati decreases rapidly due to the decrease of economic activities in Sabang which used to be free port from 1970 through 1985.

- In Port of Telukbayur, rehabilitation projects for infrastructures are on-going. After the completion of these projects, cargos are expected to increase rapidly. For the case of Port of Meulaboh, amount of cargos remains constant throughout these years, and it is apparent that the lack of facilities is main reason for this phenomenon.

- For Port of Tembilahan, international cargos are dominant because of export oriented agricultural products and for other ports, domestic cargos are dominant.

Table 76. Calling Ships in the Region (1988)

Ship Kind	Samudera		Nusantara		Khusus	
Port	Call	GRT	Call	GRT	Call	GRT
1. Belawan	1,456	6,245,414	1,973	4,351,028	112	1,119,542
2. Lhokseumawe	225	637,353	93	67,921	568	23,796,103
3. Dumai	713	19,654,115	258	535,480	385	3,712,748
4. Telukbayur						
5. Malahayati	8	3,417	52	206,202	192	654,908
6. Kuala Langsa	127	542,640	53	17,380	599	303,618
7. Meulaboh	56	145,904	95	95,553	237	97,679
8. Sibolga	39	416,848	145	281,355	97	165,526
9. Pekanbaru	621	3,917,612	227	172,544	1,356	1,565,803
10. Tembilahan	100	580,767	3	897	266	91,363



Source: Japan Railway Technical Service, General Railway Development Plan In Sumatra

Figure 43. Cargo Traffic among Major Ports in Sumatra (1984)

Ship Kind / Port	Local		Perahu		Total	
	Call	GRT	Call	GRT	Call	GRT
1. Belawan	464	427,552	0	0	4,005	12,143,536
2. Lhokseumawe	66	51,350	0	0	952	24,552,727
3. Dumai	529	40,264	411	16,581	2,296	23,959,188
4. Telukbayur						
5. Malahayati	450	194,367	0	0	702	1,058,894
6. Kuala Langsa	10	351			789	863,989
7. Meulaboh	19	2,222	0	0	407	341,358
8. Sibolga	1,087	95,294	535	68,881	1,903	1,027,904
9. Pekanbaru	657	137,757	496	21,521	3,357	5,815,237
10. Tembilahan	379	45,916	865	11,296	1,613	730,239

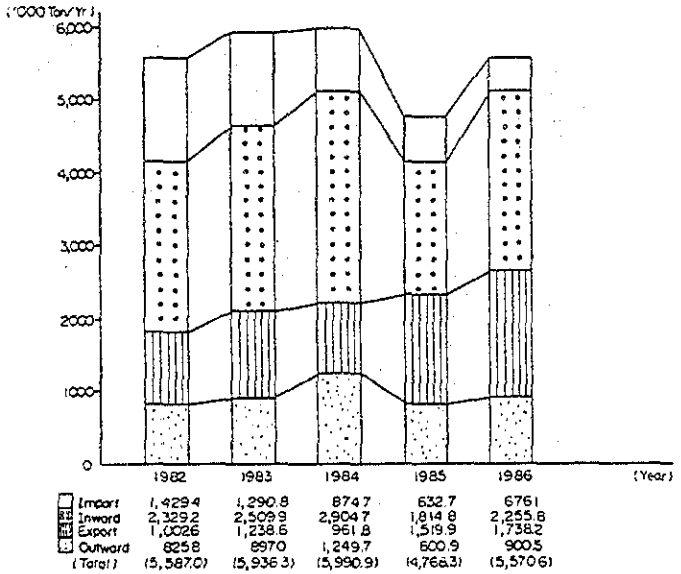
370. The flow of cargoes in the Region is schematically illustrated in Figure 44, from which several characteristics in water transportation are observed as below:

- Port of Belawan is the core of cargo flows in the whole Sumatra Island for all principal cargos.
- Port of Dumai plays an important role as cargo distribution center of the Riau Province.
- Cargo flows to/from West Sumatra is dominant along the west side of Sumatra Island. Port of Telukbayur, the biggest port in this region, functions as the key port for west side of Sumatra.

371. As for the physical condition of the major ports, main ports in the Region, except for Ports of Belawan and Malahayati, are located, in the vicinities of hinterland city. Belawan is connected with Medan by highway, and Malahayati is also connected with Banda Aceh by good conditioned road within 40 minutes. Accesses to main ports are roads except for Belawan and Tembilahan. Belawan is connected with the eastern part of North Sumatra by railways and currently container transportation by railways is under consideration. There is no road access to Tembilahan because of undesirable soil conditions for the developments of roads. In Riau swamp area, there are many ports which have no road accesses. Port of Kuala Enok is a typical example.

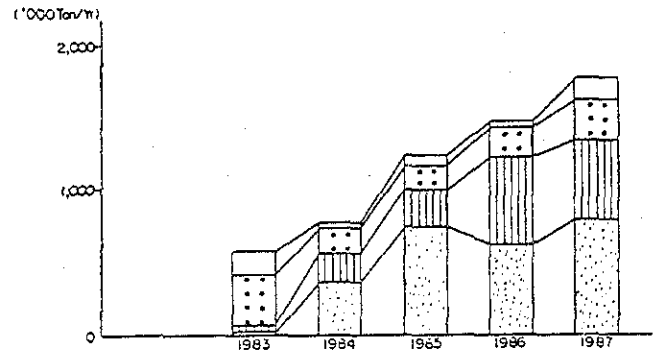
372. Most of ports are located in the shadow of capes where breakwaters are not required for the protection of waves. Among all main ports in the Region, Ports of Telukbayur and Lhokseumawe are only exceptions which have breakwaters to protect ports areas form ocean waves. Concerning berthing facilities, deep sea facilities which can accommodate ships more than 5,000 DWT are concentrated in the east coast of the Region. On the west coast, there are no deep sea facilities except for Port of Telukbayur. Total length of berthing facilities are rather limited except for Ports of Belawan, Lhokseumawe and Telukbayur. Besides Ports of Belawan and Telukbayur, main facilities are made of wood and many of them are obsolete conditions. Table 77 summarizes above described physical characteristics of main ports in the Region.

373. Inland waterways have been historically developed in the Sumatra Island. Especially in southern Riau Province, due to bad soil conditions, no main roads have not been developed in the swamp area and river transportation is the sole transportation means for cargoes and passengers. Inland waterways are also very important transportation means for the transmigrants mainly living near river basins throughout northern Sumatra. Table 78 shows the outline of the characteristics of inland waterways for each province. The number of existing inland



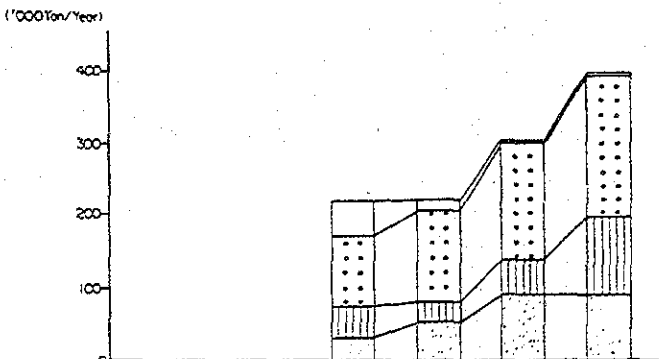
	1982	1983	1984	1985	1986
Import	1,429.4	1,290.8	874.7	632.7	676.1
Inward	2,329.2	2,509.9	2,904.7	1,814.8	2,255.8
Export	1,002.6	1,238.6	961.8	1,519.9	1,738.2
Outward	825.8	897.0	1,249.7	600.9	900.5
(Total)	(5,587.0)	(5,936.3)	(5,990.9)	(4,766.3)	(5,570.6)

(A) Port of Belawan



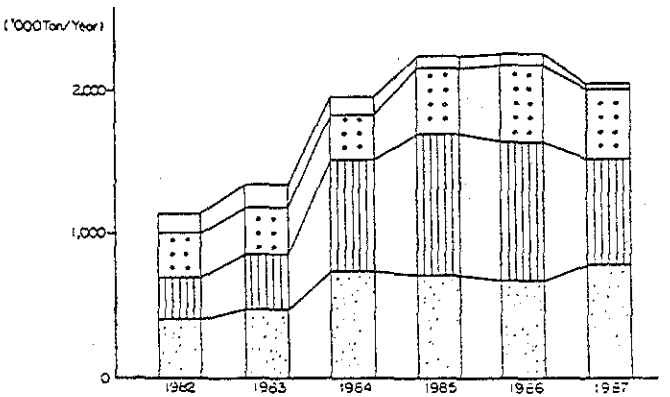
	1983	1984	1985	1986	1987
Import	170.9	29.4	70.1	47.6	157.4
Inward	354.3	174.5	164.7	201.1	283.1
Export	46.4	205.1	257.5	607.9	543.0
Outward	25.5	372.9	784.0	638.5	817.4
(Total)	(597.1)	(781.9)	(1,256.3)	(1,495.1)	(1,800.9)

(B) Port of Lohk Seumawe



	1984	1985	1986	1987
Import	48.1	14.0	17.0	15.4
Inward	94.3	123.9	147.3	187.2
Export	43.6	28.9	48.1	107.3
Outward	30.9	51.5	89.6	88.7
(Total)	(216.8)	(217.4)	(302.0)	(398.6)

(C) Port of Dumai



	1982	1983	1984	1985	1986	1987
Import	132.2	159.6	127.9	88.1	70.8	52.0
Inward	310.8	327.9	312.9	452.2	536.6	463.0
Export	280.3	375.5	772.2	981.7	962.8	729.5
Outward	418.1	478.4	737.1	711.2	677.6	779.4
(Total)	(1,141.4)	(1,341.4)	(1,956.1)	(2,233.2)	(2,237.8)	(2,043.9)

(D) Port of Telukbayur

Fig. 44. Trend of Cargo Handlings at Majon Ports (1)

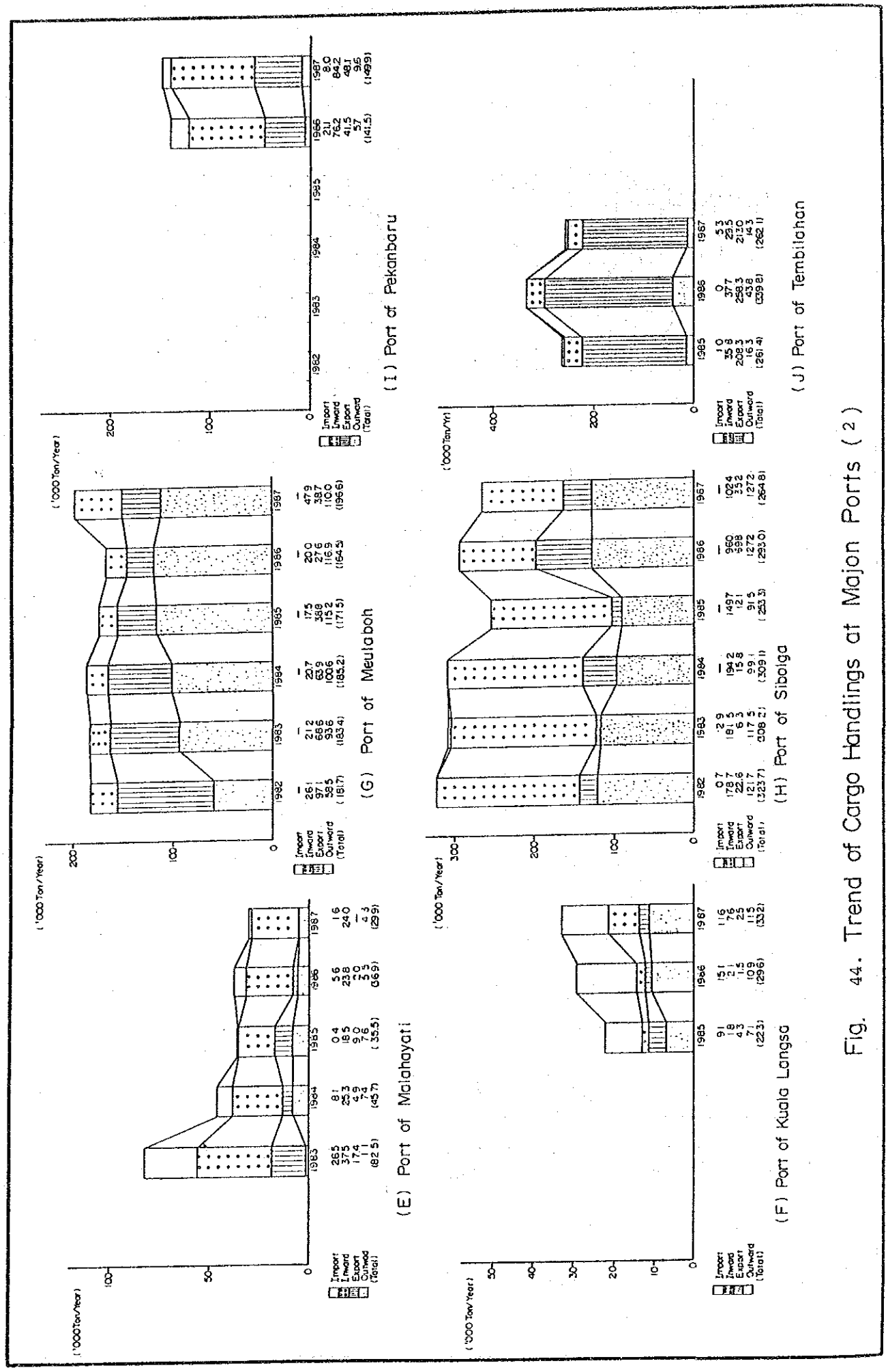


Fig. 44. Trend of Cargo Handlings at Major Ports (2)

Table 77. Physical Characteristics of Main Ports

Dimension	Belawan	Lhokseumawe	Dumai
	(Excluding Pertamina)	(Excluding MIGAS Facility)	(Excluding Pertamina)
1. Socioeconomic Conditions			
(1) Location	Lat. : 03 - 47' - 00"	Lat. : 05 - 15' - 00"	Lat. : 01 - 41' - 14"
	Lon. : 98 - 41' - 00"	Lon. : 97 - 02' - 00"	Lon. : 101 - 27' - 42"
(2) Nearest City	Medan (25km)	Lhokseumawe (in City)	Dumai (in City)
(3) Main Access	Road, Railway	Road	Road
2. Natural Conditions			
(1) Configuration	Mouth of Belawan River	Artifically dredged port	Protected by Rupat Island
(2) Waves	Calm	< 1.2m (81%)	Calm
(3) Tides (m)		1.74	2.58
(4) Littoral Drift	Maintenance dredging (4Mm3/y)	-------	Siltation
3. Facility Dimensions			
(1) Port Area (ha)			
(2) Breakwater (m)	-------	500+500	-------
(3) Berth			
(a) Depth (m)	-6.0 ~ - 11.0	-3.0 ~ - 10.0	-1.0 ~ -10.0
(b) Length (m)	3,634	830	532
(4) Handling Facility			
(a) Transit Shed (m2)	56,981	576	11960 (a+b)
(b) Warehouse (m2)	5,822	300	
(c) Yard (m2)	101,854	5,000	18,823
(5) Handling Equipment			
(a) Quay Cranes (unit)	4	6	3
(b) Loader & Unloader (unit)	0		
(c) Forklift (unit)	44	4	12

Dimension	Telukbayur	Malahayati	Kuala Langsa
1. Socioeconomic Conditions			
(1) Location	Lat. : 01 - 00' - 00"	Lat. : 05 - 35' - 50"	Lat. : 04 - 33' - 00"
	Lon. : 100 - 23' - 00"	Lon. : 95 - 30' - 35"	Lon. : 98 - 03' - 00"
(2) Nearest City	Padang (7km)	Banda Aceh (32km)	Langsa (8.0km)
(3) Main Access	Road	Road	Road
2. Natural Conditions			
(1) Configuration	Northern end of semicircular bay	Protected by cape	Mouth of river
(2) Waves	< 2.5m (95%)	< 0.4m	Calm
(3) Tides (m)	1.7	2.2	2.3
(4) Littoral Drift	-------	Sedimentation around berth	
3. Facility Dimensions			
(1) Port Area (ha)			
(2) Breakwater (m)	800+275	-------	-------
(3) Berth			
(a) Depth (m)	-6.0 ~ -9.5	-9.0	-8.0 ~ -10.0
(b) Length (m)	1,050	100	100
(4) Handling Facility			
(a) Transit Shed (m2)	8,000	800	1,260
(b) Warehouse (m2)	5,400		
(c) Yard (m2)	11,133	2,000	5,000
(5) Handling Equipment			
(a) Quay Cranes (unit)	2	1	0
(b) Loader & Unloader (unit)		0	0
(c) Forklift (unit)	15	4	1

Table 77. Continued.

Dimension	Meulaboh	Sibolga	Pekanbaru
1. Socioeconomic Conditions			
(1) Location	Lat. : 04 - 07' - 50"	Lat. : 01 - 44' - 23"	Lat. : 0 - 32' - 42"
	Lon. : 96 - 08' - 00"	Lon. : 98 - 46' - 04"	Lon. : 101 - 26' - 00"
(2) Nearest City	Meulaboh (in City)	Sibolga (in City)	Pekanbaru (in City)
(3) Main Access	Road	Road	Road
2. Natural Conditions			
(1) Configuration	Protected by cape	Protected by cape & island	River port (width 70m)
(2) Waves	Calm	Calm	-------
(3) Tides (m)			-------
(4) Littoral Drift	Siltation		
3. Facility Dimensions			
(1) Port Area (ha)			
(2) Breakwater (m)	-------	-------	-------
(3) Berth			
(a) Depth (m)	-1.2	-1.8 ~ - 5.5	-6.0
(b) Length (m)	55	244	281
(4) Handling Facility			
(a) Transit Shed (m2)	300	2,000	
(b) Warehouse (m2)		900	1,920
(c) Yard (m2)	2,500	2,433	2,640
(5) Handling Equipment			
(a) Quay Cranes (unit)	1	1	2
(b) Loader & Unloader (unit)	0	0	0
(c) Forklift (unit)	2	4	9

Dimension	Tembilahan	Sabang	Gunung Sitoli
1. Socioeconomic Conditions			
(1) Location	Lat. : 0 - 19' - 40"	Lat. : 05 - 53' - 0"	Lat. : 01 - 17' - 28"
	Lon. : 103 - 09' - 41"	Lon. : 95 - 10' - 0"	Lon. : 130 - 09' - 41"
(2) Nearest City	Tembilahan	Sabang	Gunung Sitoli
(3) Main Access	River	Road	Road
2. Natural Conditions			
(1) Configuration	River port	Weh Island	Nias Island
(2) Waves			
(3) Tides (m)	4 ~ 5 m		
(4) Littoral Drift			
3. Facility Dimensions			
(1) Port Area (ha)			
(2) Breakwater (m)			
(3) Berth			
(a) Depth (m)	-4.0	-8.0 ~ -9.0	-3.0 ~ -11.0
(b) Length (m)	172	328	135
(4) Handling Facility			
(a) Transit Shed (m2)			
(b) Warehouse (m2)		11,399	360
(c) Yard (m2)		7,100	1,824
(5) Handling Equipment			
(a) Quay Cranes (unit)	0	0	0
(b) Loader & Unloader (unit)	0	0	0
(c) Forklift (unit)	0	1	0

waterways port in the Region is shown in Table 79, and the inland waterways fleet is shown in Table 80.

Table 78. Outline of Inland Waterways

Name of Province	Number of Navigable Rivers	Total Length of Rivers (km)	Total Navigable Length (km)
Aceh	9	1,497	635
North Sumatra	17	1,780	1,347
West Sumatra	6	1,960	701
Riau	18	2,471	1,819
Total	50	7,708	4,502

Source: Directorate General of Land Communications

Table 79. Existing Inland Waterways Infrastructure in 1987

Province	Inland Waterways Terminals (Government Owned)
Aceh	10
North Sumatra	17
West Sumatra & Jambi	30
Riau	7

Table 80. Inland Waterways Fleet (1988)

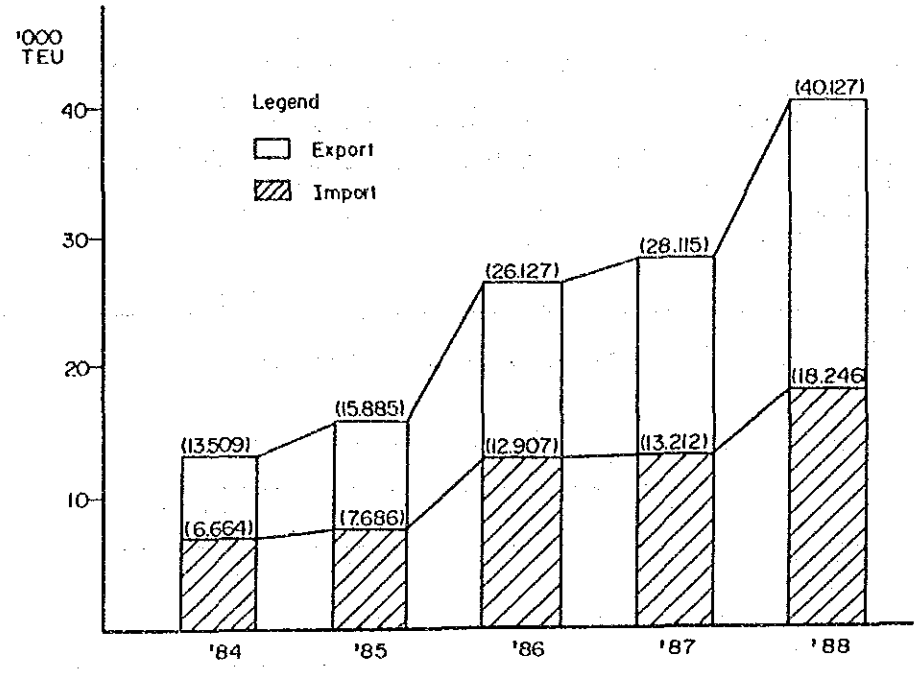
Province	Type of Fleet				Total		
	Cargo & Pass	Tug Boat	Barge	Others	Fleet	GRT	Horse Power
Aceh	1,326	38	46	439	1,849	28,719.83	-
North Sumatra	614	47	58	230	949	3,122.71	-
West Sumatra & Jambi	2,231	92	659	2,725	5,707	89,853.32	121,346
Riau	5,110	55	1,769	1,406	7,267	118,824.42	-

374. Finally, it should be remarked about containerization. Port of Belawan is the only one port which is furnished with container berths in the Region. Although containers have been handled also in Port of Telukbayur, these numbers are limited and currently multi-purpose berth is under construction for the increasing demand for containers. Figure 45 shows the trend of container movement through Port of Belawan. Volume of containerized cargo has been increasing constantly and in 1988 the volume amounts to 429,433 tons (40,127 TEUs) of which export is dominant, shares about 2/3. Containerization ratio (defined as volume of containerized cargo/volume of general cargo) is about 10% as shown in Figure 45. Containerization ratio stays relatively low due to the lack of facilities, however, after the completion of Phase II development plan, the ratio is expected to increase rapidly reflecting the role of Port of Belawan in the Region.

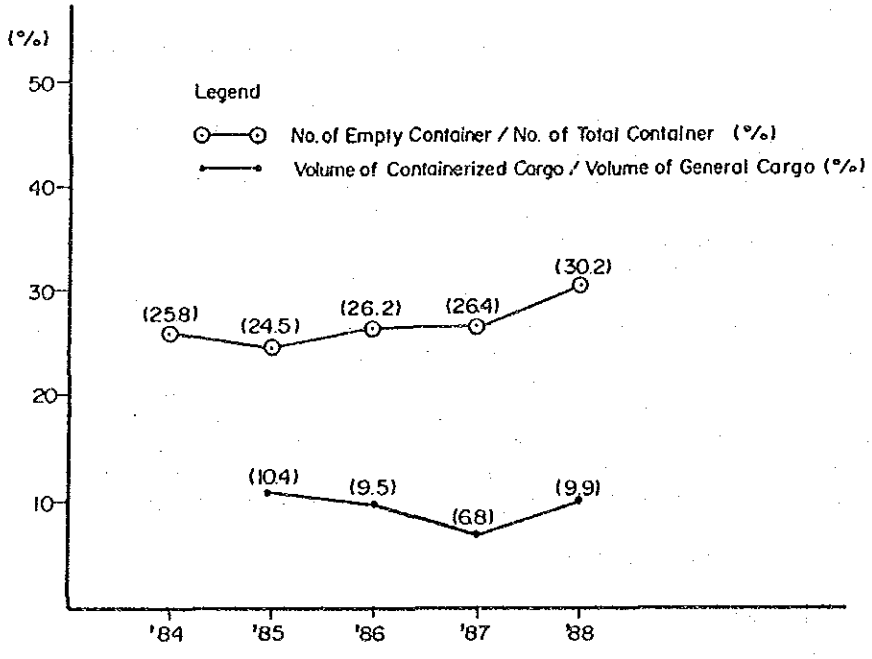
2.4. Air Transportation

(1) General

375. The air transportation network in Indonesia is fairly well developed compared to other developing nations for her archipelagic formation in geography. The regular routes of civil aviation are shown in Figure 46.



Trend of Containerized Cargo (TEU)



Empty Container Ratio & Containerization Ratio

Fig. 45. Recent Trend of Containerization in Port of Belawan

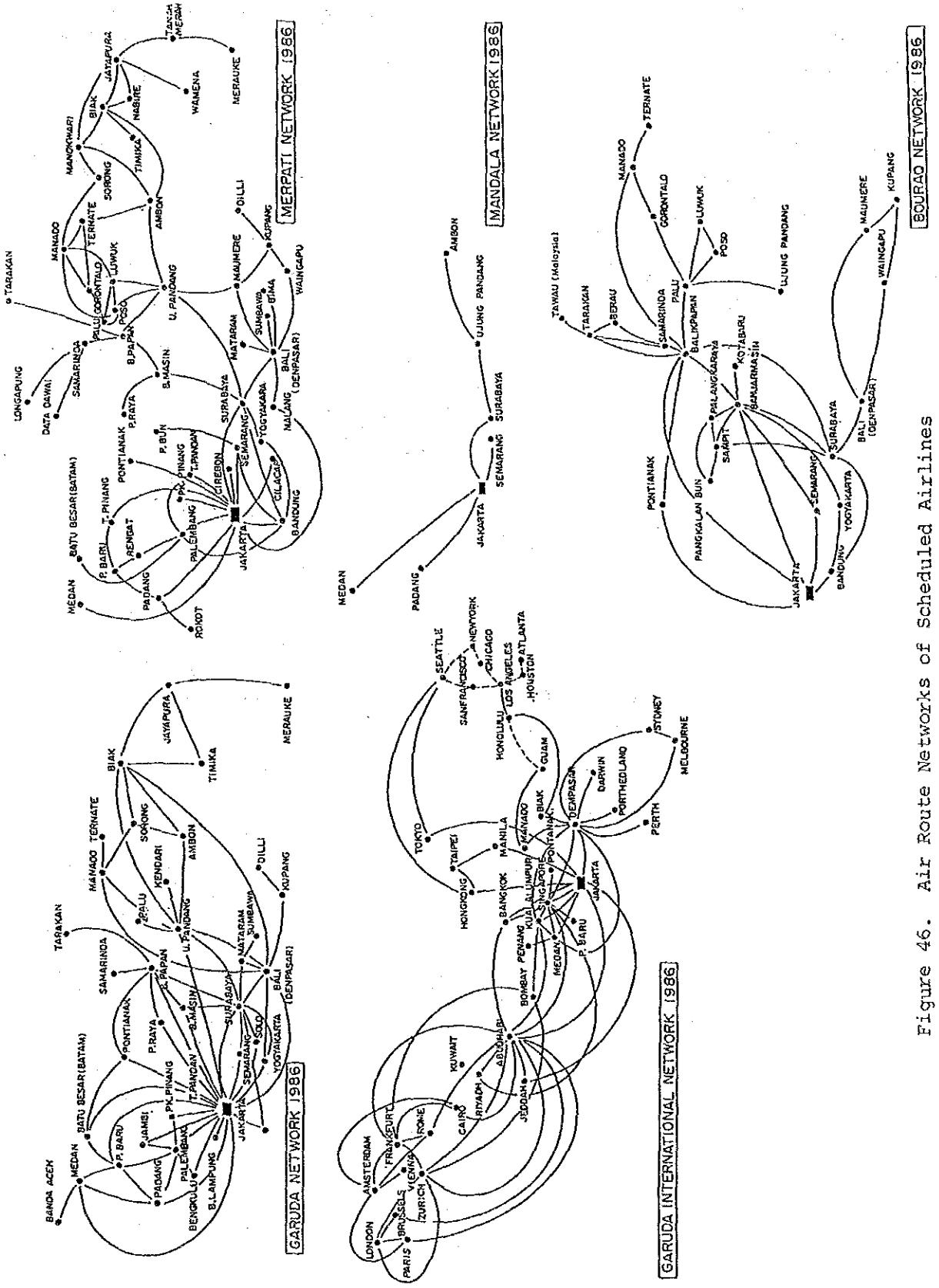
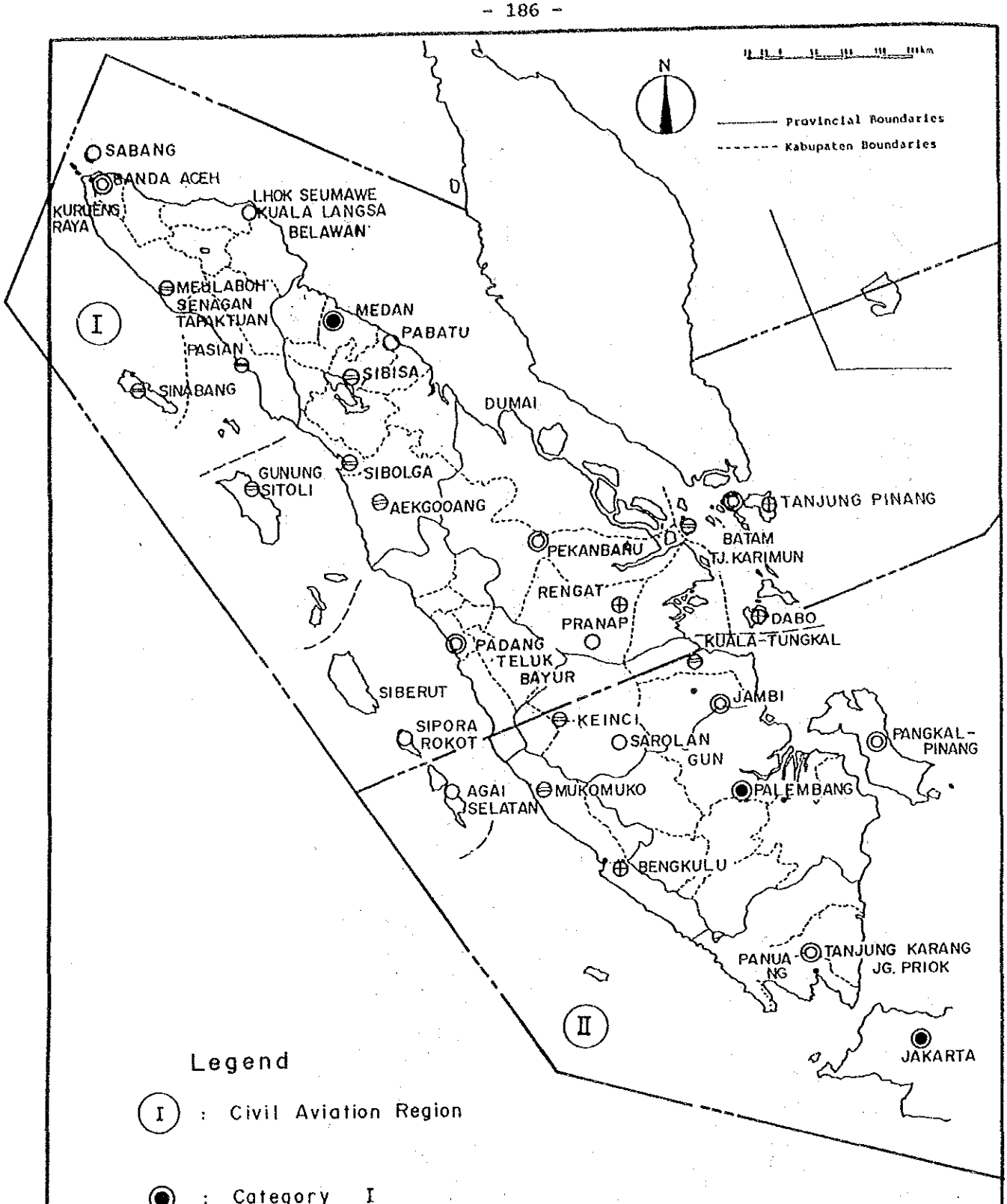


Figure 46. Air Route Networks of Scheduled Airlines



Legend

(I) : Civil Aviation Region

◉ : Category I

◎ : Category II

⊕ : Category III

⊖ : Category IV

○ : Category V

Fig. 47. Location of Airport by Classification of Port

376. In the Region, Medan, Padang, Pekanbaru, Banda Aceh and Batam are major airports receiving scheduled flights. All the airports in the Region are under the control of No. I Civil Aviation Region among 6 of these Regions set forced by Directorate General of Air Communications as shown in Figure 47.

377. According to the legislation by the Civil Aviation Bureau in Indonesia, all the airports are classified into five (5) categories as below:

Category-I. International/Regional, Major Airport
Category-II. Regional, Border/Major Airport
Category-III. Provincial, Feeder Airport
Category-IV. Municipal, Pioneer Airport
Category-V. Municipal, Pioneer Airport

Location and classification of major airport in the Region are shown in Figure 47.

(2) Characteristics and Issues in the Air Transportation

378. The number of passengers at major airports are shown in Table 81. Figure 48 illustrates inter-airport passengers among major airport in the Region. From which following characteristics in air transportation are derived:

- International airservices are conducted mainly at Medan airport to and from neighbouring countries such as Singapore and Malaysia.
- Capitals of four provinces (Banda Aceh, Medan, Padang and Pekanbaru) are centers of intra-regional air transportation.
- The numbers of passenger to and from Jakarta are dominant in any major airport.

Table 81. Passengers at Major Airports (1986)

(1) Domestic

Unit: person

Airport / Description	Blang Bintang Banda Aceh	Polonia Medan	Tabin Padang	Simpang Tiga Pekanbaru
Departure	22,794	349,190	61,356	127,329
Arrival	20,487	330,390	58,447	144,440
Transit	-	14,617	6,466	17,747

Airport / Description	Kijang Tg. Pinang	Japura Rengat	Dabo Singkep
Departure	35,326	16,347	5,923
Arrival	32,778	15,097	5,847
Transit	4,041	1,918	2,467

(2) International

Unit: person

Description \ Airport	Polonia Medan	Simpang Tiga Pekanbaru	Kijang Tg. Pinang
Departure	98,282	11,174	88
Arrival	106,663	11,959	827
Transit	-	5,602	475

Source: BPS, Air Transport Statistics 1986

379. Relating to the air transportation in the Region, following issues are pointed out, although these are not peculiar issues to the Region but to whole of the Indonesian air transportation.

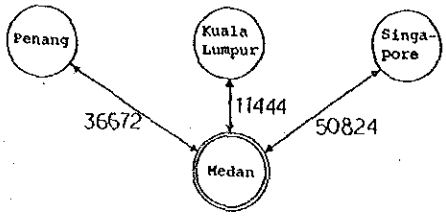
- Due to the newly operation of larger aircrafts such as A-300, most of the airport facilities including run-ways are to be improved for the landing and take-off of these aircraft.

- Most of the airport facilities are out dated and under capacity for expected increase in air transportation, which along with the recent trend explained in (1), entail the compilation of airport master plan.

- Telecommunication, air navigation and electric facilities are not always reliable as most of these facilities have been installed as old as in 1970s. It is urgent to remodel and upgrade these facilities. In addition, proper steps are to be taken for the improvement of safety.

- Regulation and legality for the air traffic should be modernized to cope with the rapid growth of air traffic.

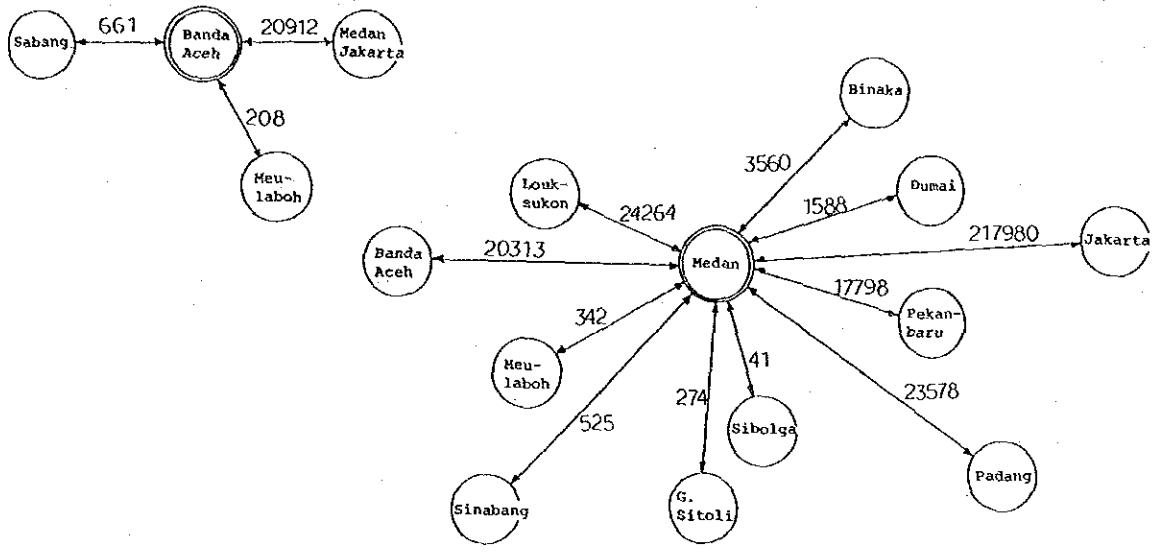
380. Physical condition of airport and type of airplane in operation at some of the airports in the Region are listed in Table 82. From this table along with the site survey conducted by the Study Team, present issues for major airport are itemized as shown in Table 83.

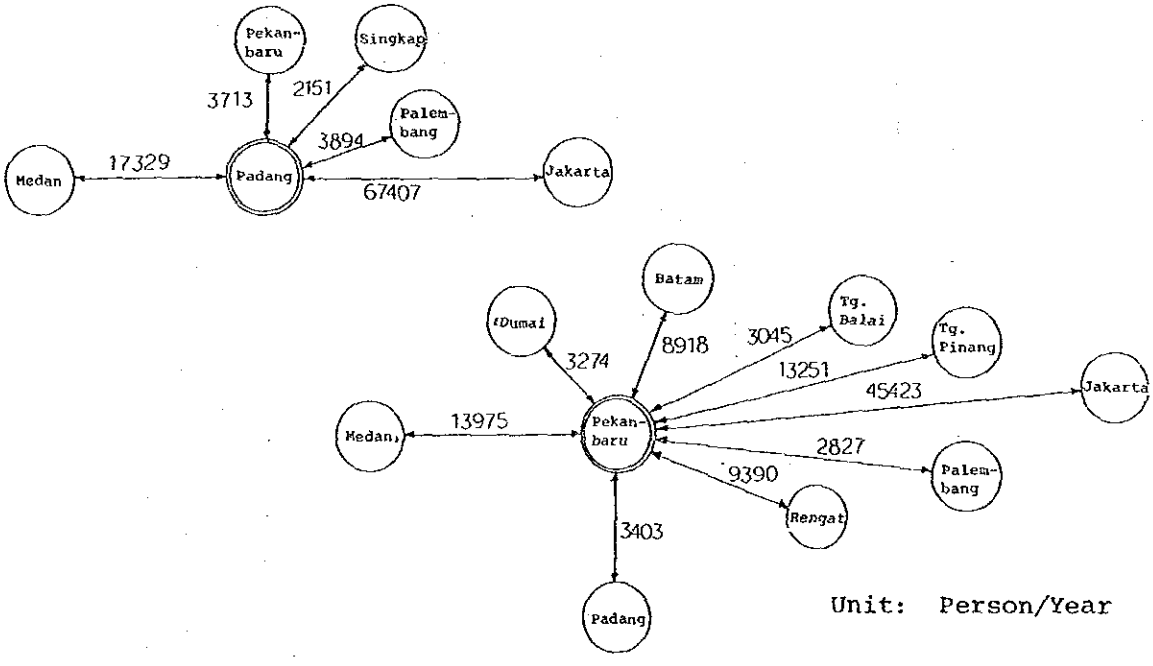


Unit: Person/Year

Figure 48-1 Traffic Flow at Medan Airport
International Passenger-1985

Source: DJPU





Unit: Person/Year

Figure 48-2 Traffic Flow at Major Airport
Domestic Passenger-1985

Source: DJPU

Table 82. Physical Condition of Major Existing Airports

CITY/AERODROME	COORD LOCATION	ELEVATION (FEET)	LANDING AREA						– Authority/ super vising – Unlimited Use Critical A/C – Restricted Use Critical A/C
			DIMENSION (IN METER)				SURFACE	R/W strength –Grossweight (in lbs.) –Declared R/W LCN	
			RUNWAY	TAXIWAY	APRON	STRIP			
2	3	4	5	6	7	8	9	10	11
BLANG BINTANG-BANDA – ACEH	05.31 N 095.25 E 6 NM.ESE	62 17/35	1850x45	200x23	210 x 96	160x1970	ASPHALT CONCRETE	84000/1 108.000/2 LCN 45	DGAC U : FOKKER 28 R : DC 9
DABO–SINGKEP	00.29.S 104.35.E 1,5 NM.NE	95 14/32	1175x30	110x15 110 x 15	40 x 25	100 x 1295	ASPHALT CONCRETE	30.000/1 40.000/2 LCN.14	DGAC U : F. 27
JAPURA–RENGAT	00.20.S 102.19.E	61 10/28	1300x30	150x18	225 x 90	150x1420	ASPHALT	30.000/1 45.000/2 LCN. 16	DGAC U : F - 27
KIJANG TG. PINANG	00.55 N 104.32 E 7.5. NM.E	56 04/22	1400x30	227x18 227 x 18	125 x 50	150x1520	ASPHALT	30.000/1 42.000/2 LCN 16	DGAC U : F - 27
SIMPANG TIGA PAKAN BARU	00.28 N 101.27 E 4.4 NM.S	102 18/36	1850 x 30	90x23 90x18	100 x 90 100 x 90	150 x 1970	ASPHALT CONCRETE	52.000/1 65.000/2 LCN 22	DGAC U : F - 28 R : DC 9 – 32
PINANG SORE SIBOLGA	01.33 N 098.53 E	33 12/30	1400x30	170x18	45 x 190	90 x 1520	ASPHALT	30.000/1 40.000/2 LCN 14	DGAC U : F 27
POLONIA - MEDAN	03.34 N 098.41 E 1 NM.S	39 05/23	2900x45	150X23 330x23	150 x 80 555 x 110	300x3100	ASPHALT CONCRETE	145.000/2 550.000/4 300.000/4 LCN. 75	DGAC U:B747 U : DC 9 VANGUARD U. DC. 10 SR. 30 U. A. 300
TABING-PADANG	00.53 S 100.21 E 5 NM. N	19 16/34	2150x45	150x23	230 x 90	225 x 2350	PCEMENT CONCRETE	180.000/2 LCN.60	DGAC/IAF U : DC 9 - SR 32
CUT NYAK DHIEN-MEULABOH	04.15 N 096.13 E	3 15/33	750 x 23	75x18	60 x 40	810x80	ASPHALT PENETRASI	25.000/2 LCN 6	R : CASSA 212

Source: DJPU.

Table 83. Present Issues of Existing Airport

Airport	Location	Perspectives for Development
Banda Aceh	Aceh	- Runway - Airport facility - Flight safety
Meulaboh	Aceh	- Airport facility - Flight safety
Nias Island	North Sumatra	- Airport facility - Flight service
Medan	North Sumatra	- Airport facility - Flight safety
Padang	West Sumatra	- Airport facility - Flight safety
Siberut Island	West Sumatra	- Airport facility - Flight service
Rengat	Riau	- Airport facility - Flight safety
Tanjung Pinang	Riau	- Airport facility - Flight safety
Singkep	Riau	- Airport facility - Flight safety
Pekanbaru	Riau	- Airport facility - Flight safety
Bangkalis	Riau	- Airport facility - Flight safety
Batam Island	Riau	- Runway

3. Identification of Development Potential

3.1. Nature of Transportation Issues in the Region

381. It seems oppotune to analyze the nature of transportation issues in the Region, before the articulation of individual region's characteristics in transportation issues. In sum, the issues in transportation seem to come from "unlinkaged" or "disintegrated" nature of existing transportation system. This is not only in locational terms but in functional terms.

382. In fact the words "unlinkage" or "disintegration" in this context, contains a variety of activities in the Region. In one sense, it might be lack of sufficient provision of transportation service to the whole of the area, and another might be lack of smooth transportation activities among industries within the region, and sometimes, they might be inefficient pattern of modal choice among competitive modes of transportation or lack of interdependent relation among the modes.

383. As it has been shown in the preceeding study, the economy in the Region is still in the premature stage for the nation's economical "take off" to the industrialized nation. The backbone of the transportation network has just provided with the opening of trans-Sumatra highway, length of railway is still short and disjoint within the Region, and functionally interdependent relation between port and land transportation has not yet been established. Like that way, all of the issues in transportation are deemed attributed to unlinked or disintegrated disposition of activities as shown in the schematic relation below (Figure 49):

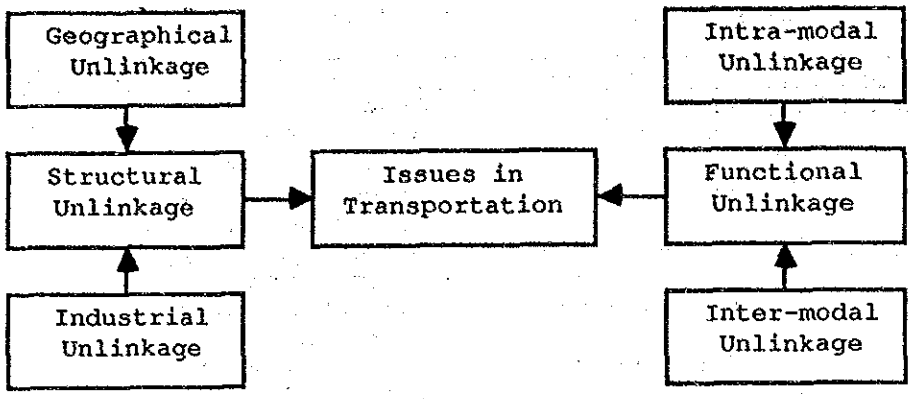


Figure 49. Relationship of Transportation Issues

(1) Structural Unlinkage

384. Structural unlinkage consists of two types of unlinkage here, one is geographical and the other is industrial as explained below:

Geographical Unlinkage

As the Region is vast with a variety of geographical condition as well as the historical pattern of development, most of the transportation facilities are not homogeneously distributed. In other words, transportation services available differ by regions. Besides it even the linkages among transportationally developed areas, such as those among provincial capitals, are not fully provided. Existence of steep mountain and vast swamp area and shortage in absolute amount of investment in the past are main factors behind the phenomenon. Compared to the north to south axis, east to west axis is not well linked due to the steep mountains which traverses the area from north to south direction. This fact along with the vast swamp mainly in the east coastern area in the Region has forced the intraregional interdependence in transportation to locally isolated one.

Industrial Unlinkage

Self-reliant style of community life which had continued until the beginning of modernization of the nation, has not entailed so much economic linkages among the mutually isolated communities which has hampered the creation of industrial structure oriented to inter-regional industrial dependency. In other words, highly advanced input-output relation among the industrial products has not yet been attained in the economy of the Region. Transportation demand for both industrial material/products and for trip for business have been very limited to the domain of rather developed localities. With the more location of modern and sophisticated industries which based on the usage of local product, the transportation network should be provided so as to strengthen the industrial interdependence.

(2) Functional Unlinkage

385. Functional unlinkage here is defined as the disjointed nature of transportation system originated in itself. This unlinkage is classified into two categories for its nature, one is the unlinkage within same mode of transportation and the other is unlinkage among different modes of transportation.

Intra-modal Unlinkage

Substandard provision of transportation facilities is sometimes apt to force considerable amount of inefficiency to the transportation even within the same categories of transportation facilities, say road, railway, and water transportation. As for the road, poor provision of road, due to malfunction of pavement and bridges and to shortage in absolute length and inadequate capacities of vehicles force transportation on road to very inconvenient one. Road networks, as well as high standard of individual road, which realize efficient road transportation should be established in a future, in which the functional role of individual road, linehaul, feeder in terms of transportation of freight and passenger are to be clearly defined.

Same is true of other modes of transportation, rail, ship and airplane. The rail in North Sumatra has two types of gauge; one is 1,067 mm and the other is 750 mm. This difference of gauges has been forcing tremendous diseconomy in the fact that unnecessary loading and unloalding must be done at the junctions. Continuous and high standard railway system which saves these chores is essential to be established in near future. As for the port and airport, same kind of inefficient handlings of cargoes and passengers are still common. Transportation development planning with having internal consistency within the same mode at least is being awaited.

Inter-modal Unlinkage

Finally, there also exists inconsistency among the transportation on different modes. This could be seen especially at the hinterland of large ports such as Belawan and Telukbayur. Cangoes once embarked and/or disembarked have to go through poor management of loading and/or unloading due to the poor provision of transportation access to the port area, along with the substandard capacities of transfer facilities such as warehouse and transit house. It is inevitable that comprehensive transportation planning not only for port cargoes but for overall transportation system in the Region should be introduced for the realization of efficient transportation system.

3.2. Characteristics in Transportation and Development Potential

386. Corresponding to the above recognition of the nature of the transportation in the Region, region-wise characteristics in transportation and perspectives for future development are set forth as shown in Table 84.

B. Proposition of Development Strategy

1. Basic Stance for Future Regional Development

1.1. Role of Regional Economy in the Region

387. It is expected that the Region would play important roles in the Indonesian Development toward the "take-off" and beyond. Specifically, the Region is expected to manuever the following roles:

Table 84. Characteristics in Transportation Issues and Perspectives for Development

Characteristics in Transportation	Perspectives for Development
Aceh	
An unbalanced development pattern exists between the east and the west coast	Improvement of roads along the west coast (Reconstruction of bridges on trunk road)
Most major cities are located along the coastline.	Easy connection between the east coast and the west coast
The central or inner part lack a road network which links to these cities on the coastline.	Vitalization of corridors along the east coast of the Province (upgrade of trunk road, revival of railway).
Southern half of the province holds strong socio-economic connection with North Sumatra province.	
Industrial development is proposed for the areas on the east coast. On the other hand, agricultural development is proposed for the areas on the west coast.	
Small- and medium-sized ports along the coastline play an important role as the centers of production as well as distribution.	Upgrading of port facilities, expansion of port capacities (Lhokseumawe, Langsa, Meulaboh, Malahayati, Tapaktuan, etc.).
Situated at the northern end of Sumatra island.	Vitalization of air transportation service to isolated island in the province and other parts of nation.
North Sumatra	
East coast of Medan is heavily located with manufacturing industry	Upgrading of trunk roads.
Two distinct sub-provincial regions exist: the east and the west coast. More homogeneous development is needed within the province.	Vitalization of feeder road service (especially in the hinterland of the port of Sibolga and in areas near the border of West Sumatra province).
A heavy concentration of urban facilities is seen in the city of Medan.	Improvement of the urban transportation system in Medan (railways, buses, roads, etc.).

Water transportation is concentrated in the port of Belawan.	Introduction of new transportation link which connects to the northern part of Riau (trunk road, railway).
Areas located near the border of Riau, are relatively hindered from economic development.	
Rich potential in tourism development exists in the province (Lake Toba, Karo heights, Nias island).	Transportation facilities improvement in line with tourism development (airport, roads, ferry, etc.).
Relatively weak linkage between Tapanuli area and east coast of province along the center of province (nearby Asahan).	Vitalization of trunk road in the central area of province which connects Tapanuli area with the area in the east coast.
Nias Island is isolated and left behind from development.	Strengthening of transportation between the Nias island and mainland (Sibolga).
North corner of the west coast is hindered from development.	Construction of strategic road for regional development.
West Sumatra	
Cities and towns are scattered relatively evenly within the province, although the geography here is rich in variety.	Introduction of better road linkages among the major cities.
Industries are diversified compared with other province.	Improvement of transportation (roads or railways) which connect between mining and agricultural centers with the city of Padang.
Areas in north and south corners along the west coast are remained undeveloped.	Introduction of roads in the coastal areas and new roads which traverse the province from east to west.
Potentials for agriculture, mining and tourism are great.	Improvement of road facilities including bridges.
Potential transportation to and from the neighbouring provinces is hindered by the lack of transportation networks.	Upgrading of the Telukbayur port as a vital point for trade with other provinces and foreign countries.
Islands off the west coast of the province are isolated from the mainland and have been hindered from development.	Better linkage between mainland and islands off the west coast of the province (Mentanai islands).
Relatively heavy concentration of urban facilities is seen centered around the city of Padang.	Improvement of urban transportation system in Padang.

Riau

A vast marshland and tropical rain forests have been obstacles for the development of the province.	Need of roads which connect cities and towns within the province. Reconstruction and new construction of bridges over the rivers.
Plantation development is intended in large scale along the east coast of the province.	Expansion of the Dumai port as a gateway port for Riau.
Urban facilities are concentrated in the city of Pekanbaru and Dumai.	Vitalization of transportation centered around the port of Dumai and the capital city of Pekanbaru.
Many settlements are along the riversides taking advantage of river transportation.	Improvement of inland waterway.
Connection with neighbouring provinces except for West Sumatra is poor due to the lack of transportation network, mainly due to geographical reason.	Need of interregional linkages with nearby provinces (particularly North Sumatra and Jambi).
The province has close relation with Singapore and Malaysia.	Vitalization of international transportation.
Many islands including Batam island are under the administration of this province. Batam island and nearby islands are growing their tie with Singapore.	Vitalization of sealines which connect small and medium-sized ports (e.g. Tg. Pinang and Singkep). Pioneer airport.

- Foodstaff production base for domestic consumption (local, Sumatra and Indonesia)

- Major exporter, foreign exchange earner (oil/gas, agricultural products, manufactured goods and tourism)

- Largest industrial base outside Java

- Major recipient of migrants from Java (via urban growth and transmigration)

- Integration of the Region's potentials as a strong supporter of the national development

388. In this context, the transportation planning in the Region has dual meanings. First, transportation planning should be conducted so as to smoothen the ongoing economic activities through the provision of satisfactory standard of service level to the users. Second, transportation should be conducted in a manner in which regional development effect becomes maximum through the innovation in transportation system. In other words, transportation planning should be done so that the Region's economic potential may be enhanced so as to attain above goals in the Region.

1.2. Planning Principle

389. Reflecting upon the world-wide tendency of various levels of planning which is oriented toward income approach (small scale, non bureaucratic and equity oriented) rather than output approach (big scale and growth oriented), modest and steady stance with minimum output approach for regional plannings are to be widely accepted. Therefore, following principles were introduced for the transportation study here:

- Small but output efficient projects are to be emphasized

- Maintenance and rehabilitation, rather than new construction of infrastructure with large scale, are to be emphasized
- Aspect of equity among the components of the soceity is to be kept in mind.

1.3. Planning Phase

390. As is generally known, innovation in transportation facility creates regional development effects on surrounding areas. This will be phenomenized in stronger inter-industrial relationship or regional inter-dependence resulted from the innovation of the transportation system. Therefore, in the formulation of transportation planning, these interdependences among socio-economic sectors should be carefully taken into consideration. Generally, impacts or indirect effects of transportation innovation will appear with a time lag: some of the impacts will appear in a short term and others in a long term. But in any case, these effects should be so directed as to motivate regional socio-economic development and attain the ultimate goals of national planning in a long run. Figure 50 illustrates the above relation.

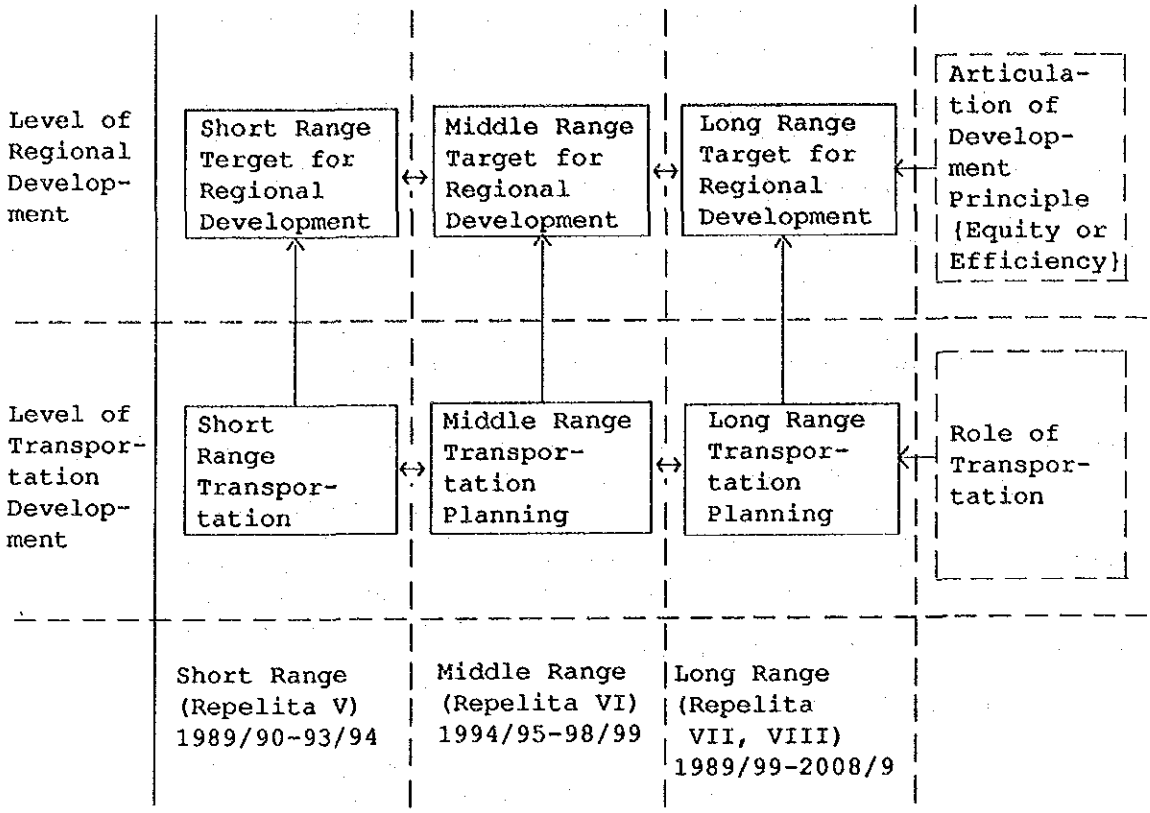


Figure 50. Role of Transportation Planning in the Regional Planning with Different Range of Time (Short, Middle and Long)

2. Strategy for Transportation Development

2.1. Sectoral Strategies for Transportation Development

391. In junction with the planning principle proposed earlier, strategies and goals for transportation development for each of the transportation sectors are introduced as shown in Table 85.

Table 85. Conceivable Strategy for Transportation Development

Sector	Conceivable Strategy	Long Term Goal	Relation with Regional Economy
Road	• Betterment of existing road through maintenance works and rehabilitation • Betterment of road linkages which connect vital points of production, consumption and vital points in transportation such as port * Betterment of strategic road * Improvement of feeder road * Construction of toll road	• Formation of balanced road network within the region • Eradication of transportation-poor	• Incentives for close industrial interdependence • Stability and equity for backward regions • Contribution to exporting industries, increase in regional income and employment
Railway	• Improvement of obsolete operation system and facilities (signal, station facilities and so on) • Reinforcement of truck for heavier freight cars including container car and improvement of railway alignment • Improvement of cars and locomotives	• Innovation of railway system which cooperates with other transportation facilities (ports, feeder roads) and regional industrial activities (agriculture, mining and manufacturing)	• Mass-transportation of commuters and industrial products with cheaper cost • Contribution to export industries, regional income and employment increases.
Waterway	• Expansion of port facilities (berth, yard, transition house and so on) for commercial ports • Efficient management (control system, optimal charge, port worker and so on) • Improvement of inland waterway (dredging, navigation training) • Shipping service to isolated islands	• Creation of integrated and innovated waterway as a network	• Activation of inter-island transportation • Contribution to exporting industries, regional income and employment increases • Enhancement of equity and stability for isolated islands and regions
Airway	• Expansion of airport facilities for the accommodation of larger aircrafts • Modernization of safety control system • Frequent service to isolated areas (e.g. pioneer airport) • Enahancement of airport amenity by improving terminal and related facilities	• Creation of integrated and innovated network within the region as a condition for national development • Eradication of transportation-poor	• Encouragement of inter regional activities through frequent air services • Enhancement of equity and stability for isolated areas • Encouragement of tourism

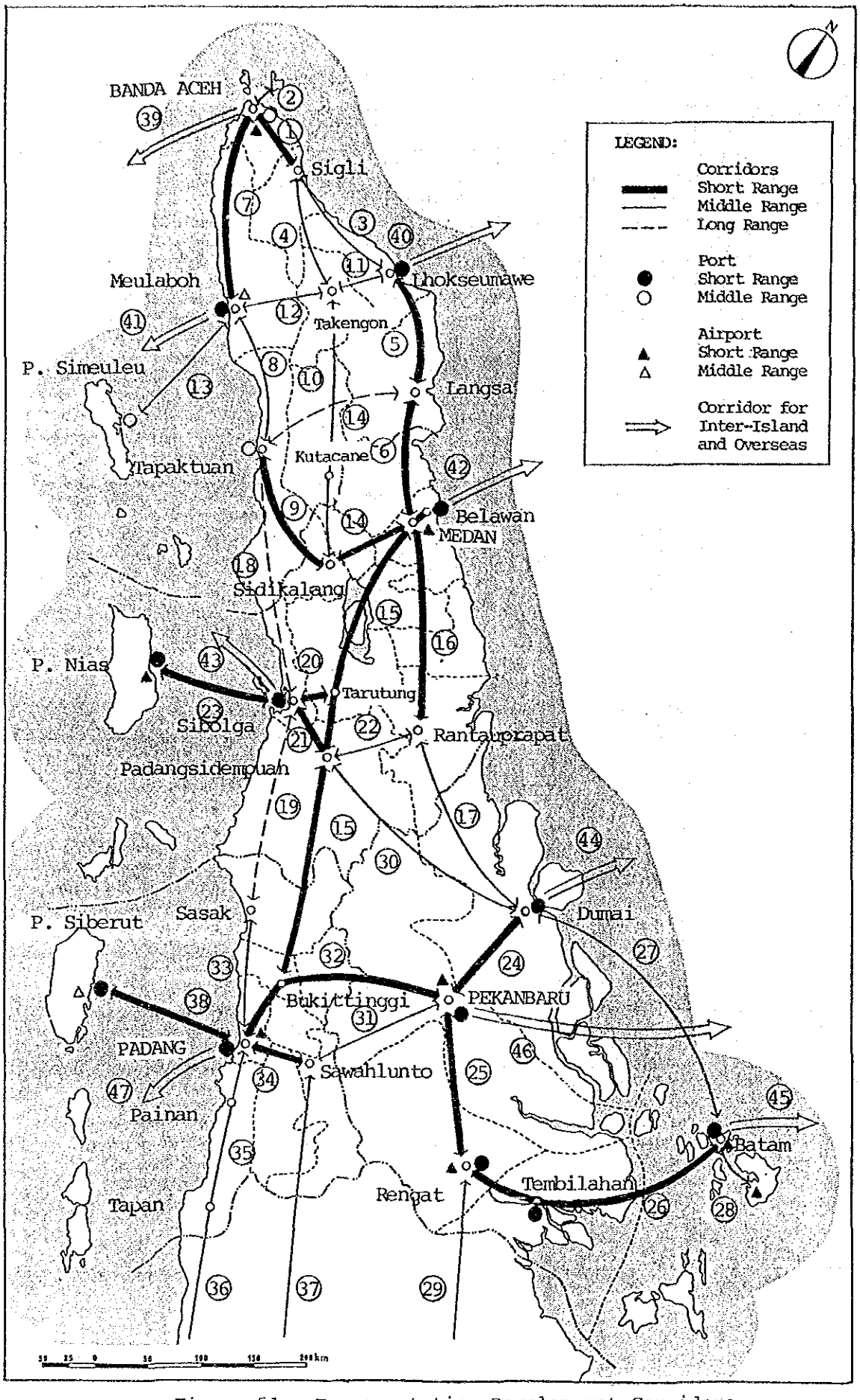


Figure 51. Transportation Development Corridors

2.2. Concept of Transportation Development Corridors

392. According to the planning principle and sectoral development strategies, 47 of transportation development corridors were defined as shown in Figure 51 and Table 86 with interpretion of each of the corridors in the same table. Each corridor was classified into 3 planning ranges, that is, short, middle and long ranges taking into consideration of maturity or recommendable timing of innovation.

Table 86. Interpretation of Transportation Development Corridors

No.	Development Corridor	Planning Range	Interpretation of Development Corridor
(1)	Banda Aceh - Sigli	Short	• Expansion of Banda Aceh influential area
(2)	Banda Aceh - Sabang	Middle	• Industrial linkage, fishery and tourism (Pulau Weh)
(3)	Sigli - Lhokseumawe	Middle	• Vitalization of industrial linkage centered around Lhokseumawe
(4)	Banda Aceh - Takengon	Middle	• Mountain area development
(5)	Lhokseumawe - Langsa	Short	• Vitalization of industrial linkage centered around Lhokseumawe • Specialization of industry [heavy industry (Lhokseumawe), light (Langsa)]
(6)	Langsa - Medan	Short	• Easy and efficient transportation of industrial and consumption goods to and from city of Medan and port of Belawan • Expansion of industrial area centered around Medan
(7)	Banda Aceh - Meulaboh	Short	• Creation of agro-industry and mining oriented manufacturing industry through the combination of two different types of regional cores
(8)	Meulaboh - Tapaktuan	Middle	• A strip of agricultural and agro-industrial belt in the western coast of Aceh province
(9)	Tapaktuan - Sidikalang	Middle	• Strong industrial and transportation linkage between the west coast of Aceh and North Sumatra province, especially Medan and port of Belawan
(10)	Takengon - Sidikalang	Middle	• Strategic corridor for further development in the central area of Aceh province
(11)	Lhokseumawe - Takengon	Middle	• Combination of different land use pattern between industrially developed east coast and mountain area in the center, the latter has great potential of agricultural, forestry and tourism industry
(12)	Takengon - Meulaboh	Middle	• Form a shortcut corridor which connect industrially developed east coast and agricultural area of west
(13)	Meulaboh - Simeuleu	Middle	• Strategic development corridor for the development of Simeuleu island. Agricultural and husbandary industries in Simeuleu will be promoted through good accessibility to mainland
(14)	Medan - Sidikalang	Short	• Vital corridor for the promotion of agricultural, manufacturing and tourism industry cented around Lake Toba and Karo Height • Artery which connects central and south west coast of Aceh
(15)	Medan - Padangsidempuan - Bukittinggi	Short	• Backbone of northern part of Sumatra island, taking advantage of existing trans-Sumatra Highway • Combination of different industries along the corridor
(16)	Medan - Rantauprapat	Short	• One of the most vital corridors in the study area, which penetrates agriculturally and industrially developed areas in North Sumatra province as well as densely populated area
(17)	Rantauprapat - Dumai	Middle	• Strategic corridor aiming at plantation development along the corridor which has long been out of development for geographical reason • Linkage between port of Dumai and industrially developed North Sumatra Province

Table 86. Continued

No. Development Corridor	Planning Range	Interpretation of Development Corridor
(18) Tapaktuan - Sibolga	Long	• Strategic development corridor for the future development of isolated areas located in the south-west corner of Aceh and north-west of North Sumatra Province
(19) Sibolga - Sasak	Long	• Strategic development corridor for the future development of south-west corner of North Sumatra Province, which has been isolated from development
(20) Tarutung - Sibolga	Short	• Form a partial link which connect east coast and west coast of North Sumatra province • Indirectly contributing tourism and industrial development of Nias island
(21) Padangsidempuan - Sibolga	Short	• Incentive for the regional development in Southern Tapanuli
(22) Rantauprapat - Padangsidempuan	Middle	• Strong linkage between industrially developed south-east part of North Sumatra Province and West Sumatra Province • Contribution to agricultural and industrial development in Tapanuli
(23) Sibolga - Nias	Short	• Aiming at Nias island development especially for tourism
(24) Dumai - Pekanbaru	Short	• One of the most vital transportation corridor which connects two major cities in Riau province, one is Dumai, industrial and exporting center, and the other is Pakanbaru, capital city of Riau and center of regional economy
(25) Pekanbaru - Rengat	Long	• Strategic development corridor for the development of vast rain forest area intending for plantation development, located along the corridor • Strengthening linkage to isolated area on this axis
(26) Indragiri River Corridor (Rengat - Tembilahan - (Kuala Enok) - Batam & Overseas)	Middle	• Industrial material supply belt to the Batam island, in which ambitious industrial development is intended • Plantation development in the south-east region of Riau will be encouraged through the vitalization of this corridor
(27) Batam - Dumai	Middle	• Combination of two great industrial centers • Functional mutualism is being proposed
(28) Batam - Bintan	Middle	• Expansion of influential area of Batam island
(29) Rengat - Jambi	Long	• Form a potential artery which penetrate Sumatra island from North to South direction along the east coast of the island
(30) Padangsidempuan - Dumai	Middle	• Incentive role for development in Southern Tapanuli • Linkage of west coast of North Sumatra with Riau Province
(31) Pekanbaru - Sawahlunto	Middle	• Secondary linkage between Riau and West Sumatra Provinces, taking advantage of mutually different land use patterns
(32) Pekanbaru - Bukittinggi	Short	• Further industrial linkage along this corridor between the east coast and west coast of Sumatra island will be attained through the vitalization of this axis
(33) Sasak - Padang	Middle	• Expansion of Padang influential area. • Plantation development along this corridor will be promoted
(34) Sawahlunto - Padang	Short	• Industrial interdependence between Sawahlunto, coal producing area, and Padang, center of industry and exporting, will be promoted through the vitalization of this axis
(35) Padang - Painan - Tapan	Middle	• Strategic development corridor for the area located along the west coast of West Sumatra and Bengkulu provinces

Table 86. Continued

No.	Development Corridor	Planning Range	Interpretation of Development Corridor
(36)	Tapan - Bengkulu	Long	• Strategic development corridor for the area located along the west coast of West Sumatra and Bengkulu provinces
(37)	Sawahlunto - Bengkulu	Middle	• Combination with Bengkulu province. Integrated development of the whole of the areas in Sumatra island is aimed at
(38)	Padang - Mentawai	Short	• Strategic development corridor for the development of the Mentawai islands which have great potential for future development (forestry, agriculture and tourism)
(39)	Banda Aceh - Overseas & Interisland	Short	• Socio-economic development centered around the city of Banda Aceh
(40)	Lhokseumawe - Oversease Interisland	Short	• Industrial and agricultural development in Lhokseumawe, Bereuen and Takengon area
(41)	Meulaboh - Overseas & Interisland	Short	• Creation of agro-industrial base in the west coast of Aceh province
(42)	Medan - Overseas & Interisland	Short	• Efficient and activated transportation to and from port of Belawan and Polonia airport
(43)	Sibolga - Overseas & Interisland	Short	• Incentive role for agro-industrial development in southern part of North Sumatra province and northern part of West Sumatra province
(44)	Dumai - Overseas & Interisland	Short	• Plantation development in southern part of North Sumatra province and northern part of Riau Province • Contribution of swamp area development
(45)	Batam - Overseas & Interisland	Short	• Strong connection with Jakarta and overseas
(46)	Pekanbaru - Overseas & Interisland	Short	• Socio-economic development centered around the city of Pekanbaru
(47)	Padang - Overseas & Interisland	Short	• Expansion of exporting industry in West Sumatra province

2.3. Conceivable Methodologies for Vitalization of Each of the Transportation Development Corridors

393. In line with the planning principle set up in Table 86 development methods for each of the transportation development corridors were introduced as shown in Table 87. For the definition of the methodologies following criteria were taken into account:

- Maximum effect with minimum cost
- Quick yielding
- Realistic

Table 87. Conceivable Methodologies for Vitalization of the Transportation Development Corridors

No.	Development Corridor	Conceivable Methodology for Development
(1)	Banda Aceh - Sigli	• Rehabilitation and upgrading of existing road and if possible road extension for Kreung Raya to Sigli along the coast line
(2)	Banda Aceh - Sabang	• Improvement of ferry service
(3)	Sigli - Lhokseumawe	• Rehabilitation and upgrading of road including bridge
(4)	Banda Aceh - Takengon	• Construction of missing road links
(5)	Lhokseumawe - Langsa	• Construction of missing road links
(6)	Langsa - Medan	• Rehabilitation and upgrading of road • Construction of expressway • Revival of Aceh railway
(7)	Banda Aceh - Meulaboh	• Rehabilitation and upgrading of road including bridge
(8)	Meulaboh - Tapaktuan	• Betterment of airplane service and facilities and maintenance of road
(9)	Tapaktuan - Sidikalang	• Rehabilitation and upgrading of road including construction of bridges
(10)	Takengon - Sidikalang	• Eradication of impassable road links
(11)	Lhokseumawe - Takengon	• Construction of shortcut road with higher standard
(12)	Takengon - Meulaboh	• Eradication of impassable road links
(13)	Meulaboh - Simeuleu	• Improvement of ferry service and port related facilities
(14)	Medan - Sidikalang	• Rehabilitation and upgrading of trunk roads including in this corridor such as Brastagi-Medan link
(15)	Medan - Padangsidempuan - Bukittinggi	• Upgrade and rehabilitation of trans-Sumatra highway
(16)	Medan - Rantauprapat	• Rehabilitation and upgrade of railway and its related facilities • Maintnance of trunk roads
(17)	Rantauprapat - Dumai	• Maintenance of trunk road and feeder road improvement for plantation development • Possibility of railway construction and related facilities
(18)	Tapaktuan - Sibolga	• Construction of feeder roads for plantation development
(19)	Sibolga - Sasak	• Eradication of missing road links
(20)	Tarutung - Sibolga	• Rehabilitation and upgrading of road including tunnel
(21)	Padangsidempuan - Sibolga	• Rehabilitation and upgrading of existing road
(22)	Rantauprapat - Padangsidempuan	• Rehabilitation and upgrading of existing road
(23)	Sibolga - Nias	• Improvemnt of sea and air transportation and their related facilities
(24)	Dumai - Pekanbaru	• Rehabilitation and upgrading of roads along the corridor
(25)	Pekanbaru - Rengat	• Upgrading of road network (trunk road, feeder roads) in the swamp area • Renovation of air services and related facilities
(26)	Indragiri River Corridor	• Upgrading of road • Expansion of port facilities • Improvement of inland waterway
(27)	Batam - Dumai	• Increased sea transportation for plantation products
(28)	Batam - Bintan	• Frequent ferry service and related facilities (port, road access)
(29)	Rengat - Jambi	• Upgrading of road and construction of missing road links including bridges
(30)	Padangsidempuan - Dumai	• Upgrading of trunk road and feeder roads connection
(31)	Pekanbaru - Sawahlunto	• Upgrading of road
(32)	Pekanbaru - Bukittinggi	• Upgrading of road
(33)	Sasak - Padang	• Construction of missing road links
(34)	Sawahlunto - Padang	• Renovation of railway and related facilities including operation • Disaster prevention of road in the hillside
(35)	Padang - Painan - Tapan	• Upgrading of road

Table 87. Continued

No.	Development Corridor	Conceivable Methodology for Development
(36)	Tapan - Bengkulu	• Rehabilitation and upgrading of road
(37)	Sawahlunto - Bengkulu	• Rehabilitation and upgrading of road
(38)	Padang - Siberut	• Improvement of ferry service and related facilities
(39)	Banda Aceh - Overseas & Interisland	• Renovation of airport facilities
(40)	Lhokseumawe - Overseas & Interisland	• Frequent ferry services to nearby countries
(41)	Meulaboh - Overseas & Interisland	• Expansion of port facilities, possibly construction of new port area • Direct transportation to island of Java
(42)	Medan - Overseas & Interisland	• Expansion of port facilities • Improvement of air transportation and airport facilities
(43)	Sibolga - Overseas & Interisland	• Expansion of port facilities • Improvement of air transportation and airport facilities
(44)	Dumai - Overseas & Interisland	• Frequent and direct transportation to and from neighbouring countries • Expansion of port facilities
(45)	Batam - Overseas & Interisland	• Frequent and direct transportation to and from neighbouring countries • Expansion of port facilities
(46)	Pekanbaru - Overseas & Interisland	• Renovation of airport facilities • Improvement of river port
(47)	Padang - Overseas & Interisland	• Expansion of port facilities • Improvement of airport facilities

C. Evaluation

1. Introduction

394. In this Section the major strategies for transportation development proposed in Section B are to be evaluated in terms of prospect of future transportation demand socio-economic impacts and possible costs. Through the evaluation here, theoretical background for each of the strategies, issues related and schedules for implementation will be more clarified. Especially, for such corridors which have more than two (2) alternatives of development strategy, a kind of comparison study was to be done for the set up of most recommendable future plans. The study here consists of following sub-studies:

- Study about the future prospect of transportation demand
- Tentative cost estimate for urgent and critical projects
- Study about possible socio-economic impacts in junction with future development strategies of productive sectors.

2. Perspective for Future Traffic Demand in the Region

2.1. Road Transportation

395. As the result of simple linear regression applied to inter-Kabupatan traffic volume and magnitude of regional GDP by Kabupatan within the Region, traffic volumes of these traffic in the years of 1998 and 2008 are forecasted at 32 million and 70 million vehicles/year respectively compared to that of 20 million vehicles in 1988. From this average annual increasing rates during the periods of 1988 - 1998 and 1988 - 2000 are estimated as 6.4% and 7.0% as shown in Table 88.

The above increasing rates are deemed applicable to the intra-Kabupatan traffic within the Region.

396. As a result, region-wise future road traffic increasing rates during the same periods were forecasted as shown in Figure 52. From it it could be noticed that high annual increasing rates of more than 5.5% are to be attained in the most of the advanced area in the Region during the period of 1988 - 1998.

Table 88. Prospect of Future Road Transportation

	1988 (Present)	1998	2008
Traffic Volume (thousand vehicles/year)	20,339	32,174	70,126
1998 (2008) / 1988	-	1.58	3.45
Average Annual Increasing Rate (%)	-	6.4 (1988 - 1998)	7.0 (1988 - 2008)

Source: Team's estimate

397. Through the comparison of present vehicle O-D table, with those in 1998 and 2008 established by the Study Team, it is estimated that traffic volumes on arterial roads will increase at the average annual increasing rates of 6.8% and 7.3% during the periods of 1988 - 1998 and 1988 - 2008 respectively. (Origin and Destination table for vehicle traffic Inter-regional road traffic patterns in 1998 and 2008 are illustrated in Figure 53.) On the other hand, corresponding increasing rates on collector road and the lower category are estimated at 4.9% and 6.0% respectively. Above fact suggests that arterial roads are rather intensively used than the lower class roads as long as foreseeable future is concerned, although the function of latter road is as important as the former.

398. From the forecasted O-D Table, following characteristics in road use could be pointed out:

Over-all Traffic Volume

According to the Team, inter-Kabupaten vehicle traffic volumes (excluding intra-Kabupaten traffic) in 1998 and 2008 are estimated at 32.2×10^6 and 70.1×10^6 vehicles/year which are 1.58 and 3.45 times as large as that of 1982 respectively. Annual increasing rates during the periods of 1988 - 1998 and 1988 - 2008 come up with 6.4% and 7.0% respectively.

Traffic Volume by Type of Road

The traffic volume on arterial roads are expected to increase at annual rate of 6.8% and 7.3% up to the years 1998 and 2008 respectively, on the other hand, the increasing rates on collector roads are estimated at 4.9% and 6.0% during the same period, which are a little bit below those on the arterial roads.

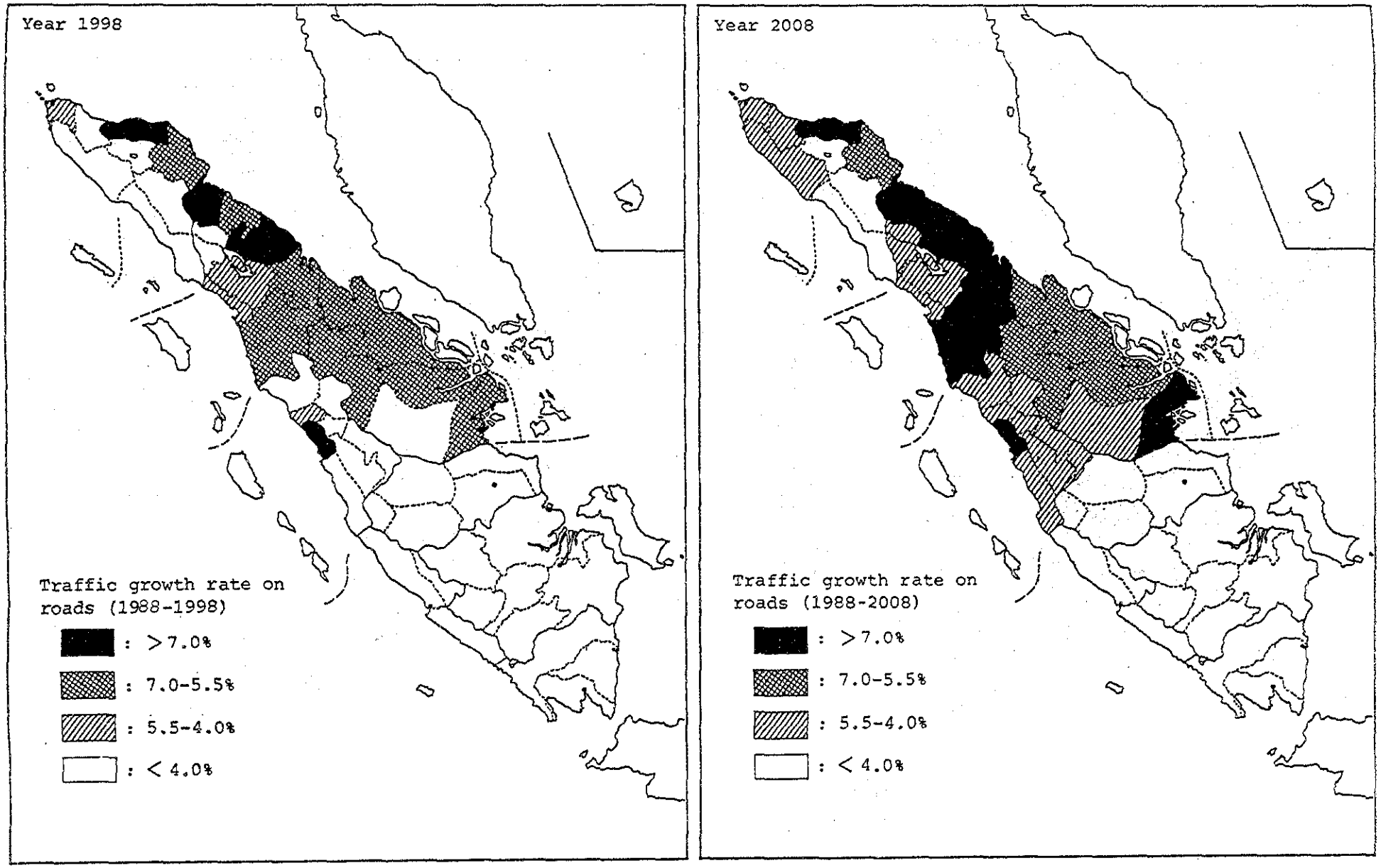
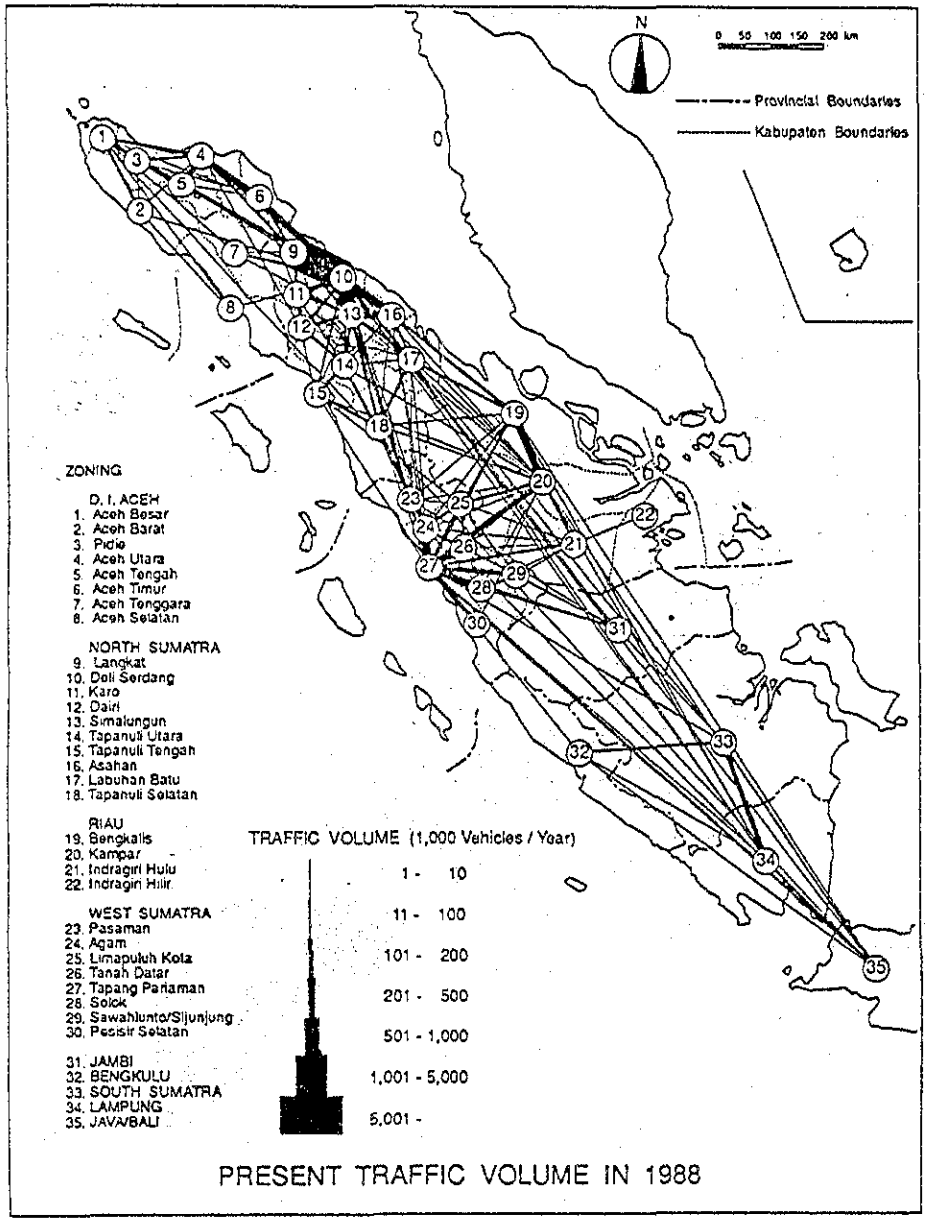


Figure 52. Prospect of Future Road Traffic Growth by Region.



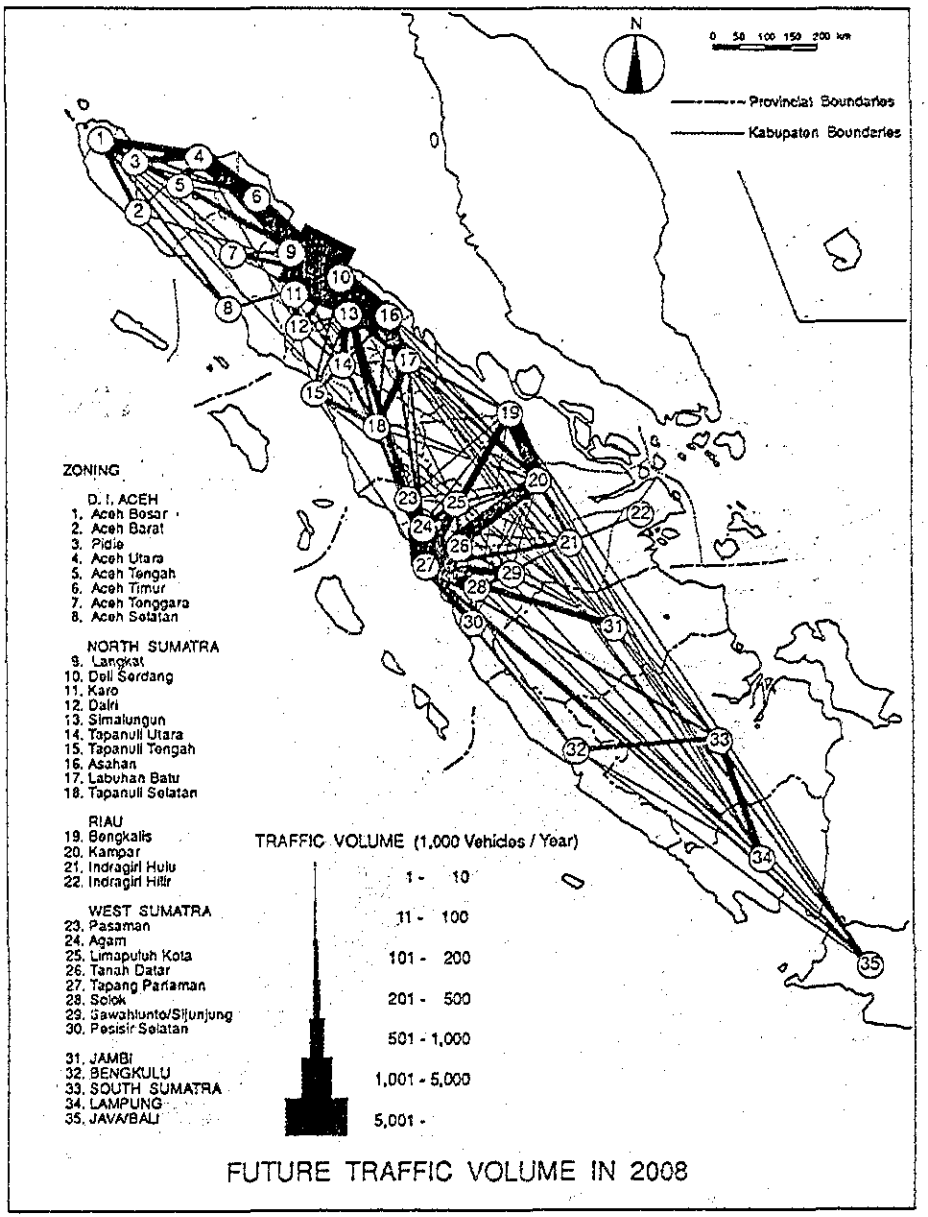


Figure 53. Prospect of Future Road Traffic Volume

2.2. Water Transportation

399. With the intensive investment of production sectors proposed in this study, the hinterlands of major ports are expected to expand as shown in Figure 54. (Present sphere of hinterland was shown in Figure 42.) It is needless to say these expanded hinterlands as well as more frequent transportation to and from these hinterland will induce more amount of cargo handling for each of the ports. It is impossible to forecast exact amount of cargo handling for each of the ports in the Region at the stage of master plan study. But future magnitude of regional GDP for each of the hinterlands suggests possible future amount of cargo handlings to some extent as the result of simple correlation analysis. Table 89 shows the expected amount of cargo handlings based upon estimation by DGSC and the Study Team.

Table 89. Perspective for Cargo Handlings at Major Ports

	Categories	Port	Cargo Handling (year) ('000 ton)	Cargo Handling (1993/1994) ('000 ton)	Remarks
Waterway	Gateway Port	Belawan	5,571 (1986)	13,500	Annual increasing rate of cargo handling during the period of Repelita V is estimated as 13.5%
	Regional Collector Port	Telukbayur	2,044 (1987)	2,500	Annual increasing rate of cargo handling during the period of Repelita V is estimated as 3.2%
		Dumai	496 (1988)	800	Annual increasing rate of cargo handling during the period of Repelita V is estimated as 7.3%
		Lhokseumawe	1,801 (1987)	3,100	Annual increasing rate of cargo handling during the period of Repelita V is estimates as 8.0% Including fertilizer handled at private berth
		Sibolga	265 (1987)	400	Annual increasing rate of cargo handling during the period of Repelita V is estimates as 4.5%
	Trunk Port	Kreung Raya	30 (1987)	30	Annual increasing rate of cargo handling during the period of Repelita V is estimates as 0%
		Kuala Langsa	33 (1987)	80	Annual increasing rate of cargo handling during the period of Repelita V is estimates as 13.9%
	Other Major Port	Meulaboh	197 (1983)	300	Hinter land GDP increasing rate of 4.5% (1983 - 1998 annually) is applied

Source: DGSC except for Meulaboh which was estimated by the Team

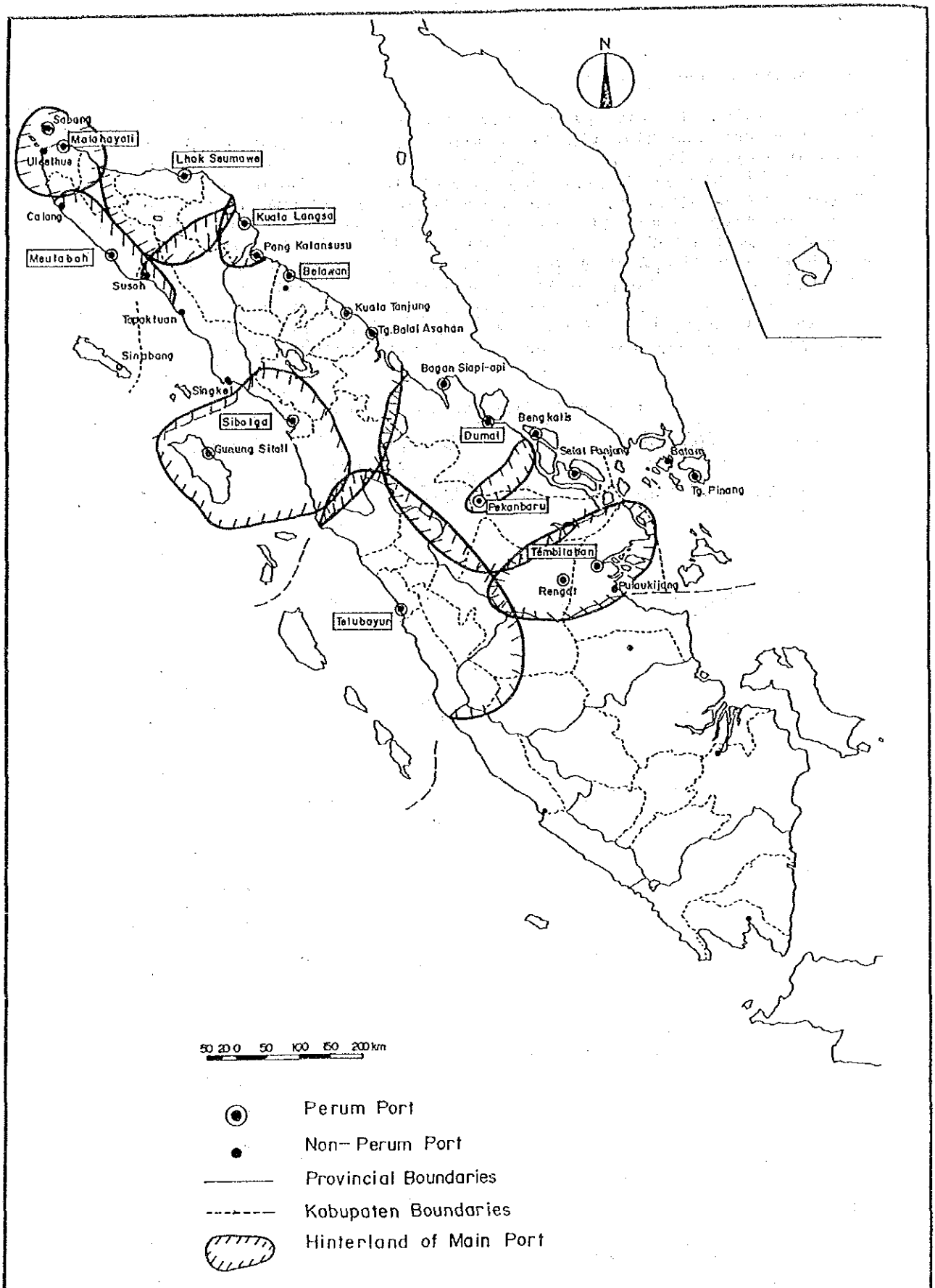


Fig. 54. Hinterlands of Main Ports* (Future)

* As for the possible port in west Aceh, Muelaboh is tentatively assumed in this figure.

2.3. Railway Transportation

400. As for the future railway transportation, future amount of traffic volumes were estimated by the Study Team as shown in Table 90.

Table 90. Perspective for Railway Transportation

	Categories	Line	Present Traffic Volume	Future Traffic Volume	Remarks
Railway	North Sumatra Railway	Belawan Line (Medan - Belawan)	485×10^3 ton to and from Belawan (1983/84)	1717×10^3 ton to and from Belawan (1983/94)	13.5% annual increase is assumed base on cargo handling at Belawan in 1983/94
		Medan Urban Area	N.A.	809×10^6 ton.km in 2000	Based on JICA study (1980)
		Medan - Rantau Prapat including Siantar line	N.A.	417×10^6 ton.km in 2000	Based on JICA study (1980)
		Binjai - Besitang	N.A.	173×10^6 ton.km in 2000	Based on JICA study (1980)
		Besitang - Langsa	N.A.	75×10^6 ton.km in 2000	1/2 of oil plantation product, mineral product are assumed to be converted to rail from road
		Langsa - Lhokseumawe	-	128×10^6 ton.km in 2000	1/2 of oil plantation product, mineral product are assumed to be converted to rail from road
		Rantauprapat - Dumai	-	14×10^6 ton.km in 2000	All the plantation product is assumed to be carries by rail
	West Sumatra Railway	Ombilin - Telukbayur	49×10^6 ton.km (1983/84)	83×10^6 ton.km in 1992	Coal from Ombilin is to increase to $1,265 \times 10^3$ ton (1992) from the present level of 965×10^3 ton (1988)
		Naras - Simpangempat	-	13×10^6 ton.km in 2000	1/2 of oil and plantation products are assumed to be converted to rail from road

Source: Team, except for Medan Urban area which based on "Medan Urban Area Transportation Study (JICA 1980)".

2.4. Air Transportation

401. The perspective for future air transportation was set up as shown in Table 91 based upon the estimation by DJPU.

Table 91. Perspective for Air Transportation

	Categories	Passenger	Freight	Remarks
Airway	International	9.1% annual increase throughout the period of Repelita V	11.6%	Prospect by DJPU
	Domestic	8.6%	5.6%	Prospect by DJPU
	Pioneer	11.2%	5.6%	Prospect by DJPU

Source: DJPU

3. Comparative Study about Possible Development Alternatives on Some Corridors

402. Relating to the transportation development corridors proposed earlier, details of each corridor were analyzed. Especially for the corridors which contains more than two alternatives for development, a kind of comparison study was conducted, in which, expected future traffic volume, socio-economic impact, issues and constraints and expected cost required for the implementation were analyzed. The results of comparative study are shown in Table 92.

Table 92. Comparative Study among Development Alternatives

Name of Corridor		Banda Aceh - Sigli	
Possible Alternatives		Rehabilitation and upgrading of existing road	Road extension from Krueng Raya to Sigli along the coat line
Prospect of Future Traffic		6,424 vehicles/day (1995) (Bina Marga)	3,212 vehicles/day (1995) (Bina Marga)
Expected Socio Economic Impact	Direct effect	Improved alignment and surface condition will alleviate the damage of cargoes transported and will increase the amenity of drivers and passengers	Rehabilitated road will contribute to the enhancement of industrial relationship among Banda Aceh, Sigli and Lhokseumawe areas
	Indirect effect	This new road will contribute to the reduction of present travel time between Banda Aceh and Sigli to the half	The areas around Krueng Raya port and those of between the Sigli will receive impact for development
Issues & Constraints		• Due to the geographical condition, winding alignment in the mountain section is unchangeable. • Bumps due to poor maintenance work should be rehabilitated	• Swamp area along the coast line requires additional construction cost
Tentative Estimated Cost		US$12 million	US$37 million
Remarks		-	One half of the vehicles passing between Banda Aceh and Sigli will be converted to this new road

Table 92. Continued

Name of Corridor		Lhokseumawe - Langsa	
Possible Alternatives		Rehabilitation and upgrading of existing road	Revival of Railway
Prospect of Future Traffic		1,920 vehicles/day (1995) (Bina Marga)	128 × 10^6 ton.km/year (2000) (Team)
Expected Socio Economic Impact	Direct effect	Reconstruction of dilapidated bridges (one lane) will contributed to the reduction of travel time and alleviation of driving risk	Heavy and bulky cargoes produced especially in Langsa area will be transported to Lhokseumawe port with the completion of expansion work of the port
	Indirect effect	Enhancement of inter-industrial activities along the industrial belt on the coast of Aceh and North Sumatra provinces	Expansion of industrial hinterland centered around Lhokseumawe
Issues & Constraints		• Construction of bridge is inevitable	-
Tentative Estimated Cost		US$25 million	US$174 million
Remarks		-	Transportation policies which aim at the realization of efficient pattern of modal-split between road and railway is to be established through setting up of proper fee and related transportation policy

Table 92. Continued

Name of Corridor		Medan - Rantauprapat	
Possible Alternatives		Maintenance of existing road	Rehabilitation of existing railway (Serdang Siantar - Rantauprapat)
Future Traffic		5,000 - 6,000 vehicles/day in the section between Kisaran and Rantauprapat (1995) (Bina Marga)	417 × 10^6 ton.km/year (2000) (Team)
Expected Socio Economic Impact	Direct effect	• Improvement of road transportation (driving condition and conjestion) • Reduction of traffic accident	• Realization of efficient land transportation system such as container transportation • Passenger service
	Indirect effect	• Encouragement of industrial and plantation development in the southern part of North Sumatra province	• Reduction of road traffic through the improvement of railway • Industrial and plantation development in the southern part of North Sumatra
Issues & Constraints		-	• Reinforcement of truck corresponding to the containerization
Tentative Estimated Cost		US$10 million	US$9 million
Remarks		-	-

Table 92. Continued

Name of Corridor		Rantauprapat - Dumai	
Possible Alternatives		Upgrading of existing road	Construction of railway
Prospect of Future Traffic		1,300 vehicles/day (2000) (team)	13×10^6 ton.km/year (2000) (Team)
Expected Socio Economic Impact	Direct effect	• Reduction of travel time and cargo damages • Easy access to Dumai	• Easy and economical transportation of plantation products to the port of Dumai
	Indirect effect	• Incentive role for plantation development in the southern part of North Sumatra and northern part of Riau • Alleviation of elawan congestion	• Incentive role for plantation development in the southern part of North Sumatra and northern part of Riau. • Alleviation of Belawan congestion
Issues & Constraints		-	• Method of construction and maintenance works of the truck on the soft and weak ground in the swamp land should be researched
Tentative Estimated Cost		U$429 million	US$714 million
Remarks		-	No great amount of transportation by rail is anticipated in near future

Table 92. Continued

Name of Corridor		Langsa - Medan		
Possible Alternatives		Rehabilitation and upgrading of existing road	Construction of Binjai-Medan express way	Revival of railway (Langsa - Besitang)
Prospect of Future Traffic		7,068 vehicles/ day up to the border with North Sumatra Province (1995) (Bina Marga)	25,000 - 32,000 vehicles/day (2000) (Medan Urban Area Transportation Study, JICA)	75×10^6 ton.km/year (Team)
Expected Socio Economic Impact	Direct Effect	• Travel time in this section will be reduced by improving of the bridges • Especially heavy traffic in this section will receive great benefit	• Good access to the port of Belawan and market in Medan, especially for such products as plantation and industrial product in the area of southern Aceh • Commuting service to Medan	• Heavy and bulky industrial and plantation products would be transported (timber, fertilizer and palm oil, produced in the southern part of Aceh)
	Indirect Effect	• Expansion of industrial belt which extends to southern part of Aceh and North Sumatra province • Expansion of Medan Urban Area	• Expansion of Medan Urban Area • Industrial and agricultural development in the southern part of Aceh • Residential development in the suburbs of Medan	• Uniform industrial development along the Medan-Langsa corridor • Alleviation of road transportation
Issues and Constraints		• Reconstruction of bridges is inevitable	• Proper toll rate should be charged so that the express way plays incentive role in the regional development	• 1067 mm track is to be introduced corresponding with the truck width in North Sumatra so as to dispense with reloading at the junctional terminal
Tentative Estimated Cost		US$25 million	US$77 million	US$85 million
Remarks		-	• Belawan access should be emphasized	-

Table 92. Continued

Name of Corridor		Sawahlunto - Padang	
Possible Alternatives		Betterment of existing road (Sawahlunto - Solok - Padang)	Rehabilition of existing railway
Prospect of Future Traffic		6,700 vehicles/day (1995) (Bina Marga)	80×10^6 ton.km/year (1992) (Team)
Expected Socio Economic Impact	Direct effect	• Easier access from the area along the trans-Sumatra highway to Padang	• Reduction of coal transportation cost
	Indirect effect	• Expansion of Economy centered Padang	• Contribution to increasing coal production
Issues & Constraints		• Need land slide prevention	• Improvement of rack-track
Tentative Estimated Cost		US$9 million	US$50 million
Remarks		-	• Improvement of existing track is more recommendable rather than construction of new track

Table 92. Continued

Name of Corridor		Rengat - Tembilahan - Batam	
Possible Alternatives		Road construction along the Indragiri River	Inland waterway improvement and ports development
Prospect of Future Traffic		Frequent passenger service on land is proposed	84×10^3 tons of cargo will be transported to and from the port of Rengat in 1995 (Team)
Expected Socio Economic Impact	Direct effect	• Reduction of travel time by road between two center economy (Tembilahan and Rengat)	• Economical transportation of plantation product by using the river transportation • Easy transportation of plantation product to the island of Batam
	Indirect effect	• Enhancement of Inter-regional dependency (trade, social life etc.)	• Encouragement of plantation development in the swamp area of southern part of Riau • Transmigrant service
Issues & Constraints		• Technical constraint of construction of high standard road on the soft and weak ground along Indragiri river	• Periodic dredging of Indragiri river is inevitable as well as navigation training
Tentative Estimated Cost		US$55 million	US$10 million
Remarks		-	• To be reviewed in the integrated regional development plan of the Indragiri river basin

Table 92. Continued

Name of Corridor		Aceh Western Coast Port Development	
Possible Alternatives		Meulaboh	Tapaktuan
Prospect of Future Traffic		300 × 10^3 ton/year (1995) (Team)	163 × 10^3 ton/year (1995) (Team)
Expected Socio Economic Impact	Direct effect	• Increased capacity will be beneficial to users (reduction of waiting time, etc.)	• Increased capacity will be beneficial to users (reduction of waiting time, etc.)
	Indirect effect	• Incentives for regional development in the western coast of Aceh (plantation forestry, manufacturing and mining)	• Incentives for regional development coast of Aceh (plantation, forestry, manufacturing, fishing and mining)
Issues & Constraints		• Issues of siltation due to geographical reason	• Narrow hinterland to be developed and less potential for further development
Tentative Estimated Cost		US$2 million	US$2 million
Remarks		• Two 100 m berth is assumed in case of new construction (4.5 m deep)	• If new Meulaboh port is not developed, one half of the expected cargo at Meulaboh will be transferred to the port of Tapaktuan • Two 100 m berths are assumed in case of new construction (4.5 m deep)

4. Conclusion

403. Through the comparative study and project evaluation method explained earlier, projects with high priority were selected as listed in the Long List in Volume IV with priority S. Total number of projects selected here is 40, among which 14 were road projects, 14 water way projects, 4 railway projects and 8 airway projects. These projects are recommended to be initiated during the period of Repelita V although some of them entail master plan formulation, feasibility study and detailed engineering study.

404. About the corridors which contain more than two alternatives for implementation, following conclusions were tentatively obtained:

(i) Banda Aceh - Sigli

Instead of extension route from Krueng Raya to Sigli along the coast line, improvement of existing road is recommendable due to less cost requirement and less geological constraints involved in the latter.

(ii) Lhokseumawe - Langsa

As the economy surrounding this corridor is still in premature stage for the construction of railway whose cost is estimated at some US$174 million, rehabilitation of existing road is far better off than the revival of the railway.

(iii) Langsa - Medan

Due to the great advantage that this area is located very close to the city of Medan, all of the alternatives should be conducted. But as some of them require preparatory studies, implementation schedule is proposed as follows, subject to their positive outcome:

Period of Pepelita V

- Rehabilitation of existing road
- F/S and E/S of Binjai - Medan expressway
- Construction of said expressway
- F/S and E/S of Langsa - Besitang - Medan railway

Period of Repelita VI

- Construction of said railway

(iv) Medan - Rantauprapat

Both of the alternatives, that is, maintenance of existing road and improvement of existing railway, should be conducted simultaneously.

(v) Rantauprapat - Dumai

Upgrading of existing road corresponding to the expected future traffic increase is far better off than constructing of new railway in this corridor, although great socio-economic impact is expected through the introduction of railway.

(vi) Rengat - Tembilahan - Batam

In consideration of the great potential for future development and geographical constraint of this area, comprehensive transportation development centered around waterway development is strongly recommended. Besides the above, implementation of integrated regional development planning study is proposed.

(vii) Sawahlunto - Padang

For the coal mining development in Sawahlunto and resultant export increase and boost of regional industry, the role of railway is significant, although this project entails fairy much amount of investment cost.

(viii) Aceh Western Coast Port Development

Meulaboh seems to have more advantages than the other possible places for its concentration of population and industry as well as vast hinterland surrounding the place. The above consideration was incorporated in the aforementioned selection of project with urgent priority.

405. It is worthwhile to note here that the costs estimated in Table 92 (as well as project profiles in Chapter II, Volume IV are tentative ones with no detailed engineering study, but estimated cost totals some US$1,151 million as shown below:

Estimated cost by sector (US$ million, 1989-2008)

Road	520
Waterway	226
Railway	209
Airway	196
Total	1,151

VIII. TELECOMMUNICATION

1. Analysis of Present Situation

1.1. General

406. In Indonesia the telecommunication sector has been making significant progress in terms of the number of telephone subscribers. It has increased about 10% annually during the last ten years. Nevertheless, the demand for telephone services has increased much faster, thereby causing an imbalance in the demand and supply of telecommunication services. From the international point of view, however, the telephone penetration ratio still remains the lowest among the ASEAN countries (Table 93). When regressed on GDP per capita cross-sectionally, Indonesia's ratio is located far below the regression line indicating the country's low level of telecommunication development (Figure 55).

Table 93. Telephone Penetration Ratio in ASEAN Countries

Country	Telephone Penetration Ratio
Indonesia	0.4
Malaysia	6.3
The Philippines	1.0
Singapore	32.5
Thailand	1.5

Note: Telephone penetration ratio is calculated as main telephone sets per 100 inhabitants.
Source: ITU, Year Book of Common Carrier Telecommunication Statistics, 1987.

Improvement of this situation has been difficult due to severe budget constraints. The target of 0.9 penetration ratio during Repelita IV now seems almost impossible to achieve. It is apparent that this delay in service provision has had some adverse effects on the Region's overall development.

407. Set against this general background, this Study will focus on the following points:

- -Clarifying the present status of the telecommunication sector in the Region;
- -Identifying its development needs;
- -Specifying the sectoral development concept; and
- -Preparing projects or programs for supporting and strengthening social and economic infrastructures in the Region.

1.2. Analysis of the Present Situation

408. From the management viewpoint, there are several major problems with the sector. They summarily indicate the existing condition of telephone facilities in the Region. Data concerned are shown in Tables 95 to 101. As is seen in the tables, the telephone

Table 94. Telephone Penetration Ratio (Main Telephones) and GDP per Capita from 62 Countries

No.	Country	GDP Per Capita (US$)	Telephone Penetration Ratio	No.	Country	GDP Per Capita (US$)	Telephone Penetration Ratio
1	Argentina	2,230	7.6	32	Malaysia	2,007	6.3
2	Australia	11,172	40.1	33	Mexico	2,060	4.5
3	Austria	9,140	36.1	34	Netherlands	9,520	40.1
4	Belgium	8,610	31.0	35	New Zealand	6,749	39.5
5	Brazil	1,710	5.1	36	Norway	13,750	41.3
6	Canada	13,140	45.1	37	Pakisan	380	0.8
7	Chile	1,710	4.4	38	Panama	2,349	8.1
8	Colombia	1,320	6.0	39	Paraguay	1,242	2.4
9	Denmark	11,290	49.7	40	Peru	980	2.2
10	Ecuador	1,124	3.0	41	Philippines	535	1.0
11	Egypt	720	1.9	42	Portugal	1,970	13.8
12	El Salvador	710	1.8	43	Singapore	6,869	32.5
13	Ethiopia	104	0.2	44	South Africa	2,260	8.4
14	Finland	10,830	44.6	45	South Korea	2,271	16.1
15	France	9,860	40.8	46	Spain	4,470	23.8
16	Ghana	350	0.3	47	Sri Lanka	339	0.5
17	Greece	3,740	29.5	48	Sudan	340	0.3
18	Guatemala	1,120	1.6	49	Sweden	11,880	62.7
19	Honduras	700	1.1	50	Switzerland	15,990	50.2
20	Hongkong	6,277	31.9	51	Taiwan	3,748	19.0
21	India	260	0.4	52	Tanzania	210	0.2
22	Indonesia	640	0.4	53	Thailand	745	1.5
23	Iran	3,090	3.0	54	Tunisia	1,270	2.6
24	Iraq	3,200	3.5	55	Turkey	1,200	4.4
25	Ireland	5,000	19.8	56	Uganda	230	0.2
26	Israel	5,100	28.2	57	United Kingdom	8,570	38.3
27	Italy	6,440	30.4	58	United States	15,476	45.3
28	Jamaica	1,150	6.2	59	Uruguay	1,970	9.8
29	Japan	11,054	37.1	60	Venezuela	3,220	7.0
30	Jordan	1,710	6.1	61	West Germany	11,090	62.1
31	Kenya	300	0.6	62	Zaire	140	0.1

Source : ITU,Year Book of Common Carrier of Telecommunication Statistics, 1987

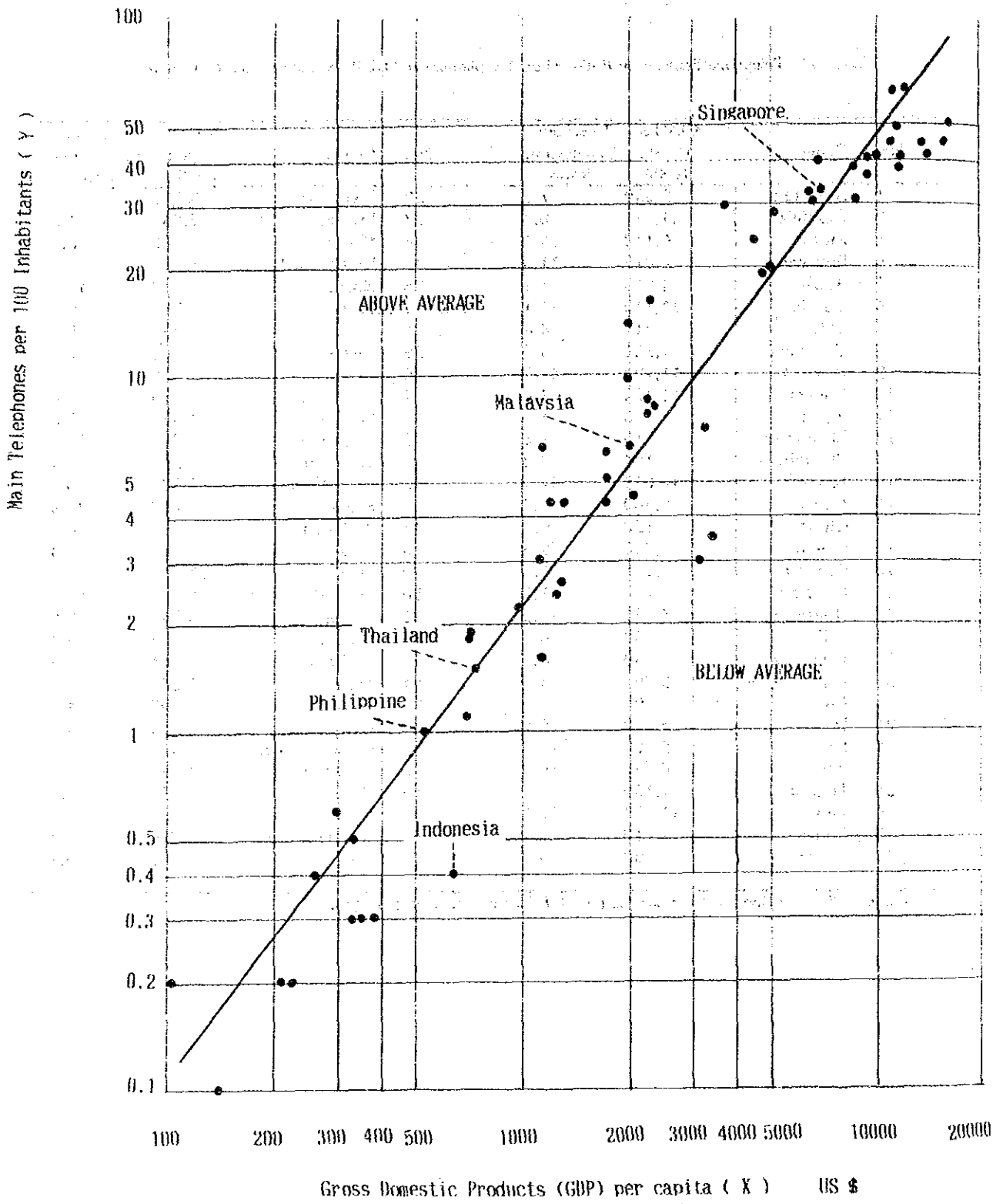


Figure 55. Telephone Penetration Ratio (main telephones) and GDP from 62 Countries

Table 95. Summary of Condition of Existing Telephone Facilities

Province	Dev.Area	SC(A)	SC(M)	A%	LU	A%	SUB	A%	TPR	Demand	D/P
Aceh	1	3	1	75.0	3,550	98.6	3,428	99.4	0.82	5,656	1.35
	2	4	6	40.0	4,950	68.7	4,204	74.4	0.30	5,136	0.37
	3	3	1	75.0	1,700	94.1	1,433	95.5	0.25	1,740	0.31
	4	0	2	0.0	450	0.0	336	0.0	0.18	365	0.19
	5	1	4	20.0	1,296	69.1	904	88.9	0.26	1,029	0.30
	6	0	4	0.0	850	0.0	681	0.0	0.21	685	0.21
	7	-	-	-	-	-	-	-	-	-	-
Total		11	18	37.9	12,796	73.4	10,986	79.3	0.34	14,611	0.45
North Sumatra	8	2	0	100.0	36,000	100.0	34,582	100.0	1.88	55,190	3.01
	9	7	20	25.9	14,450	69.2	11,795	70.3	0.23	13,772	0.27
	10	1	3	25.0	2,050	48.8	1,544	56.0	0.28	1,620	0.29
	11	1	5	16.7	1,480	54.1	993	45.3	0.13	1,013	0.13
	12	1	4	20.0	3,020	66.2	2,022	58.4	0.17	2,080	0.17
	13	1	0	100.0	1,000	100.0	593	100.0	0.10	616	0.11
Total		13	32	28.9	58,000	87.6	51,529	89.2	0.51	74,291	0.74
West Sumatra	14	2	6	25.0	14,430	90.1	10,707	89.8	0.56	17,446	0.91
	15	0	2	0.0	230	0.0	200	0.0	0.05	222	0.05
	16	0	1	0.0	960	0.0	894	0.0	0.23	1,217	0.32
	17	0	7	0.0	2,040	0.0	1,351	0.0	0.18	1,613	0.22
	18	0	2	0.0	740	0.0	228	0.0	0.06	264	0.07
	19	-	-	-	-	-	-	-	-	-	-
Total		2	18	10.0	18,400	70.7	13,380	71.8	0.34	20,762	0.54
Riau	20	1	1	50.0	5,200	96.2	5,110	96.2	0.64	9,319	1.16
	21	1	4	20.0	2,416	24.8	2,051	29.0	0.25	3,230	0.40
	22	0	3	0.0	650	0.0	427	0.0	0.13	458	0.14
	23	0	1	0.0	960	0.0	786	0.0	0.19	1,049	0.25
	24	4	3	57.1	6,556	95.4	4,165	95.8	0.90	7,513	1.63
Total		6	12	33.3	15,782	75.1	12,539	75.8	0.44	21,569	0.76
Northern Sumatra		32	80	28.6	104,978	81.0	88,434	83.4	0.44	131,233	0.66
Indonesia		280	405	40.9	840,000	90.0	700,000	-	0.40	1,240,000	0.71

Notes : - : No data available
SC(A) : Number of Automatic Switching Centers
SC(M) : Number of Manual Switching Centers
A% : Rate of Automization
LU : Number of Line Units
SUB : Number of Subscribers
TPR : Telephone Penetration Ratio (set/100 persons)
Demand : Waiting Applications + Subscribers
D/P : Demand per Population

Source : Data from WITEL - I, WITEL - II, MATEL, PERUMTEL as of 1988.

Table 96. Existing Telephone Facilities --Aceh

Dev.Area	No.	Name of Exchange	MDL	CAP	SUB	CO. PH	Wait	Demand
1	1	Banda Aceh Centrum	OT	3,000	2,970	29	2,072	5,042
1	2	Sabang	OT	400	394	1	97	491
1	3	Seulimun	LB	50	21	-	2	23
1	4	Janth	OT	100	43	0	57	100
2	5	Takengon	LB	400	394	-	82	476
2	6	Meurendu	LB	200	58	-	32	90
2	7	Beureunun	LB	250	193	-	98	291
2	8	Sigli	OT	600	468	2	53	521
2	9	Matangglupang Dua	LB	300	181	-	10	191
2	10	Lhoksukon	OT	400	288	2	13	301
2	11	Pantonlabu	LB	300	198	-	11	209
2	12	Samalanga	LB	100	53	-	0	53
2	13	Bireuen	OT	400	396	3	234	640
2	14	Lhok Semawe	OT	2,000	1,975	19	399	2,374
3	15	Idi	OT	400	181	1	22	203
3	16	Langsa	OT	800	796	8	242	1,038
3	17	Kuala Simpang	OT	400	392	4	28	420
3	18	Peureulak	LB	100	64	-	15	79
4	19	Kuta Cane	LB	400	301	-	29	330
4	20	Blangkejeren	LB	50	35	-	0	35
5	21	Jeuram	LB	50	7	-	0	7
5	22	Calang	LB	50	47	-	0	47
5	23	Lamno	LB	100	46	-	49	95
5	24	Meulaboh	OT	896	647	0	76	723
6	25	Blang Pidie	LB	300	236	-	0	236
6	26	Bakungan	LB	50	30	-	0	30
6	27	Singkil	LB	150	98	-	4	102
6	28	Tapaktuan	LB	350	317	-	0	317
7	29	Sinabang	LB	200	157	-	0	157
		Total		12,796	10,986	69	3,625	14,611

Notes : MDL: OT : Automatic
LB : Local Battery
CB : Central Battery
CAP : Number of Line Units
SUB : Number of Subscribers
CO. PH : Number of Coin Telephone Sets
Wait : Number of Waiting Applicants
Demand : Subscribers + Waiting Applicants

Source : Data from WITEL - I, WITEL - II, MATEL, PERUMTEL as of 1988

Table 97. Existing Telephone Facilities -- North Sumatra

Dev.Area	No.	Name of Exchange	MDL	CAP	SUB	CO. PH	Wait	Demand
8	1	Belawan	OT	1,000	962	6	89	1,051
8	2	Medan Centrum	OT	35,000	33620	210	20,519	54,139
9	3	Merbau	LB	40	22	-	0	22
9	4	Langga Payung	LB	30	27	-	0	27
9	5	Negeribaru	LB	30	27	-	0	27
9	6	Aek Nabara	LB	100	92	-	0	92
9	7	Lubuhan Bilik	LB	60	36	-	0	36
9	8	Kota Pinang	LB	100	95	-	0	95
9	9	Mambang Muda	LB	220	130	-	2	132
9	10	Rantau Prapat	LB	720	690	-	199	889
9	11	Tanjung Balai	CB	1,170	954	-	236	1,190
9	12	Labuhan Ruku	LB	100	61	-	10	71
9	13	Inalum/Newtown	LB	1,000	325	1	12	337
9	14	Kisaran	OT	1,000	991	9	112	1,103
9	15	Pulau Rakyat	LB	50	40	-	12	52
9	16	Pematang Siantar	OT	4,000	3952	26	369	4,321
9	17	Prapat	OT	1,000	324	3	0	324
9	18	Perdagangan	LB	400	252	-	32	284
9	19	Dolok Merangir	LB	100	63	-	19	82
9	20	Tebing Tinggi	LB	1,000	977	5	84	1,061
9	21	Perbaungan	LB	200	182		12	194
9	22	Galang	LB	100	82	-	4	86
9	23	Sungai Rampah	LB	80	46	-	12	58
9	24	Lubuk Pakam	LB	600	465	-	33	498
9	25	Binjai	OT	1,000	992	3	509	1,501
9	26	Pangkalan Brandan	OT	1,000	731		131	862
9	27	Kuala	LB	50	46	-	32	78
9	28	Tanjungpura	LB	200	137	-	147	284
9	29	Pangkalan Susu	LB	100	56	-	10	66
10	30	Sidikalang	LB	600	479	-	48	527
10	31	Kabanjahe	OT	1,000	865	8	18	883
10	32	Brastagi	LB	400	159	-	7	166
10	33	Tiga Binanga	LB	50	41	-	3	44
11	34	Balige	LB	200	148	-	7	155
11	35	Siborong Borong	LB	140	101	-	0	101
11	36	Dolog Sanggul	LB	140	122	-	0	122
11	37	Porsea	LB	100	86	-	3	89
11	38	Pangururan	LB	100	86	-	2	88
11	39	Tarutung	OT	800	450	1	8	458
12	40	Penyabungan	LB	200	85	-	11	96
12	41	Kotanopan	LB	50	24	-	0	24
12	42	Padang Sidempuan	LB	740	708	-	31	739
12	43	Batang Toru	LB	30	24	-	2	26
12	44	Sibolga	OT	2,000	1181	12	14	1,195
13	45	Gunung Sitoli	OT	1,000	593	3	23	616
		Total		58,000	51,529	287	22,762	74,291

Source : Data from WITEL - I, WITEL - II, MATEL, PERUMTEL as of 1988

Table 98. Existing Telephone Facilities -- West Sumatra

Dev.Area	No.	Name of Exchange	MDL	CAP	SUB	CO. PH	Wait	Demand
14	1	Padang Panjang	LB	400	376	-	140	516
14	2	Batu Sangkar	LB	390	299	-	111	410
14	3	Padang Centrum	OT	11,000	7,628	68	6,231	13,859
14	4	Pariaman	LB	400	285	-	51	336
14	5	Muara Siberut	LB	50	19	-	0	19
14	6	Bukittinggi	OT	2,000	1,983	15	206	2,189
14	7	Maninjau	LB	40	29	-	0	29
14	8	Lubuk Basung	LB	150	88	-	0	88
15	9	Lubuk Sikaping	LB	200	179	-	22	201
15	10	Talu	LB	30	21	-	0	21
16	11	Payakumbuh	CB	960	894	-	323	1,217
17	12	Solok	CB	840	812	-	233	1,045
17	13	Alahan Panjang	LB	200	29	-	0	29
17	14	Muara Labuh	LB	200	46	-	0	46
17	15	Sawahlunto	LB	200	164	-	27	191
17	16	Sungai Dareh	LB	200	40	-	0	40
17	17	Sijunjung	LB	200	102	-	2	104
17	18	Silungkang	LB	200	158	-	0	158
18	19	Balai Selasa	LB	100	42	-	0	42
18	20	Painan	CB	640	186	-	36	222
		Total		18,400	13,380	83	7,382	20,762

Source : Data from WITEL - I, WITEL - II, MATEL, PERUMTEL as of 1988

Table 99. Existing Telephone Facilities -- Riau

Dev.Area	No.	Name of Exchange	MDL	CAP	SUB	CO. PH	Wait	Demand
20	1	Pekanbaru Centrum	OT	5,000	4,916	26	4,026	8,942
20	2	Bangkinang	LB	200	194	-	183	377
21	3	Dumai	OT	600	595		1,083	1,678
21	4	Bengkalis	LB	550	542	-	96	638
21	5	Bagansiapiapi	LB	826	564	-	0	564
21	6	Selatpanjang	LB	400	339	-	0	339
21	7	Pulau Halang	LB	40	11	-	0	11
22	8	Rengat	LB	320	308	-	31	339
22	9	Air Molek	LB	130	46	-	0	46
22	10	Telukkuantan	LB	200	73	-	0	73
23	11	Tembilahan	LB	960	786	-	263	1,049
24	12	Batam Batu Ampar	OT	3,000	1,693		2,081	3,774
24	13	Batam Sekupang	OT	1,000	222		0	222
24	14	Tanjung Batu	LB	200	95	-	0	95
24	15	Tanjung Balai Karium	OT	256	117		0	117
24	16	Ranai	LB	50	35	-	0	35
24	17	Tanjung Pinang	OT	2,000	1,959		1,267	3,226
24	18	Dabo Singkep	LB	50	44	-	0	44
		Total		15,782	12,539	26	9,030	21,569

Source : Data from WITEL - I, WITEL - II, MATEL, PERUMTEL as of 1988

penetration ratio in the Region remains at a low level compared with the international level, but is higher than the national figure: Region 0.44, Indonesia 0.40. Considering the level of telephone service provisions, the rate of automization of switching equipment is high, but the rate of automization of switching centers is low (Region 28.6%, Indonesia 40.0%). It is still very difficult for many subscribers to make long distance calls by means of direct dialing. There are still many applicants waiting for subscription to telephone services in big and medium switching centers in the Region. This is especially true in Medan, Batam, Banda Aceh, Pekanbaru and Padang, as is shown below in Table 100. The installation rate in 11 major cities is 68%.

Table 100. Installation Rates in Major Centers

City	Line Units (1)	Subscribers (2)	Waiting Applicants (3)	Demand (4)=(2)+(3)	Installation Rate (1)/(4)%
Banda Aceh	3,000	2,970	2,072	5,042	60
Lhokseumawe	2,000	1,975	399	2,374	84
Langsa	800	796	242	1,038	77
Medan	35,000	33,620	20,519	54,139	65
Binjai	1,000	992	509	1,501	67
P. Siantar	4,000	3,952	369	4,321	93
Padang	11,000	7,628	6,231	13,859	79
Bukittinggi	2,000	1,983	206	2,189	91
Pekanbaru	5,000	4,916	4,026	8,942	56
Dumai	600	595	1,083	1,678	36
Batam	3,000	1,693	2,081	3,774	79
Total	67,400	61,120	37,737	98,857	68

On the other hand, there are many kecamatans in the Region which do not have telephone services. For example, telephone lines have not yet been installed in 88 kecamatans in Aceh and in 122 kecamatans in North Sumatra. There is a considerable backlog of engineering and construction work owing to the lack of investment funds, as shown in Table 101.

1.3. Telecommunications Networks and Integrated Development Program (IDEP) Sites

409. Existing telecommunications networks, telephone exchanges and the IDEP sites are shown in Figures 56 and 57. Following points can be observed from those Figures:

(i) There are few telecommunications networks in the IDEP sites;

(ii) There are not a sufficient number of telephone exchanges to cover the IDEP sites;

(iii) It is necessary to expand the telecommunications local networks in the IDEP sites in connection with the implementation of IDEP.

1.4. Field Survey Results

410. A field survey was carried out to confirm the present situation described above and collect information from the Region. Local agencies and residents have the following demands:

(i) The number of applicants waiting for subscription to telephone services (waiting applicants) is increasing rapidly in major

Table 101. Present Status of Repelita IV as of Dec. 1988

System	Province	Plan		Completion	Remarks
	A	0		0	
Digital Local	B	12,000		10,000	On - going
Telephone Network	C	3,000		1,000	On - going
Switching	D	2,000		2,000	Completed
(Line Units)	E	1,052,000		360,000	On - going
	A	6,000		0	On - going
Digital Local	B	128,000		20,000	On - going
Telephone Network	C	7,000		7,000	Completed
Cable	D	29,000		800	On - going
(Air)	E	1,829,000		577,000	On - going
	A	-		-	
PCM Junction	B	1,680		0	On - going
Transmission	C	-		-	
(Ch)	D	480		480	Completed
	E	350,000		240,000	On - going
	A	528	(12)	0	On - going
Optical Fiber	B	1,460	(21)	150	On - going
and Microwave	C	1,048	(21)	450	On - going
(Ch (Links))	D	1,420	(30)	770	On - going
	E	79,000	(650)	11,000	On - going
	A	5		0	On - going
Small Earth	B	9		0	On - going
Stations	C	10		0	On - going
(Station)	D	5		0	On - going
	E	93		0	On - going

Notes : A : Aceh B : North Sumatra C : West Sumatra D : Riau E : Indonesia
Source : BINPROSISTEL, PERUMTEL as of Dec. 1988

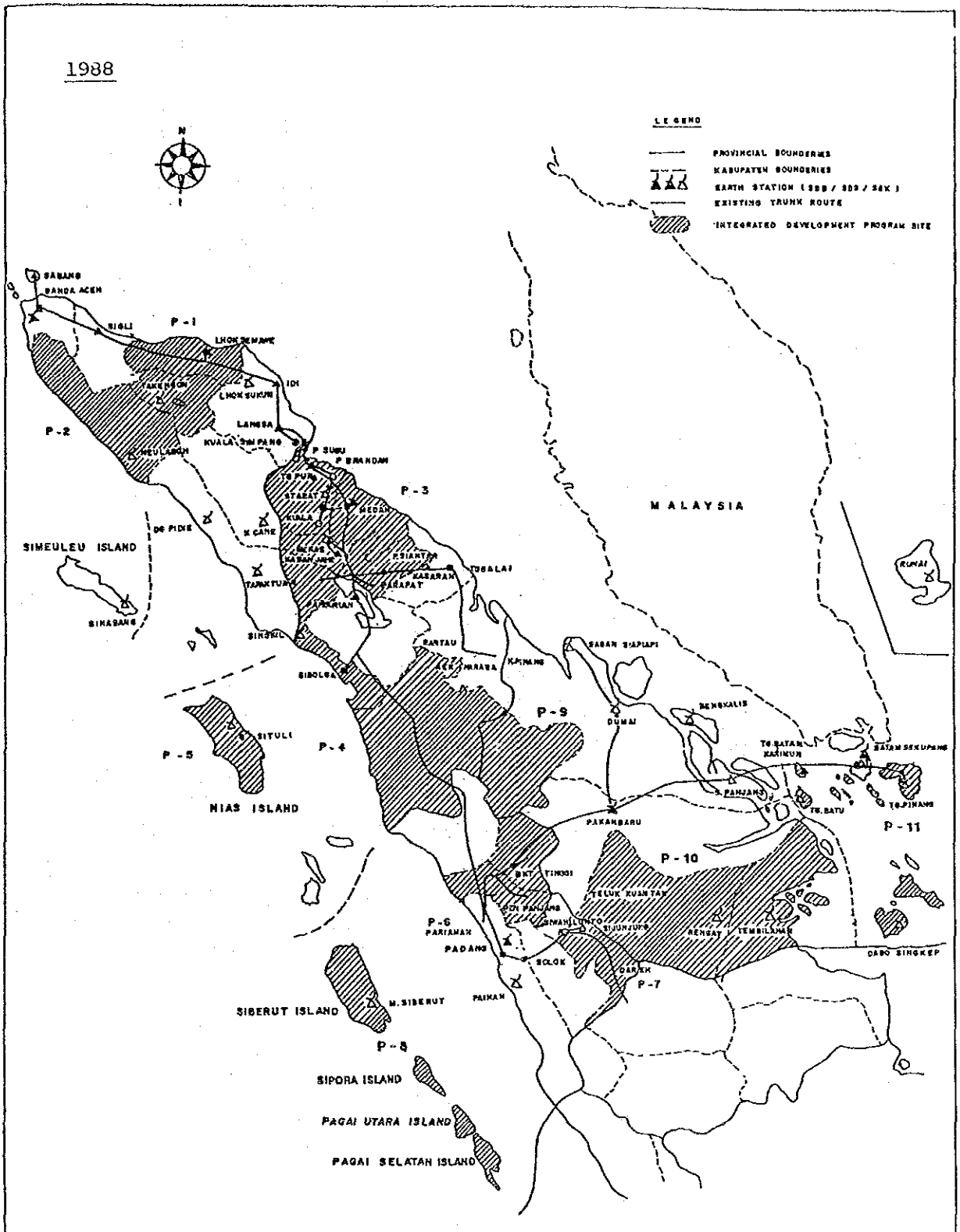


Figure 56. Existing Trunk Routes
and Integrated Development Program Sites

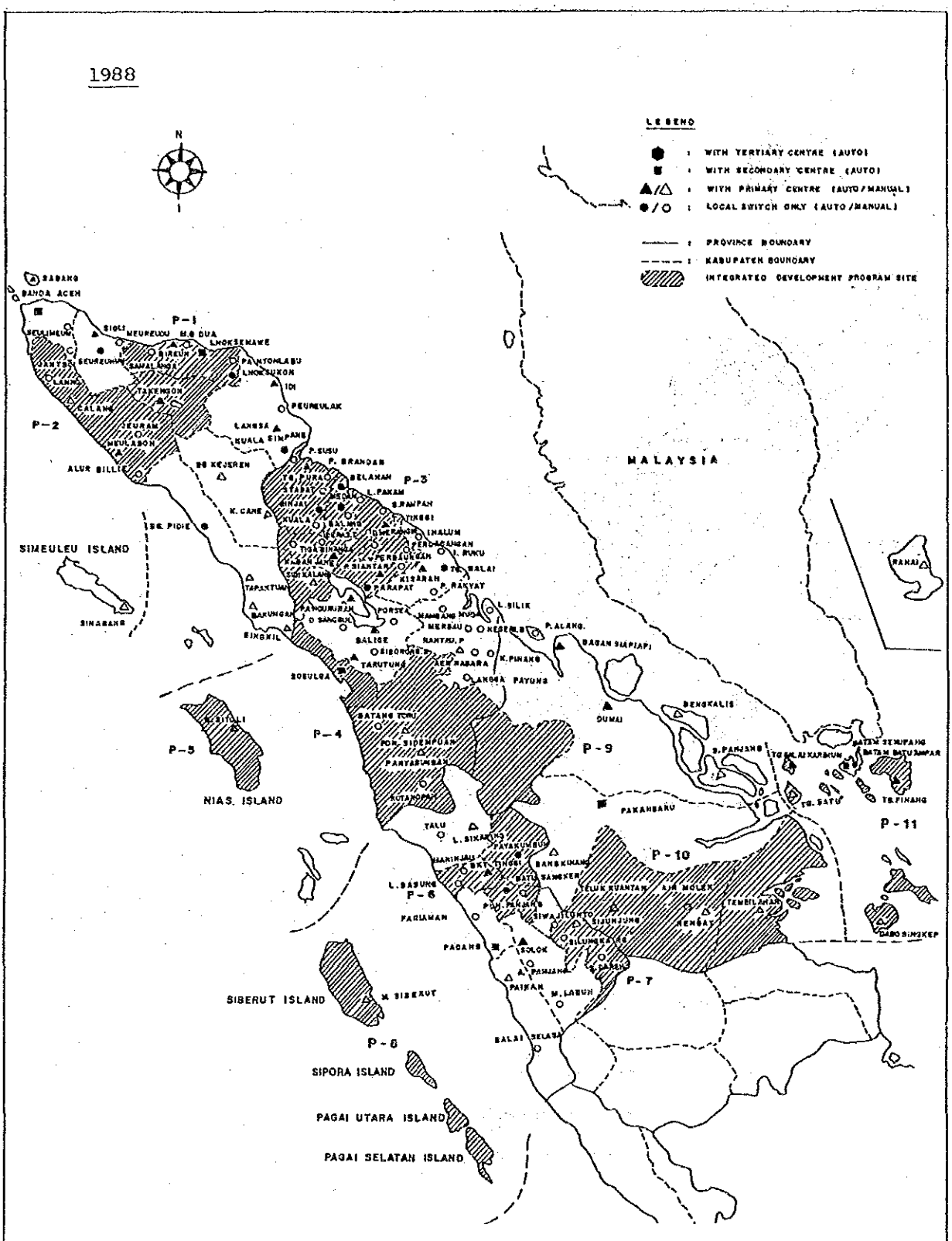


Figure 57. Existing Telephone Exchanges and Integrated Development Program Sites

cities. The installed telecommunications infrastructure cannot satisfy the demand. Expansion of local cable networks is an urgent problem.

(ii) Although the number of waiting applicants in small and medium size cities is not large, residents are demanding the telephones to be installed as quickly as possible.

(iii) Many rural areas do not have telephone services. As a result, one basic necessity for a safe, modern social life is missing.

(iv) In small cities and rural areas, the switching system mainly used is the manual switch board which takes a long time to access to long distance calls. Residents are therefore demanding an automatic switching system.

411. Other problems also exist as follows:

(i) In response to the increase in telecommunication facilities, advanced telecommunication systems such as intelligent terminals were introduced. Maintenance of these terminals is getting more difficult every year. It is therefore necessary to establish maintenance and training centers.

(ii) As the achievement of the Repelita IV program was relatively low, especially in the outside plant projects, the number of waiting applicants has increased. Therefore, acceleration of Repelita V is inevitable.

(iii) The construction costs in developing areas would be twice as high as those in major cities where telecommunication network facilities already exist. It is necessary for the government to give special consideration and assistance to developing areas when investing in PERUMTEL.

(iv) Expansion of telecommunication facilities is carried out in response to increases in the demand. When a duct is built, it follows that a road must be excavated. It is getting difficult to obtain digging permits from city authorities and thus delays in the construction period occur. It is necessary to hold coordination meetings between the local government and PERUMTEL with regard to the excavation of ducts.

2. Identification of Development Potential

412. Generally, the development of telecommunications is of benefit to national and regional development. Major benefits are:

-The support of socio-economic activities;

-The support of the public sector's administrative activities;

-The support of national unity; and

-The lessening of disparities between urban and rural society.

2.1. Telecommunication Sector's Role in the Integrated Development Program (IDEP)

413. The sector is expected to contribute to the IDEP in the following ways:

(i) Telecommunication media are essential to the smooth implementation of the IDEP and to the operation and maintenance of facilities after implementation;

(ii) Planned production of agriculture and industry may be possible, linking the productive base to the consuming area by telecommunication lines;

(iii) The extension and expansion of telecommunication networks may help develop education, social activities, and medical services;

(iv) Disparities between urban and rural areas may be lessened; and

(v) Socio-economic activities may become vitalized.

2.2. Development Strategies

414. With regard to the telecommunication development in the Region, the following objectives are of high priority, considering the present situation of telecommunications and the development goals to be attained by 2008:

(i) To expand telecommunication facilities based firmly on demand with due consideration to efficiency. Emphasis should be placed on high yield investment and strengthening the infrastructural base. Industrialized areas, commercial areas and administrative centers are of high priority;

(ii) To increase the telephone penetration ratio;

(iii) To advance the automization of subscriber dialing with due consideration to the satellite communication system;

(iv) To improve service quality;

(v) To lessen disparities between urban and rural telecommunication services, stressing the use of the satellite telecommunication system and the extension of rural telecommunication networks;

(vi) To develop manpower for the purpose of preparation for establishing a digital network; and

(vii) To improve operating and maintenance capability.

415. Based on the above objectives, development strategies to achieve the development goals are as follows:

(i) To expand local cable networks in the capital cities of the four provinces;

(ii) To make a long-term plan for telecommunication local networks because yearly expansion plans must always be based on the latest long-term plan according to the stage of city development;

(iii) To extend and expand rural telecommunication networks;

(iv) To establish Outside Plant Maintenance Centers (OPMC);

(v) To construct a digital microwave route in south Riau.