THE IMPACT OF TRANSPORT ON REGIONAL DEVELOPMENT IN INDONESIA

A Case Study of Province of North Sumatera

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ABSTRACT

THE IMPACT OF TRANSPORT
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Experiences from many countries show that transport can have conflicting results on development. This is a question as to whether the provision of roads can stimulate the centres to generate ripple and trickle down effects or whether they drain raw material, capital, labour and entrepreneurial talent from surrounding areas. There is also a hypothesis that if there is a relationship between capital formation and economic growth, there must be a relationship between transport and the growth. This study explore this phenonmenon in depth in the context of a case study of North Sumatera in Indonesia.

Economic growth factors and traffic volume data were collated from different sources covering the whole province of North Sumatera and were subjected to standard statistical tests. Despite the deficiencies in the data base, the findings suggest that the positive impact of roads on private investments, government activities and interregional trade is significant although roads may stimulate the concentration of investment and at the same time encourage interregional trade in the ports surrounding the primate city. It is also found that roads do not have a significant influence on the expansion of land use.

The findings also show that in this case, the provision of roads has an impact on regional income but the speculation that the long term impact of roads leads to a backwash effect from the less developed subregions appears to be true. Regional inequalities may be reduced in some measure when all settlements in the region can be accessed by vehicles in all weathers.

A simple model is constructed to examine the relationship between the volume of traffic and economic growth factors. This model is based on the gravity model. The findings show that agricultural land use and population have significant contribution to the generation of the volume of trucks and buses, respectively. Capital investment influences significantly on the generation of the volume of cars and trucks. Despite the level of significance, population makes the the smallest contributor to the volume of traffic.

Due to data problems, the conclusions from this study must be drawn carefully. The findings of this study therefore are more indicative than conclusive. Even though they may indicate and permit an anticipation of the future role of transport, they should be interpreted more as trends and tendencies than an absolute predictions.

To: Dini, Irma, Nina

and

Ida

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I.1 Overview of the Regional Planning and Transport System in Indonesia

A huge geographic dimension with natural fragmentation, a significant resource base and a large population need a good transport system to cope with distribution problems. Indonesia had a population of more than 165 million people in 1985 and the population was very unevenly distributed. About 65 per cent of the population were crowded into the islands of Java and Madura in 1961 and 61 percent in 1985, which made up 7 per cent of the nation's total land area.

In contrast, Sumatera, which forms 15 per cent of the nation's total land area, had only 16 per cent of the total population, and Kalimantan, which forms 26 per cent of the total land area, had only 4 per cent of the total population. The rate of population growth in Indonesia was 2.1 per cent in 1961-1971, 2.32 per cent in 1971-1980 and 2.15 per cent in 1980-1985, respectively[1]. The political system also shows that the central government controls strongly all economic and social sectors in whole regions of the country[2]. Indonesia as a whole can be seen in the Figure I.1.

Given Indonesia's situation as mentioned above, whether viewed in either physical, political or cultural terms, the country may need to formulate a regional development strategy which would coordinate other development policies and also strengthen the integration of the more isolated areas under central government authority. Since what

1. The figures are calculated from Indonesia Statistical Book 1986.
2. The democracy and government administrative system makes this control possible. In the development funds, the dependency of the local governments on the central government is also very strong, as **TJOKROWNOTO (1981: pp9)** stated, " ... plans, together with the regional development strategy formulated in Jakarta, helped determine budgetery allocations for sectoral projects and local government subsidies .. ".

Fig. I.1 Republic of Indonesia

is called the 'New Order' came to power in the late 1960's, a number of development approaches have been adopted in the country which emphasize "...on large-scale infrastructure projects in the late 1960s, changing in the 1970s to the focus on human investment and rural development projects aimed at directly benefiting the rural poor" **(MacANDREWS et al, 1982: pp 43)**. These projects have been proposed through Indonesia's first three Five-Year Plans started in 1969.

The First Five-Year Plan (1969-73) gave priority to economic growth, stabilization, and the rehabilitation of infrastructure. One significant programme that was introduced in this Plan was Inpres (Instruksi Presiden). This programme channels central government development funds through the local government structure by a system of direct and flexible subsidies.

The Second Five-Year Plan (1974-79) continued the First Plan and considerations of social equity were emphasized. Inpres regional development subsidy programmes were expanded, receiving in this period between 15 and 20 per cent of the national budget and it accounted for up to 20 per cent of the provincial development **(MacAndrews et al, 1982: pp 48)**. In the same period, 1974, Bappedas were established as provincial planning boards to coordinate all planning at the second hirarchy of the government administration, Provincial Government level. Provincial Bappedas are directly under the Governor's control.

The Third Five-Year Plan (1979-83) focussed " on coordinating the different regional planning efforts, building up the capacities of local government planning organizations, and implementation of local area plans in selected parts of the country" **(MacANDREWS et al, 1982:pp 51)**. Bappedas which had been set up in provinces, in this period, were extended to the third level hierarchy, or Kabupaten level. The third plan greatly emphasized rural development activities.

As stated in the beginning of this study Indonesia consists of many islands. This leads to physical disadvantages in the sense of coordination and distribution of development in the country. The roles of transport and communication are essential to overcome the disadvantages. The government is aware of the importance of this sector, which is shown in the budget allocated in every plan since 1969.

Before 1969, linkages between islands were mainly operated by a sea fleet which was in very poor condition. Land transport was provided by the road system and in some parts of Indonesia, the road system was supplemented by a rail system. The condition of road development in Indonesia, compared between 1939 and 1959 showed there was serious deterioration. It was illustrated by the length of asphalted road which declined from 12,269 kms in 1939 to 10,047 in 1959. The length of non-agricultural road had declined from 40,521 kms to 22,910 kms **(POND, 1968: pp 58).**

Over the same period, motor vehicles increased by nearly 200 per cent. Almost all of the highway in that period was designed to accommodate low vehicle roads and low volumes. Most of existing roads were constructed prior the Second World War **(Ibid).**

The railway which was also constructed prior to the Second World War had 7,324 kms in 1939 and 6,640 kms in 1959. There was no new investment after 1949. Over the same time passenger traffic increased from 68.4 to 192.7 million per year. Freight carried by the rail system dropped from 10,797 to 6,110 thousand tons in 1959[3].

The government realized that transport was important for stimulating the economic growth as a national development objective. The road improvement program was introduced in the late 1960's. This programme was financed by the national budget with the assistance of several foreign donors.

The First Highway Project was funded by the World Bank in 1969. The purpose of this project was to rehabilitate 3000 kms in 5 provinces: West Sumatera, South Sumatera, West Java, East Java, South Sulawesi and a four-year maintenance programme in twenty provinces. The available funds from the World Bank for this purpose were about US$ 28 million. The UNDP (United Nation Development Program) also provided a group of consultants to develop a framework for planning and for the extension rehabilitation and development of highways[4].

A Second Highway Project costing US$ 34 million in 1971, was proposed to construct a section of Trans-Sumatera which served as a major site of transmigration development. This project was completed in 1977. A Third Highway Project, costing US$ 14 million which started in 1975 was provided to give access to a new irrigation area in North Sulawesi, the Dumoga. The purpose of this project was to stimulate the increase in rice, copra and other agricultural production.

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3. This information is taken from Statistical Handbooks, Jakarta, Central Bureau of Statistics.
4. The information about transport projects in this study is taken from **LEINBACH (1986)**.

The Fourth Highway Project was provided to achieve broader objectives than the previous ones. Included in this programme was the establishment of regional offices to evaluate, design, and supervise construction works The projects which were supported by this programme were some major roads in West Java, Central Java, East Java, Bali and North Sumatera. Major links in North Sumatera which were rehabilitated under this programme were Tebing Tinggi to Rantau Parapat, Pematang Siantar to Sibolga, and Gunung Tua to Jembatan Merah. Almost all of these links have national road status[5].

The National budget itself has contributed a considerable share to transport development. The end of The First-Five Year Development Plan (PELITA I:1969/70-1973/74), which started in 1969, showed an increase in the budget allocation from central government to the road sector. The total transport budget allocation was approximately Rp 297 billion. More than a half of this budget was allocated to road improvement or new construction. This budget covered 100,000 kms of roads to be maintained, 6534 kms of roads to be rehabilitated, 3784 kms of roads to be upgraded and 367 kms of roads to be reconstructed or newly constructed.

Total transport expenditure in the Second-Five Year Development Plan (PELITA II:1974/75-1978/79) was Rp 753 billion. Forty per cent of the total expenditure was allocated into the road sector. The total transport expenditure was about 15 per cent of the Central Government's total development budget. The main objective of this plan was to achieve a balance between the various modes, between the scattered resource-rich outer islands and the concentration of major market areas on Java; between urban areas and rural areas. It was expected that improvement of roads would stimulate entrepreneurs to begin new activities.

5. All of these settlements can be seen in the Figure I.2.

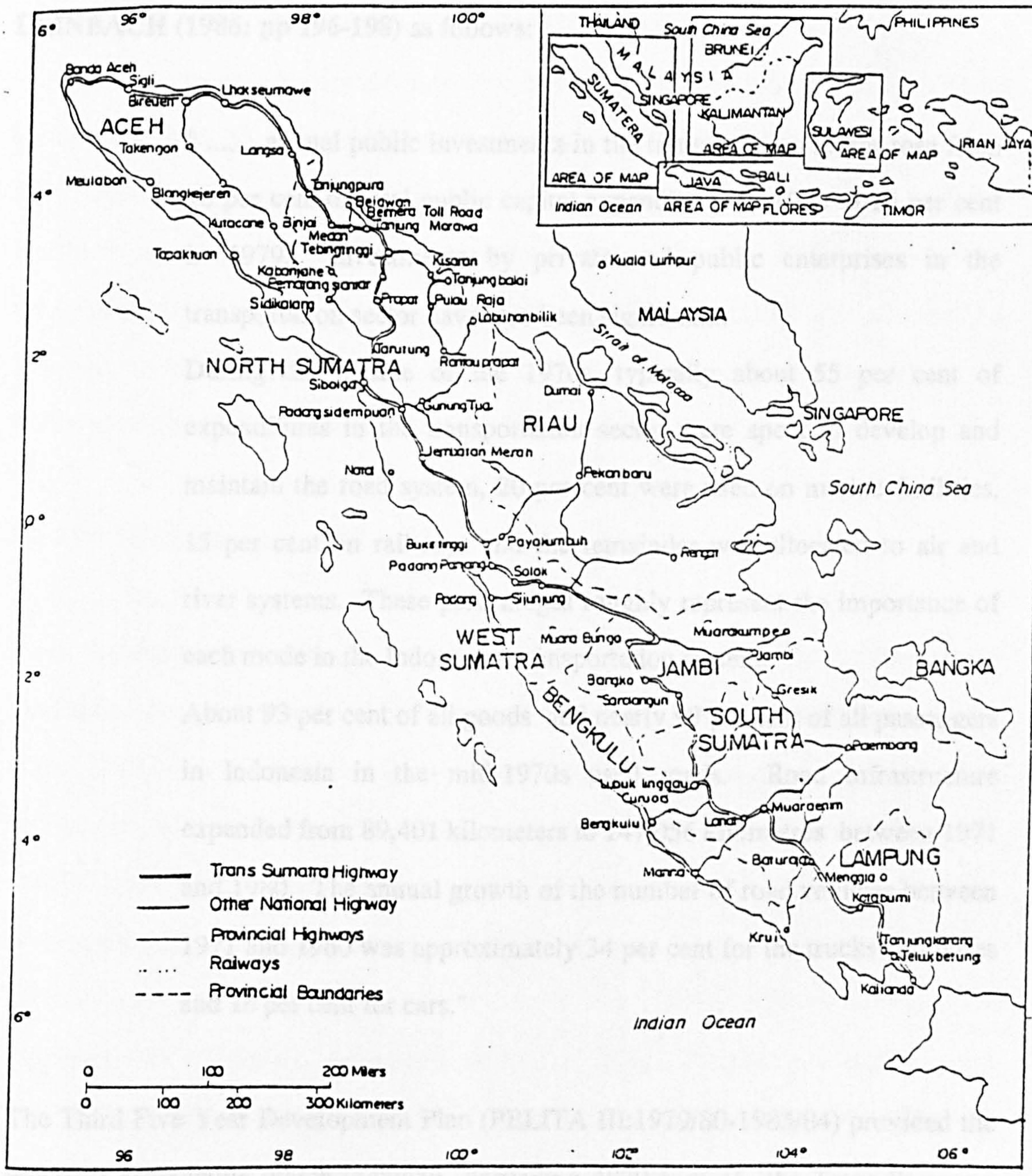

Fig. I. 2 ROAD AND RAIL NETWORKS OF SUMATERA
(Source: LEINBACH, 1986)

The transport development trend in Indonesia during 1970's has been described by **LEINBACH (1986: pp 196-198)** as follows:

> " .... annual public investments in the transportation sector rose from 10 per cent of total public capital expenditures in 1970 to 16 per cent in 1979. Investments by private and public enterprises in the transportation sector have also been significant.
>
> During the decade of the 1970s, typically about 55 per cent of expenditures in the transportation sector were spent to develop and maintain the road system, 20 per cent were used on marine facilities, 15 per cent on railways and the remainder was allocated to air and river systems. These percentages roughly represent the importance of each mode in the Indonesian transportation system.
>
> About 93 per cent of all goods and nearly 99 per cent of all passengers in Indonesia in the mid-1970s used roads. Road infrastructure expanded from 89,401 kilometers to 147,056 kilometres between 1971 and 1980. The annual growth of the number of road vehicles between 1971 and 1980 was approximately 34 per cent for the trucks and buses and 16 per cent for cars."

The Third Five Year Development Plan (PELITA III:1979/80-1983/84) provided the transport programme which included upgrading 4930 kms of the Trans-Sumatera Highway and the construction of 433 kms of Trans-Sumatera Highway. The concentration of the construction was in the provinces where the transport projects took place, such as Muara Bungo and Lubuk Linggau. The Belmera Toll Road, as a section of the Medan outer ring road which channels through traffic from Siantar to port Belawan was included in this programme. The Belmera Toll Road was the first toll road outside Java.

The fund to finance the Belmera project was supported by US$ 18 million from Kuwait and US$ 23 million from West Germany. This project was completed in 1988. Roads play a more important role than the other sectors in REPELITA III, as shown by the percentage of budget allocation in the road sector. Fifteen per cent of the total plan investment, about Rp 2.99 trillion (US$ 4.8 billion) was allocated in transport sectors. Over 50 per cent of the transport budget was planned to be allocated on the road infrastructue.

I.2 Rural Roads in Indonesia

From the above description, it can be seen that the emphasis of the government on road development was very clear. The trend of road development is high enough since 1970 but it still cannot cope with the lack of access to many villages and rural settlements. Generally, budgets which are provided by Central Government are allocated into roads which are under national status. Provincial roads, particularly rural roads which are under kabupaten still lack finance.

20 per cent of villages on Java and 30 per cent of villages outside Java still were not accessible at the beginning of the 1980s. The emphasis on transport development as shown from the First Year Plan to the Third Year Plan, particularly in the road sector, show that the government realized the lack of road network was an obstacle to national integration, civil administration and economic development especially to agricultural development.

Rural roads are mainly under the Kabupaten responsibility. Kabupaten roads comprise 68 per cent of the total road length in Indonesia and it is estimated that only 23 per cent of these roads may be classified as 'good' and the remainder classified from adequately maintained to heavily damaged. This average percentage varies considerably so that Java has 35 per cent of its kabupaten roads classified as good while Sumatera and Kalimantan have only 19 per cent, Sulawesi 21 per cent; Bali, Nusa Tenggara and Maluku 12 per cent, and Irian Jaya only 2 per cent in 1980 **(LEINBACH, 1986: pp 204).**

The capability of kabupaten governments to finance their rural roads is very weak because they lack resources of income. This weakness is overcome by the Central and Provincial Government efforts to finance and implement road improvements in some links at the kabupaten level. A major source is the INPRES (Instruksi Presiden) programme which provides 30 per cent of the national development budget to provinces, kabupaten and villages for infrastructure construction in the Fourth Pelita.

In theory, the planning and implementation of the roads is decentralized but, in fact, it is very often the higher hierarchy authorities who intervene in the budget allocation in the kabupaten. The result of this programme has not been satisfactory. The inexperienced personnel, inadequate supervision and maintenance are also other reasons why this programme cannot fully achieve the road programme objectives.

Another programme which was introduced by central government through the Ministry of Man Power and Transmigration which is called the Padat Karya Gaya Baru (Cash Incentive Rural Works) programme. Under this programme, income supplements are given to local residents in very poor kecamatan (=hierarchy under kabupaten) in exchange for labour on rural infrastructure projects. Between 1974 and

1979, nearly 1400 projects were completed of which 60 per cent were roads. The distribution of this project was such that over 80 per cent was allocated in Java and the rest was allocated in the outer islands.

The incapability of the kabupaten government to finance rural roads which are under their responsibility invites the effort of the higher hierarchy who have more resources of income to support more effective work in rural road programme. The World Bank, through The World Bank Rural Road Development Project, also provides financial assistance in a programme which started in 1982. The amount of loan was US$ 100 million which was distributed over a 3 year period on rural road programmes and covered 246 kabupatens in the provinces of North Sumatera, West Sumatera, Bengkulu, Jambi and West Java.

The Asian Development Bank loan provided a loan of US$ 120 million in September 1985 to develop rural roads in Central and East Java, Bali and West Nusa Tenggara. This loan supplemented an earlier loan of US$ 240 million from the World Bank for general restoration and upgrading of the network, especially inter-city linkages.

I.3 The Aims of The Study

From the above description, it can be concluded that a significant allocation has been made to the transport programme particularly in the road sector. No intensive study has been conducted to investigate the level at which road development induces regional development, except that made by the Indonesian Government during 1978 and SEATAC during 1979.

During 1978 an ex post evaluation survey was conducted to study the impact of the Rural Works programme road project in order to improve future projects **(LEINBACH, 1983: pp 23-35)**. Thirty-six feeder roads were selected from 445 projects as survey samples which were constructed between 1975 and 1978. Information was collected through household interviews either formally or informally at each of the project locations. A total of 2500 formal interviews were derived from the study. The information was collected from a sample of household heads who lived within five kilometers of the road projects.

The study found that roads had a significant impact in terms of social and economic benefits, such as visits to health facilities, markets, and journeys to seek development.

SEATAC (South East Asia Transportation Agency Committee)'s study was a collaborative research effort by four South East Asia countries and a consultant team to develop, test, and refine a model and methodology for the transport impact assesment in order to find ways to enhance the economic and social benefits of transport investments in remote areas **(SEATAC, 1979)**. In an Indonesian context, this study was conducted to investigate the impact of sea transport in Halmahera. The area of the study is shown in Figure I.1 as well. This study was funded by USAID.

Seatac's study made an attempt to identify the availabality of data in the project areas and to develop measurement methods and instruments designed to test the strength or weakness of linkages in a theoretical model of impacts of transport investment on income distribution, quality of life and regional growth in remote areas.

Data concerning four different types of transport investment were collected in six project areas in four Southeast Asian countries which are two bridges in northern

Luzon in the Philippines, two rural roads in the northeast region of Thailand, a river system in Serawak, Malaysia, and a shipping line serving the Halmahera islands in Indonesia.

As described previously, during 1975-1985, there were considerable transport improvements in Indonesia. Provision of more roads and/or road improvements is expected to stimulate an increase in agricultural production which is closely related to agricultural land use, to attract investment to regions, to distribute government activities and social development within the region, to promote interregional trade and to support regional development policy **(PURNOMOSIDHI, 1978)**. The conventional approach in transport policy which seeks the benefits of road improvement solely in agricultural production may still influence transport policy in Indonesia although some studies have started to consider the impact of transport in a broader social terms including access to education facilities, health and other facilities and increased personel travel. However, no study has investigated the impact of transport on income either at the local or at national level.

Economic progress is closely related to the supply and demand sides of the economy. The effect of transport on the supply sides of the economy is based on the assumption that an increase in the supply side will result in a rise in factor prize, if factor inputs are assumed fixed.

Road improvement leads to decreases in the transport costs, at least in theory, which seems to be important as a means at stimulating supply side of the economy such as agricultural production from new land. There is an assumption that transport networks have an influence upon such areas where economic activities take place. This assumption is also the basis for market area theory. Another assumption which is based on Thunen's theory is that the type of agricultural planted area has a relationship with distance to market centres **(TARRANT, 74)**. The importance of the factor 'distance', may be translated into transport costs which may be related to the degree of road improvement. If this assumption is true, the effects of transport are important as a stimulate of land use for certain commodities although the level of success of this stimulation still depends on the situational factors and available demand in the region in question.

A decrease in transport costs makes it possible for one market centre to enlarge its market area, and this situation will stimulate demand. The increase in demand which is induced by transport networks themselves may have a multiplier effect on regional and national income. Another argument states that transport costs are only a small proportion of the final costs of a product so road improvement may not stimulate such a condition which has been just described to exist. Despite these arguments, however, road improvement plays an important role in making possible the movement of private investments and creates the economic opportunity which induces economic growth **(WILSON, 1966)**. Government expenditure and social developments provided by governments are also one type of investment. They are called social overhead investments **(HODDER and LEE, 1974)**.

Transport networks expanding in a remote area, make it easier to supply other areas from the area in question, but at the same time will make it easier to supply that area from elsewhere. Since most of remote areas have disadvantages in terms of non-transport factors, the impact of transport may be more negative than positive. On the other hand, the region which has advantages in terms of non-transport factors that seems to be in position to get benefit from transport improvement. This situation may also exist in the impact of transport improvement to and from ports regarding the regional balance of the trade **(GWILLIAM and JUDGE, 1974)**. Ports with higher economic potential may get advantages from the less ones.

The view that provision of roads gives rise to economic growth by attracting investment to a region rests on two assumptions. The first is that investment will generate economic growth in the region. The second is that the expansion of transport networks is an efficient method of distributing economic growth. This does not always mean that the distribution of economic growth is a result of the distribution of investments or other particular development activities. It may also occur because of situational factors which make it possible for the region to grow.

As argued previously that the role of transport is a significant cause of growth and the role of government is essential as a means of providing roads efficiently. It is also clear that no region where there is a critical lack of transport facilities is moving ahead very fast, but at the same time some regions that have fairly impresive transport facilities also seem to be going nowhere because the lack of non-transport factors. Transport may be closely related to economic progress. Underdeveloped subregions will have a low volume of movement; and conversely, where transport facilities are minimal, economic progress is slow.

The first question that must be considered is as follows: if transport has a significant role in economic growth, is also significant for other development indicators such as education, health and land use since such indicators are also ingredients of economic growth. An understanding of this phenomenon is very important for the transport aspects of development policy because transport is quite different from most other economic activities. It must be recognized that the answer to this question is not conclusive but rather indicative since other aspects of development also have different levels of influence on these factors. The most important consideration is that the provision of such developments reflects the balance of supply and demand. The provision of roads, in some cases, has a significant role to make it possible.

In developing countries such as Indonesia, regional development planning is still an approach which is adopted by the government. The second question that can be raised, then, is as to the extent to which transport networks during the period of study made a significant contribution to achieving regional development goals. Following from this, are there any criteria of providing roads which could be suggested for adoption in the transport sector of development policy? These two questions provide the starting point for the research and the aims of this study[6]. They are:

1. to investigate the impact of road networks on development and income distribution; and thereby[7].
2. to provide inputs regarding the most affective ways in which road investment can be used to broaden social and economic benefits at a provincial level.

The Province of North Sumatera is selected as a case study in this investigation for the following reasons :
Firstly, North Sumatera is one of the Provinces with the highest potential outside Java. The provincial income is mainly from agriculture although an industrial share contributed into the income showed an increase. It means that rural areas still play a

6. There is slight difference between aim and objective. Aim is defined as "as desired outcome" **(ACKOFF, 1978)**, "a ... requirement to be met" **(SELLTIZ et al, 1959)** or "satisfy certain criteria" **(CHADWICK, 1971: p 114)**. To support the aim(s), one or more objective(s) are proposed. The objectives are classified into explatory, descriptive, and/or experimental in nature. The objective(s) of this study will be discussed in Chapter III.
7. Analytical method is used, as **RONDINELLI (1977: p 69)** stated "to formalize and direct the search for investment oppurtunities designed to make a strong development impact".

dominant role in provincial economic growth. This study is concerned with investigating whether development, particularly in the agricultural sector, is stimulated by the provision of roads.

Secondly, North Sumatera is one of the provinces which has benefited from foreign loans. The road improvement and the new road construction in North Sumatera were included in The Fourth Highway Programme and The World Bank Rural Road Development. The INPRES budget to the province has been allocated to many areas which lack of accessibility. North Sumatera is one of the provinces outside Java to receive the biggest amount of the road budget. The level of efficiency of the road investment needs to be identified as input to the available model which can be constructed by a regional or transport planner.

I.4 The Structure of the Thesis

This thesis is divided into 9 chapters. Chapter I introduces the regional planning and transport system in Indonesia including rural roads. Chapter I also sets out the aims of the study and the structure of thesis. Chapter II reviews the studies have been done in many developing countries in the context of roads and development. It identifies what each study defines 'development' and considered their findings in the context with transport and development. Some experiences from the U.K. are also reviewed as a comparison to those from the developing countries.

Chapter III reviews the definition of development and examines the links between transport and development. The more detailed objectives and hypotheses of the study are introduced at this stage. The last section of this chapter sets out the technique of analysis which is adopted in this study.

Chapters IV and V present a profile of North Sumatera in terms of planning process, demography and inter-regional trade. Chapter IV also reviews the development of transport modes and settlements while chapter V analyses economic growth factors in the area of study. The first section reviews the Indonesian economic environment and identifies the position of North Sumatera in the national framework. Existing land use patterns and the spatial distribution of investment and government activities are described in relation to the development of these economic growth factors and road development.

The relationship between road indicators and regional development is explained using a number of statistical techniques in chapter VI, VII and VIII. The description of road networks is discussed in the beginning of chapter VI. Chapter VII concentrates on the impact of roads on the regional economy in the terms of GDP. This chapter further discusses the spatial impact of roads on development and on income distribution. Whereas the previous chapters attempt to investigate the impact of roads on economic growth factors, Chapter VIII examines the impact of economic growth factors on generated traffic. Chapter IX summarises the main findings of the thesis and makes a number of recomendations for both policy and further research.

II. ROADS AND DEVELOPMENT: PREVIOUS STUDIES

II.1 Introduction

This chapter attempts to review the studies which have been done in many developing countries in the context of roads and developments. It identifies what each study defines 'development' and considers their findings in the context transport and developments. This study concentrates firstly on the Seatac's study since it provides a comprehensive approach to the impact of transport on development. The methodology is also reviewed. The conclusions which are drawn from this evaluation can be compared to those from other countries' experiences. Some experiences from the U.K. are also reviewed as a comparison to those from the developing countries.

The main objective of this chapter is to identify issues which are likely to occur in the area of this study and form the basis of the hypotheses of this study. Another objective is to review the methodology which may be used in this ongoing study.

II.2 SEATAC's Study: Transport and Development

Methodology

Fig II.1 shows the impact model which was introduced in Seatac's study. The model begins with three types of 'input variables' that are seen as potential stimulants to development change: the transport investment, other government investments and private investments. Combination of these investments produces several immediate impacts on employment, accessibility and environment. In the transport context, the most important impact to consider is the accessibility change.

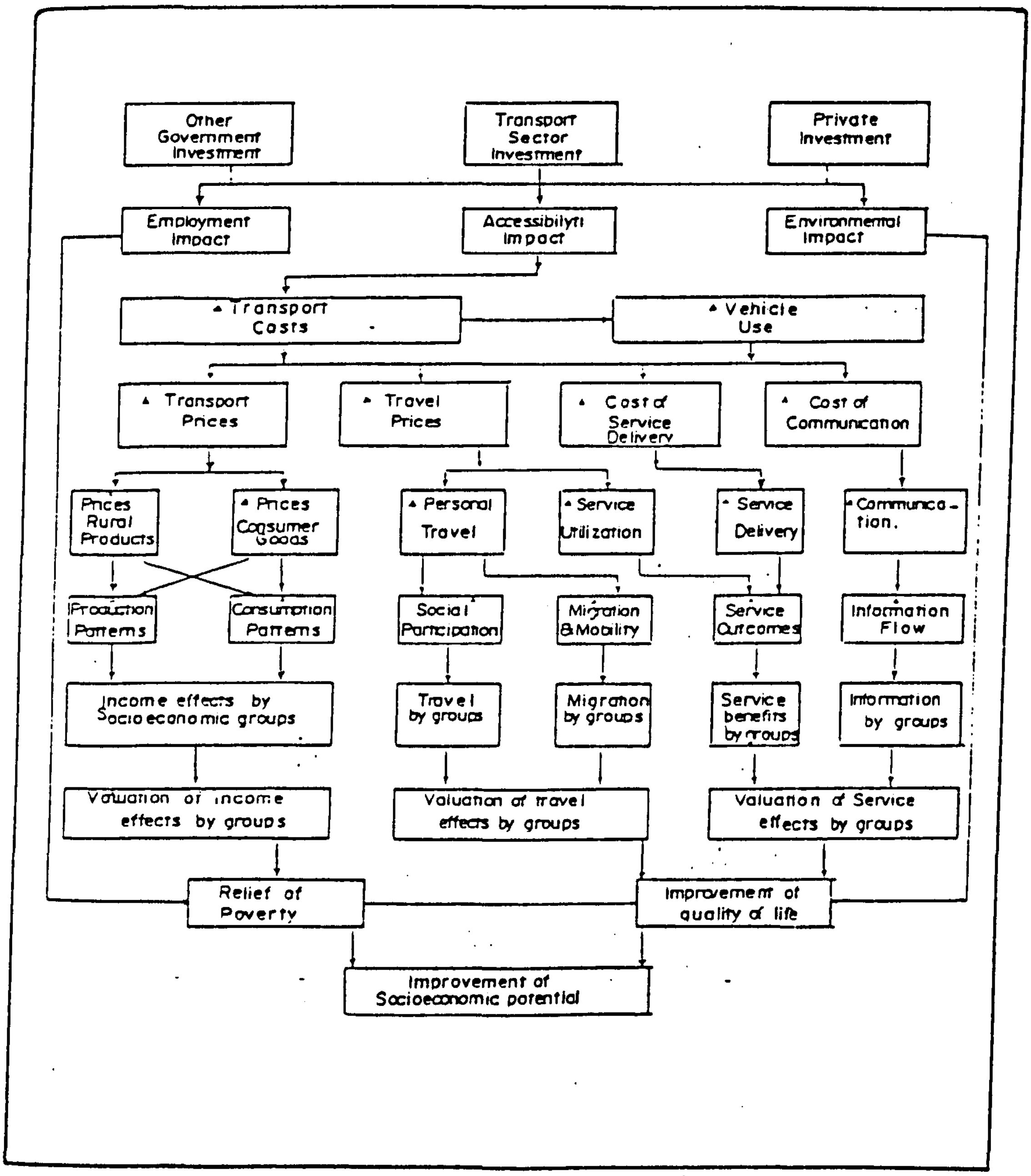

Fig. II. 1 SEATAC's Impact Model

Accessibility change leads to change in two elements. The first element is change in transport cost and change in vehicle use pattern. These two elements induce the change in four factors of traffic pattern which are transport price, travel price, cost of delivery service and cost of communication. Transport price is more concerned on goods and commodity movement costs while travel price is concerned with passenger movement.

Cost of service delivery induced service mobility such as education and health. Cost of communication is concerned with information flows including the accessibility to farmers of new techniques. The model illustrates that change in transport cost lead to change in vehicle use pattern and it simultaneously affects the behaviour change on the transporters and service providers.

The expansion of the model shows that the change of transport pattern induces second-order behavioural responses. It is hypothesized that " a reduction in transport tariffs for goods could lead to change in production and consumption pattern ; that a reduction in passenger travel costs and an increase in safety, comfort, and convenience would lead to changing pattern of association, migration, and settlement; that changes in service delivery patterns and the costs of travel to the consumer would produce varying pattern of service utilization; and that increased flows of goods, services, and information between points in a network would facilitate communication and enhance oppurtunities for local participants in development decision making" **(SEATAC, 1979: pp 1-6)**.

Seatac's study emphasizes the distribution effects, therefore the study finds ways to establish the incidence of these costs and benefits by socio-economic group. In addition, investigation of geographical limits of transport investment impacts is also considered and the way in which they vary as a function of accessibility change. The population in the study are stratified in two ways which are by socio-economic status and by distance from the study project. The behavioural responses are measured across these groups. An overall assesment on income distribution, quality of life and regional growth potentiality is studied by combining the impact on different groups as described above. Actually, Seatac's study has modified the proposed model because of data available and time limitation.

Seatac's study also considers variables whose values might vary between project sites which can lead to variation on project impacts. These variables are divided into two general classes which are situation factors and policy constraints. Situational factors 'represent' these condition that must be taken as 'given' in project planning, while policy constraints represent those condition that could be changed by governmental action at the national, regional, or local level. These variables are called mediating variables. The list of these variables is shown in Fig. II.2.

There are two conclusions which can be drawn from the Seatac's approach and which can be considered in this study as influential variables onto the level of accessibility[1]. These are transport, and public and private investments. Secondly, the different results of the impact of transport on development among the study's areas are influenced by the external factors which are called in Seatac's study as mediating variables.

In order to achieve its objective, Seatac's study had conducted the individual household surveys and then were supplemented with whatever could be found out from government administrators, village officials, and private entrepreneurs in the project areas. Approximately 200 households have been interviewed in each project area. The selection of the respondent was based on a multi-stage, stratified random sampling technique.

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1. Level of accessibility in Seatac's study is based on transport costs and vehicle use.

FIGURE II.2

MEDIATING VARIABLES

A. SITUATIONAL FACTORS

1. Physical Characteristics
   a. Terrain
   b. Soils and Geomorphology
   c. Hydrology
   d. Climate and Rainfall
   e. Vegetation

2. Population Characteristics
   a. Size and growth rates
   b. Density
   c. Age/Sex structures
   d. Socioeconomic groups
   e. Ethnicity
   f. Religion
   g. Nationality

B. SOCIOECONOMIC STRUCTURES
(Policy Variables)

1. Economic Structure
   a. Land tenure
   b. Land use
   c. Investment in rural industries
   d. Patterns of employment
   e. Structure of transport service sector
   f. Pricing/marketing/storage systems
   g. Credit systems
   h. Tax policies and effects

2. Social Structures
   a. Settlement patterns
   b. Patterns of association
   c. Formal organizations
   d. Educational levels
   e. Health levels
   f. Social control mechanisms
   g. Information levels
   h. Participation in planning

Those administrative units with population centres at varying distances from the projects were selected within a 10 kms impact zone. Within each administrative unit, three villages were selected as samples. Urban centres were excluded from this process in order to assure an adequate sample size of more population. Within each sample village, 20-25 households were selected. Questionaires were distributed to get respondents' recall of their circumstances and behaviour prior to implementation of the study project, a period of from five to ten years before the present project.

Eight socio-economic groups were proposed to take into account on the impact analysis although the result of some of these groups were not significant because of a relatively small number. The eight groups were subsistence farmers, low-income cash-cropping farmers, high-income cash-cropping farmers, food farmers with outside income, cash crop farmers with outside income, landless farm labours, nonfarm labours and others. Seatac's study provides a definition for each group.

Study's Findings

i. Agriculture

Indonesia's experience in Halmahera shows that the last five years, since the project begun, the number of farmers planting new high-value cash tree crops has increased significantly, while previous planters have increased their stands. As they come increasingly into production over the next several years, there should be substantial gains in income in the study area.

No explanation is given as to whether the transport improvement promoted new crops in the study area. The study also did not show that the increase in tree crops induced land use pattern change from other crops. Fertilizer use is virtually non existent in the study area.

Malaysian experience shows that there seems to have been a slight movement in the direction of more farms and expanding cultivated areas. The only crop that was introduced into the study area during the project period was cocoa. Pepper, fruits, irrigated rice, and high-yielding rubber are the crops that have made the greatest percentage gains over the study period. The use of fertilizer on rice was significantly increased but the use on vegetables did not change over the time period.

Cultivation of other subsistence crops (maize, cassava and sago) has also remained basically stable with a slight overall increase reflecting the addition of new farms. A significant number of farmer maize producers have abondened this crop, because of a shift into irrigated rice. Cultivation of coconuts, vegetables, and fish ponds has increased on the average, but there has also been a relatively high abandonment rate for the latter two.

Study of the Philippines shows that agricultural expansion is similar with Indonesia. The area cultivated and the cropping patterns changed relatively little over the study period. No new crops were introduced in the study area. The finding also shows that there is unlikely changing pattern in small farm cropping. The improvement of accessibility permits traders come into the study area and pay farmers a price for palay that includes transport costs. The use of both fertilizer and high-yielding variety seeds for the palay crop was a very significant change.

There is a significant increase in the percentage of farm owner-operators in Thailand's experience during the study period. There has been a definite increase in the use of fertilizer by the sample farmers since the roads were built. Among the sample households, twice as many farmers sell products now as sold them ten years ago, and there is a marked change in the point of sale and the means of transport. Road improvement only increased slightly the use of fertilizer and the socio economic condition of the farmers also has an influence. The higher the income of the farmers the more fertilizer they used.

ii. consumption

Seatac's study shows a substantial change in consumption in Halmahera over the project period. Except for farm machinery, and the one outboard owner, over half of the families owning such assets have acquired the items during the last five years. Other evidence of significant consumption change in the study area is that the number of shops and village-owned boats and vehicles increased by fifty per cent. There was no explanation of whether transport improvements in Malaysia had a significant influence on consumption.

In contrast to Indonesia's experience, The experience of the Philippines seems that the improvement of accessibility has made a striking difference in the patterns of household consumption. In Thailand, the findings show there is an increase in household consumption, similar to the Philippine's experience[2].

iii. travel

Indonesia's experience in Halmahera shows that the change in travel outside of the kecamatan was not significant. Travel is infrequent. Household heads travel most frequently about twice as many household heads as spouses make trips outside the kecamatan. On a per capita basis, travel by other household members is about one-third as frequent as it is for spouses.

2. Consumption is defined here, is the ability to buy goods such as bicycles and radios.

Malaysia's experience shows that only a very small share of those who never travelled prior to the study period have begun travelling since the project began. Different to Malaysia's experience, Seatac's study in the Philippines shows that there is a great deal more personal travel than before, particularly local trips. Children attending secondary schools are also significant users of transport.

The construction of the roads in the study area in Thailand shows a substantial increase in travel outside the village although the increase is inverse to the distance.

iv. service utilization on education, health and credit

Indonesia's experience in Halmahera appears that little change in educational attainment has taken place over the study period. Only thirty-six per cent of the respondents say that their visits to the health centre is more frequent than five years ago. It appears that change is not correlated with distance and probably reflects a growing awareness and availability of more facilities. There was no pattern of change of children born during the project period. The children born were delivered at home without a formally -trained midwife in attendance. There is little use of agricultural credit in the impact zone. It appears that transport improvement does not induce the increase in number of credit users.

Seatac's study in Malaysia shows that there is a considerable improvement in the relative position of women, an increase in numbers of literate young adults including children over the project period. More frequent visits to health centres remain high for distances up to 10 kms, but they drop off sharply thereafter.

The percentage of children born in hospitals remains small and declines slightly over the project period. It appears in Malaysia's experience that effects of transport on health care in childbirth took place in two stages. During the first half of the project period, improved mobility resulted in midwives attending home delivery with significantly more access than before. In the second half of the project period, construction of fixed facilities increased the opportunity to deliver children away from home but had the effect of withdrawing resources from services delivered in the home.

The data indicate a steady growth in credit use, largely associated with the penetration of subsidy schemes. Transport improvements do not affect other forms of credit use.

The Philippine's experience shows, in contrast to Indonesia's experience, that transport improvement induces education development. More children are going to school now than before. The number of children with no education, though, is relatively small. In the health sector, it seems that transport improvement does not stimulate the increase in number of visits to a health centre. One reason might support this finding, it appears that there are more mobile health units than before.

About 55 per cent of respondents obtain credit from a formal banking agency or institution. Eighteen per cent of respondents indicated that they obtained credit from relatives. Fourteen per cent of the respondents used private money lenders, local merchants, and middlemen and thirteen per cent never borrowed from anyone. The Philipine's experience shows that transport improvement indicated there is a slight increase in credit use from banking agencies or institutions.

Thailand's experience shows that literacy levels have been relatively stable at just under 90 per cent in the proyect area for more than twenty years. It illustrates that transport improvement could not have made much impact in terms of educational service delivery.

Only a quarter of respondents who lived ten years or more in the study area make more visits to the health centres than they did ten years ago. Part of overall increase may be attributable to the opening of new health centres although this increase is not a direct impact of transport improvement. It seems that government would be able to provide health centres without all-weather access exist. It is likely that transport improvement did not considerably stimulate the increase in the number of credit users.

v. income distribution

There is no detailed data in Halmahera's study on the actual change in income levels and income distribution occurring over the project period. It appears that the improvement of accessibility only promoted a small change on landholdings. The response shows that only six per cent have land now and did not have it before. One per cent had gone from landholding to a landless condition. All socioeconomic groups experienced little change over the project period.

The impact of roads in Malaysian experience shows only a little change in land tenure. Eighty-two percent of households were landholders both before and after the project. Only 6 per cent of landholders did not have land before, while 1 per cent had gone from landholding to a landless condition.

There is no clear indication if transport improvements affect income distribution in the Philippine's study. Seatac's study stated that "... farmers have good access now to the major palay markets in southern Luzon and that merchant/truckers from outside the study area are actively competing both between themselves and with local rice mills to purchase the crop. As a consequence of this competition, the farmer is able to get a somewhat better price for his product and need not transport his product to a market town some distance away."

Thailand's experience shows that cash farmers are ones benefiting the most from these changes, the cash farmers who have a non-farm income run second. The subsistence farmer, whether he has some non-farm income or not, is participating relatively little in these changes.

It can be concluded that regional development as defined in Seatac's study is at rather a micro-level. The main indicators which are considered are agriculture, consumption, travel, education, health, credit use and income distribution. Some of indicator results are similar among the projects and some are contradictive. The contradictive results according to Seatac's study methodology related to differences of the project's mediating variables, although the findings do not show how the mediating variables come to the different findings[3]. It seems that Seatac's study can only be adopted in a small area which is not suitable for the purpose of this study.

II.3 The Experience of Other Developing Countries

Studies in roads and development cover a very large area, therefore this section is limited to review other countries' experience in the same direction as Seatac's study in Southeast Asia. The Brooking Institution seemed to be the first one who conducted an intensive study in Latin America including Bolivia, Guatamela and El Salvador (**WILSON, 1966a and 1966b**). The approach is different with Seatac's study. The studies conducted by the Institution basically adopt economic criteria: cost benefit analysis. These studies are reviewed first in the next paragraphs of this section.

BERGMANN (1966) studies the impact of Cochabamba-Santa Cruz highway on regional development in Bolivia. This highway was opened to traffic in 1954. Full completion of this highway was in 1962. This highway linked Santa Cruz in highland

3. It is likely that the methodology used by Seatac's study is 'after and before' study.

Bolivia to Cochabamba in lowland Bolivia. The highland area was very poor and very crowded. The lowland region was sparsely populated and was virgin jungle.

The effect of road completion on regional development was very dramatic, particularly on agricultural production, marketing and population. The transport cost was sharply reduced. The new linkage which costed less resulted in the expansion of agricultural production such as sugar and rice. The increase of their production brought the country's need sufficient. Data on cargoes leaving Santa Cruz showed that sugar was the most important export from the area, with wood second, and rice third.

The city of Santa Cruz was estimated to have had a rate of population growth of almost 70 per cent between 1950-1962 which was triple that in Bolivia as a whole. The migration to Santa Cruz has slightly relieved crowding in the Cochabamba valley. This condition has probably raised average productivity of labour in agriculture[4].

KLEIN (1966) studied the impact of the Atlantic Highway in Guatemala on regional development. The transport modes in the country were railroad and the road system. Uptil 1951, no road linked Guatamela to the coast, including the largest port, Puerto Barrios port. The railroad retained its monopoly of surface transport between Guatemala city and the Atlantic coast.

The Atlantic highways opened on November 28, 1959. It was the first time in the nation's history that shippers had the possibility of choosing among transport modes available, railroads or highways. The railroad generally offered competetive rates

4. In this study the internal rate of return is a measure of benefit over costs. It finds that the minimal annual rate of return was 8 or 9 per cent. It appears that the project was a worthwile investment from the economic point of view.

leading to a reduction from $ 0.98 to $ 0.35 per hundredweight of coffee transported from Guatemala to Puerto Barrios.

After the Atlantic Highway was completed, a computation of shippers' savings showed that in 1962 and 1963 these were $ 4.6 million and $ 6.4 million, respectively. Shipper savings on local transport were not included in the 1962 computation. Although shippers have made significant changes in transport modal choice since the opening of the highways, railroads still remain the most significant means for transporting bulk commodities.

In general, there have not been considerable changes in land use along the highway but there was an increase in land prices. Klein found it difficult to quantify precisely the value of new crops grown along the highway when the effects other than shippers' savings were included. Therefore, based only on direct economic benefit, it was possible that the benefit cost-ratio in 1963 or any future year may fall below 1. Thus there are reasonable grounds for classifying the highway as a relative failure.

HIRSCH (1966) studied the effect of the Littoral highway in El Salvador on regional development. The Littoral highway connected the developed area to one major geographic region which was underutilized, the Pacific coastal plain, or the Littoral. One of the key problems was the lack of accesibility. Transport costs were high because of the poor access to markets which made surplus agricultural production in the area impossible. The small farmers were forced to survive on a subsistence basis. The highway has been completed in 1961.

Before the building of the highway, the main crops in the Littoral were corn and beans but the area devoted to cotton was increasing significant. After completion of the highway, there was a dramatic increase in the cotton grown in the region. In the eastern part of the region, land devoted to corn shifted to cotton production. In the

Littoral as a whole, it is estimated that the area devoted to corn decreased by a half. The decrease in area devoted to corn did not influence significantly the total output of corn because yield improved because of the increased use of fertilizer and hybrid seed. Bean production was estimated to have remained firmly constant.

Cattle production in the littoral dropped markedly. Output of the minor crops such rice and sorghum remained about the same. There has been a considerable increase in the output of shrimps after the highway completion. The export of shrimps increased to 4,300 metric tons worth more $5.8 million in 1961 compared to nothing in 1957. In 1962, exports amounted to over 3,600 metric tons worth $ 4,5 million.

The benefit-cost ratio of the highways was about 3 to 1, assuming an 8 per cent discount rate and twenty years economic life. The potential for tourism and other industries and the increased value of recreational land was not taken into account in the computations. Other assumptions were that the output growth of cotton and shrimps was negligable and that health benefits from stimulating the malaria eradiction program were of minor value.

The Road Research Laboratory has been conducting a study of the effects on economic development of the construction of feeder roads in Uganda (**SMITH, 1959**). The West Nile District was chosen for the study. The altitude of the study's area rises from about 2000 ft to over 4500 ft. A number of roads have been constructed in West Nile since 1948/9. Three counties have been selected in the study. The time period of data collection in Madi and Jonam counties were up to 1947, 1948-1951, 1949 or 1949 onward. One county, Terego, was analysed based on one period of time, up to 1955.

Concurrently with the construction of new roads in certain areas of the southern half of the District there have been considerable increases in the production of cash crops.

Cotton is the main cash crop and is grown in all parts of the District below 4000 ft. Arabica coffee is increasingly grown in the high altitude areas of the south west and tobacco has been introduced into the higher areas in central West Nile.

Mehodology which was selected in this study was 'sample surveys at buying points'. In cases where recognised buying points exist then when growers come to sell at these points it should be possible to interview a sample and note the origin, value and quantity of the crop they bring. However, if traders buy at the roadside as well as at recognised buying points then it may be impossible to establish the origin of the crops passing the survey point.

The population of northern Jonam rose by 70 per cent from 11,000 to 18,500 between 1948 and 1955 as compared with a rise of 13 per cent from 34,000 to 38,000 in Terego. Thus it is reasonable to assume that over 50 per cent of the rise in Jonam was accounted for by an influx of population from other areas. The population of Madi rose by only 9 per cent in the same time as Terego.

Road mileages more than doubled between 1946/7 and 1955/6 and appeared to induce the expansion of land of cotton almost five times. In the same time, in northern Jonam, the increase in road mileages from 16 to 61 per cent was likely inducing the expansion of cotton land eight times. On a per head basis it increased four and a half times. In Terego, whose road mileage remained at 48 up to 1955, cotton average in the season 1955/6 was slightly increased about 20 per cent compared to 1946/7. Acreage per head declined over the period.

This study also illustrated that it is possible to fit the relationship between acreage of cotton grown per head of population and road miles per square mile into a regression equation as long as enough data are available. Smith cocluded that the new roads in

Madi and Joman were followed by population migration and increases in cotton production were simultaneous with an increase in the income of the population.

In Thailand, two studies have been conducted in conjunction with transport and regional development. One **(KASIRAKSA, 1963)** studies the highway link which connects Saraburi to Korat, the Friendhip Highway. This link was completed in 1958.

The Friendship Highway is a paved and high standard highway 166 kms in length which replaced old roads of 340 kms in length. The counting station recorded sharp increases in highway traffic between 1957 and 1959. The traffic studies in 1959, a year and a half after the completion of the highway showed the increase of volume. For example, the volume of traffic at the west end of the Friendship Highway was about 1000 vehicles, of which trucks constituted 50 per cent. Buses and passenger cars accounted for about 25 per cent each. Traffic was about equally divided in each direction.

Before the completion of the highway, it took eleven hours to travel from Saraburi to Korut, and after completion, it took only three hours between the two nodes. Passenger fares have also been reduced from $3.00 under previous conditions to $0.50 using the new highway. It is estimated that about seventy tons and fifty passengers a day, shifted from using the railroad to the highway. This was about 12 per cent of the estimated average daily traffic of the Friendship Highway. The study also shows that the production of upland crops and vegetables in Saraburi and Korat increased substantially since the existence of the Friendship Highway.

Another study on economic effects of highways in Thailand is the study of the East-West Highway **(PATANAPANICH,1963)**. This link connects the towns of Pitsanulok and Lamsok in north central Thailand. The 131 kms built replaced 217 kms of the old roads. One objective of the new link was to exploit the substantial economic potential of the Pasak valley.

Pasak Valley supports the main cities in the area where the East-West Highway is situated. Although there was an alternative transport mode, water, the valley was still relatively isolated. There was no direct access to the railroad at Pitsanulok.

The link was completed in 1959. The average daily traffic along the western end of the highway near Pitsanulok during 1963 was estimated at about 470 vehicles a day. Because of the inaccessibility at the eastern end, Lomsak was still underdeveloped. This is reflected in the number of vehicles using the links, which was only 37 per day. It is speculated that if the road connecting Saraburi and Lomsak was improved, the traffic volume at the eastern end would increase.

Although on some parts of the highway the traffic volume was not as high as expected, the impact of the new link was reflected in the considerable reduction in travel time and travel cost between Pitsanulok and Lomsak. The bus fare on the old road was $2.00 between two towns and after completion of highway, the fare was reduced to only $0.25. The average travel time has been reduced from 11 hours to 2.5 hours.

The East-West Highway also served as a feeder road to the railroad at Pitsanulok, and had a favourable effect on the railroad. In 1960, the year in which the East-West highway was completed, the metric tonnage of goods loaded in Pitsanulok was almost twice the amount in 1959. Cattle and buffalo loaded at Pitsanulok increased by about one-third from 1959 to 1960, and forty per cent from 1959 to 1962. This study also showed that poultry production increased greatly after 1959.

Based on the two studies[5] in Thailand which have been described above, **JONES (1964, pp 31)** concluded that "The chief inference to be drawn from this research is that development roads do more than reduce the cost of transport. By opening up new areas, they encourage industry to expand and disperse; in large measure, augemented vehicular traffic is induced by activity which is external to the highway itself. In general, development roads act as a catalyst to accelarate the rate of economic progress of a region.".

A study conducted by Boney **(BONEY, 1964)** to identify the relationship between road building and the economy and social development in Sabah shows a direct relationship between (new) acres of export crop cultivation and the standard of road and distance from commercial centres. Sabah, with a 1964 population of about 454,000, produced chiefly agricultural products. The most important product was rubber. At the time of the study, the largest single export was timber.

Boney's study of Sabah has three main objectives:

(i) to develop methods of forecasting and measuring the amount and type of agricultural development following the construction of new road in an area of agricultural potential,

(ii) to develop methods of forecasting the amount and type of traffic associated with different patterns and degrees of economic develoment,

(iii) to use the information under (i) and (ii) to provide means of suggesting the standard and type of road system adequate for promotion of economic development in a given environment.

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5. Both studies show that regional development is mainly focussed on the increase in traffic volume although they also investigate the impact of transport on agricultural land use and production. The methodology used is similar with Seatac's study that is 'before and after' study.

He stated that the objectives supported the aim of the study which was to determine the correct physical requirement of investment in transport in various environments in order to promote the most efficient use of resources and development. This study also attempted to identify the impact of roads on development, particularly in terms of agricultural acreages and traffic generation although he admitted that: "...... that complementary investment in other fields is often essential in promoting development"[6].

To achieve the objectives of the study Bonney proposed two methods which would be used. Firstly, observation which is based on recorded acreage statistics for whole districts and secondly, derivation which based on the relationship between actual and estimated acreage associated with individual roads and actual transport parameters such as distance, road standard, journey time and the amount of land suitable for agriculture. The relationship is expressed in mathematical terms.

The first method, observational, using crop acreage statistics on an historical basis, estimated the normal rate of planting compared with actual rate during the period of construction. The difference was assumed to be the increase in export crop planting in response to improved communications. Sample ground and aerial photography measurements where possible were used to check the results.

Boney's conclusion from his observational analysis that the standard of roads, especially in relation to their length and to the type of commodity produced in the area which they serve, the location of the roads in relation to their surrounding terrain and the location of the roads in relation to area with growing population pressures on land can have a varying influence on the extent of land use.

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6. Although the definition of 'development' is similar with Seatac's study, the methodology is quite different. Boney's study adopts mathematical approach and he introduced a model. The model is the forecast for volume of the traffic.

In derived model, Boney proposed some assumption that reasonably constant population pressure and the area of land use for export crops per mile of roads is a function of quality of land, distance from the main commercial centre and market, and the standard of the road used. This relationship between agricultural development and amount and standard of road construction was constructed by regression analysis. The effects of complementary services and prices were assumed constant. The relationship was formulated as follows:

$$E=1015\ u(0.80-0.0066D)(1-L(S-s)/1000)^2-L/200) \ldots\ldots(II.1)$$

where

E= area of export crops,

u= proportion of the total area served by the road that is cultivable for all crops,

D= distance from the main commercial center D in miles,

S= average speed of medium commercial vehicles along on all wheather roads,

s= average speed of commercial vehicle on the road serving the area in question,

L= the length to be travelled over the inferior length of road.

Boney also constructed a model to estimate the volome of traffic in relation to rural development. He selected non-agricultural production on road indicators and omitted other indicators, tonnage of export product and value of export production from consideration. He identified that both indicators were poor correlation with the volume of traffic.

The model showing the relationship between volume of traffic and rural indicators was formulated as follows

$$Q= ((CD)^2/6400)+10 \ \ldots\ldots\ (II.2)$$

where

Q= daily flow of vehicular traffic,

C= active non agricultural population,

D= distance factor for agriculture.

In making use of this formula, Boney stated that, the size of the commercial centre and their location is important.

One of his conclusions is that industrial and commercial activity is generally of greater importance in generating traffic, in Sabah experience. He also found that non-agricultural traffic is much greater on the all-weather road than on the earth road up to about 25 miles from the area's main commercial centre. There was comparatively little difference in terms of traffic between the earth roads and the 'jeep track'.

This study was also concerned with the potential of road construction in stimulating export crop production. As already stated, all-weather roads led to development up to 25 miles from the market, while the impact of the earth roads fell off sharply between 5 and 10 miles from the market in terms of value of output. **WILSON (1966b, p 139)**'s conclusion concerning Boney's experience in Sabah is that "A close relationship was observed between the extent of cash crop production compared with subsistence farming and the type of road surface."

Miller (**MILLER, 1968**) investigated the impact of highway improvement on agricultural production in Argentina using farm production and marketing cost analysis as variables. Interviews with producers and transporters were conducted. In this case, the agricultural production related specifically to highway improvement rather than new construction.

A large fall in transport costs as a result of road improvement may have minor effects on producers' incentives. The trucking enterprises received the first gains from road improvement, then they are passed to marketing intermediaries and finally they are transferred to farmers.

The cost reduction after road improvement is not a large percentage of total costs, ranging from 1 to 2 per cent. Road improvements cannot reduce costs to the same extent as new road construction. It is important that rate changes are passed down the marketing chain if producers are to create new opportunities to substantially increase agricultural production.

Before Seatac's study, there was another study of the impact of five roads in development which was conducted in the early 1960s **(HUGHES, 1969)**. Extensive interviews to a total of 2776 households were conducted during the first six months of 1964. In that time, none of the roads was fully completed, although all were in use. Therefore whatever benefit went to villagers was regarded as a short run effect.

The results of the study show that the provision of roads increased attendance at school, greater use of medical facilities, increased reading of newspapers, use of governmental services and facilities, and introduction to other amenities of modern life. The role of other investment, in conjunction with provision of roads is very important to the development taking place. Hughes stated that if social development is a policy goal "such packages of investment may be desirable in many developing countries" **(HUGHES, 1969: pp 121)**.

SCHROEDER and SISLER (1971) investigated the impact of the Sunauli-Pojhara Highway in Nepal on regional development. The findings are that Pokhara Valley is in the enviable position of having the opportunity to progress rapidly so that production and regional income increased faster than population growth. They found that the new highway linking Pokhara with the Terai was the enabling mechanism for this improvement but many difficult tasks still lie ahead before the inhabitants of the valley could fully realise the possible economic benefits.

Another study in Nepal conducted by **BLAIKIE et al (1977)** investigated the effects of roads on West Central Nepal based on the data between 1968 and 1975 and provided criticism of the effects of such programme on peasant agricultural societies. From the beginning, they suggested that the road investments have to be viewed against the background of, and as a proposed solution to, the severe crisis afflicting Nepalese agriculture, such as a decline in yields of food grains and population growth averaging 2.1 to 2.5 per cent per annum.

The project under Blaikie et al's study consists of four roads in West Central Nepal which link Nepal to its boundary with India. The concentration of population in the study's area was in hilly, 60 per cent of the total population. The rest, 40 per cent lived on the plain area which is called Terai. The hill economy came to collapse in a very short time, through land fragmentation, declining yields, forest degradation, erosion and loss of arable land.

Terai is a plain with a narrow strip between the roof of the hills and Indian frontier approximately 15-30 kms wide along the entire width of the country. In spite of official policies to preserve the jungle, widespread settlement in the terai has taken place by illegal clearing of the jungle. Terai was still a food-grain surplus at the time of the study.

The economic relationship between Nepal and India is very interesting; forming a linkage as centre and periphery. The integration which was affected by road provision was to ensure that Nepal was integrated more closely within the Indian market. Nepal was an important market for commodities produced on a mass scale in India. This produces considerable pressure on the Indian Government to ensure that political boundaries do not provide real tariff barriers to the export of Indian manufactures. It appears that the project under study can be regarded to strengthen West Central Nepal as periphery to different centres: Kathmandu and India.

A major determinant of the local political economy was inequality between centres and periphery which was increased since a large concentration of aid projects have been located in Kathmandu valley and Nepal's rulers have appropriated surplusses from the west central region, among others. The central problems of the study area economy were predominantly agrarian economy and society in the area.

Primitive technology, low market potential, high internal transport costs in a peripheral region without effective tariffs led to domination by capitalist production at the centre. This situation ensured that local capital tends not to be used productively and invested in manufacturing, but was employed in the sphere of circulation as merchant capital. Hence accumulated resources were merely used to finance the import of goods from India and distribute them in the hills.

The provision of roads appeared that reduction in the protective tariff of transport costs has not had any profound effect since the dominance of the Indian capitalist mode of production with respect to Nepal was so complete and has been so long established. However it was difficult to judge either generated or diverted traffic as a result of road provision alone.

The provision of roads only creates a small fall in the price of imported goods. This fall was soon cancelled by secular increases due to inflation in India and the devaluation of the Nepalese rupee within a year or two of the time of the study undertaken.

In contrast to many studies which the provision of roads benefited to intermediate men, this study found that savings in transport costs of petty commodities to Indian markets were passed on to the producers. This happened because the major change on centre-peripheral linkage made it possible for capitalists to forge closer and direct relations with distributors in the hilla. This situation reduced the role of Nepalese merchants as middlemen.

Blaikie et al also argued that by saving on transport costs, the provision of roads could not stimulate the producers to use roads. Many producers continued to porter their products by foot direct to the Terai market. In general, production could not respond readily to any improvement in prices whether caused by road provision or not.

Provision of roads did not change the behaviour of producers from the semi-feudal and other forms to the characteristics of capital production. Roads have had more effect on employers in general. Provision of roads in Terai had certainly centralised marketing of paddy and rice but had not fundamentally altered the approach of producers to the market. The labourers in both semi-feudal and capitalist forms have been practically unaffected by road provision.

Provision of roads in Blaikie et al's experience showed that roads could not reduce considerably the lack of social access to the bureaucracy for credit, and the inability of the relevant departments of the bureaucracy to diffuse credit, advice and the inputs themselves to small domestic producers. Examples of this are that 85 per cent of producers in this category never received visits from extension officers, 12 per cent used at least some fertilizer and 3 per cent improved seed.

Blaikie et al concluded that roads made no substantial contribution to the economic development of West Central Nepal. They did not affect the major determinants of the local political economy, nor did they resolve the central problem of the predominantly agrarian economy and society in the area. They made clear that the extent to which such development takes place is crucially dependent upon the capacity of the local and regional economy to respond to such construction which would had to a reallocation of productive resources.

There are two studies which were concerned with the effect of roads on economic development in New Guinea and the studies provide conflicting findings. One was conducted in 1967 which claimed that the construction of the road to Rigo in Papua New Guinea stimulated village gardening, new estate production of rubber, copra, cattle and timber milling, teak production, large scale poultry farming and the growing of European vegetables **(WARD, 1970).**

The second study was conducted in 1971 and this found that there was little evidence of much change having occurred in the marketable agricultural production of the area since (and because of) the upgrading of the Okapa road **(BOUCHARD, 1972).** Bouchard's study attempted to find the relationship between transport and income from cash cropping and new monetary revenue entering village economies.

Bouchard found that the income from cash crops was not related to accessibility because of the market structure which existed. The cash crop price was uniform throught out the region. Buyers were willing to collect cash crops from any area, regardless of the types of roads and regardless of the distance from main collection points. On the other hand, total income was related to accessibility because casual employment was dependent on the proximity of urban job opportunities. Bouchard's study also suggested that new roads had a greater economic impact than road improvements.

A study of the effects of transport investment on commodities and on finance and capital for production in Bangladesh has been conducted by **EDWARD (1978)** and the findings were that the effects of transport improvement were somewhat contradictory. The fundamental effect would be a reinforcement of a tendency toward capitalistic production. At the time of the study there has been a growing labour surplus and a falling real wage rate for agricultural labourers. Transport improvements were unlikely to reverse such a trend.

Edward's study also discovered that there was a possibility of negative effects of improved accessibility on the distribution of health, education and other welfare services. The provision of roads resulted in increasing unemployment, income insecurity, rising land rents and prices and of the landless. Accessibility did not improve the distribution of health, education and other welfare services.

In 1978, there was a study of the regional impact of a new highway in Sierra Leone which found that there was little positive evidence of development if measured in terms of agricultural output, change in the number of visitors and traders and increase in entrepreneurial activity **(BLAIR, 1978)**. The study also found that the road seems to have accelerated the tendency of the young to migrate.

Another study in Sierra Leone was carried out by **ANDERSON (1980)**. Sierra Leone had an estimated GNP of $200 per capita in 1977 which has been increased from $ 140 in 1970 in term of current value. The government of Sierra Leone has increasingly financed its budget deficit through the domestic banking system, inflation has increased to a currently estimated rate of 30-35 per cent. Therefore GNP per capita in terms of constant price has fallen. Population in Sierra Leone was 3.1 million in 1977 with a population growth rate of 2.5 per cent per year.

After a number of years dependence on declining mineral exports, and in the face of a worsening balance of payment situation, Sierra Leone began to focus on agricultural development in the 1970s. The first of the CARE/Sierra Leone Rural Penetration

Roads Projects began as a component of World Bank funded Integrated Agricultural Development Project (IADP). Increasing the production of export crops such as cocoa and oil palm as well as rice were the main objectives of the Eastern IADP whereas the Northern IADP has concentrated on peanut,livestock and rice production.

One of the aims of IADP was to provide farmers with improved crop varieties, fertilizer, extension advice, and better marketing services. The first CARE/Sierra Leone Rural Penetration Road Projects began in fiscal year (FY) 1975 and phase II expected to complete in FY 1980. The total funding for the projects has been $11.7 million of which AID has provided $5.1 million, the largest single share. Additional funds has been contributed by CARE (Cooperative for American Relief Everywhere), the Government of Sierra Leone, the Peace Corps, the United Kingdom's volunteer Organization, and the World Bank.

The impact of this study appears that of the socio-economic view provision of roads has been positive. Socio-economic surveys indicated that the CARE roads are associated with more frequent agricultural extension agent visits, increased traffic and transport services, higher quality cement construction in villages, higher purchases of consumer goods, and more health services in villages served by CARE roads. It is likely that CARE roads may have played some role in facilitating increased fertilizer use; in bringing about wider cultivation and marketing of cash crops; in expanding commercial activity; and in increasing educational opportunities.

Anderson also listed the possible negative impact of road provisions. They were associated with a shorter range of fallow period for upland rice cultivation, greater rice scarcity, and increased swamp rice cultivation. All these conditions suggest substitution of cash crops for food crops, particularly rice. The above effects also had influence on declining soil fertility, deforestation, increased soil erosion, and increased exposure of swamp rice farmers to waterbone diseases.

The effect of roads on migration is not clear. Since some roads function as arterial or trunk roads connecting major provincial towns, these roads probably encourage migration. Those roads that function as true feeder roads, connecting villages to rural market towns, likely retard rural-urban migration. Anderson reviewed the positive side and negative side of road impacts and concluded that the negative impact could overwhelm the positive impacts over time.

The findings of a study in India (**BANSAL and PATIL, 1979**) of the socio-economic impact of roads on village development concluded that the effect of accessibility was greater for unimproved than for improved roads. The suggestion of this study was that the changes were influenced by the existence of any kind of traffic carrying routes regardless of their quality. They found that provision of roads positively affected most socio-economic variables. On the other hand, provision of roads negatively affected unemployment and land concentration.

A study conducted in Madagascar (**MITCHELL and RAKOTONIRINA, 1977**) analysed the impact of Andava-Sambava Road on income distribution. They found that all households gained 35 per cent in average disposable cash income after the opening of the Andava-Sambava road. This study also found that the provision of the road narrowed the differential between the lowest and the highest income groups. Farmers residing within 5 km of the main town and the road gained almost 50 per cent more than less centrally located farmers.

Mitchell and Rakotonorina discovered that the rise in incomes was affected by the higher prices in the markets, which covered all accessible farm products grown in the area. They concluded that the role of roads was only a contributing rather than the main cause of change. The study concluded that poor coordination and a lack of complementary investment was one reason why the community services had improved in some sectors and not in others. Another result was that deforestation accelerated, induced by the increase in population, urbanization and economic activities.

Other evidence from Bolivia shows that the net return per hectare for each crop and the average return for all crops declined as distance from market to farm influenced the type of crops growth. This study discussed that the ratio of value per weight of a kind of crop to the location of the crop grown. Farmers tended to grow sugar cane close to paved roads and further away from paved roads they tended to grow bananas (**WENNERGEN and WHITAKER, 1976**). It shows that a distance from road has an influence on the types of commodities planted in a such area.

Another study in Bangladesh conducted by **MATIN (1979)**, postulated four hypotheses:

1. The present lack of adequate transport facilities has significantly distorted the development potential of a rural area,
2. Transport cost savings are significant enough to induce increased production,
3. Transport savings are passed on to producers in terms of a higher price for outputs and a lower price for inputs, and
4. Better transport leads to more social and economic activity in rural society.

The results were not too optimistic in the sense that the 'impact of transport on development' as Matin stated "the present level of adequate transport facilities do not provide the major constraint of development in the rural areas". When Matin describes the findings in terms of transport cost savings and increased production, she found that the transport costs were not significant enough to induce increased production.

Matin also found that transport costs savings are not passed along to the producers. Transport cost savings probably go to middlemen, i.e. transport owners, and the traders and large farmers who own their own means of transport. Better transport would adversely affect the social and economic equity in rural society.

The methodologies which are introduced in this review can be divided into four approaches, as follows:

1. before and after studies such as Seatac's study,
2. cost-benefit analysis such as Klein's study,
3. comparing the impact of different areas such as Matin's study, and,
4. mathematical modelling such as Boney's study.

Almost of these approaches except Boney's can might be applicable in the term of accuracy in a small study area.

Except in Boney's study in Sabah, methodologies used in the other studies do not provide the results which can be as valuable inputs for the transport policy maker[7]. The variation of results among countries might be as results of the difference of the mediating variables. None of the studies, including Seatac's study, show the role of mediating variables which lead to the variations.

Other studies which have rather different approaches to the previous studies have been conducted by KANSKY (1963) and SHARIF(1986). They have studied spatial distribution of development in USA and some other countries and Bangladesh, respectively. Kansky investigated the relationship between transport network

7. Boney's model which is introduced can be used to forecast the volume of traffics. The capability to forecast is the valuable input to the policy maker.

measure and development activities. He used data of 25 countries in his investigation. Although he found that there is a relationship between those variables but the findings do not show the concentration or the distribution of the development within a particular country.

Kansky extended his investigation to smaller unit of areas and he took counties for the further analysis. He found that the most meaningful relationships between trade pattern and transport networks. This finding might not be surprised. The distribution of such development activities have been spatially distributed since the path development policy has taken place long time in the developed countries.

Sharif studies spatial distribution of development activities in Bangladesh. He used 143 development indicators based on the district level. He did not adopt transport measures which Kansky introduced since there are many criticism to the measures (WERNER, 1968). He only used road density when he investigate the relationship between transport and development indicators. His findings show that not in all cases the distribution of development activities are related to the transport network measures such as number of big industries and percentage of land area cultivated. This findings also do not prove that there is no impact of transport network on the distribution of the development activities. Since the development policy in developing countries is recently introduced, the concentration of development activities might be still in the surrounding areas of the primate city.

II.4. The Experience of Developed Countries: the Case of Britain

The review of previous studies of road impact on development, however, is not complete without reviewing what is happening in developed countries such as the United Kingdom as a comparison. QUARMBY (1986: pp 9-20) examines the impact that improvements in the primary road network have had and can have on the physical distribution of goods to retail markets.

Quarmby stated that changes in physical distribution in retailing are making the whole operation more dependent on, and more able to take advantage of, the primary route network. The continuing move from supplier-controlled distribution towards retailer-controlled distribution substantially changes the economics of the transport element; the move away from own-account to contract distribution creates more of a 'market' for distribution services, and this enables distribution networks to react and ajust more readily as changes in the road network come along.

BRICKNELL (1986: pp 21-29) analysed the changing structure and market emphasis of Imperial Chemical Industries Plc (ICI) as a model for the UK Chemical Industry and demonstrates that a comprehensive and adaptable road infrastructure is essential for the continuing success of this major exporting industry. There was a market change in export destination for the Company's product over 1960-1984 .

In 1960 Continental Western Europe (CWE) and Commonwealth countries accounted for nearly the same percentage of the total exports but in 1984 CWE accounted for 52 per cent and Commonwealth countries dropped to less than 30 per cent. It is one reason, Bricknell claims, why the role of the ports of Liverpool, Glasgow, Bristol, Southampton, Hull and London declined and on the other hand, the ports of Felixstowe, Dover, Folkestone, Immingham and numerous smaller ones have deservedly thrived. He concluded that this market change result in road infrastructure gap which should be bridged by the provision of good access to the prospective ports such as Felixstowe and Harwich.

A useful review of a number of aspects of transport and development which have been studied in developed countries but have not been considered in the previous studies have been given in the **LEITCH REPORT (1977)**. This report which reviews HARRIS' work **(HARRIS, 1974)** indicates, for example, how econometric modelling techniques can be used to develop a more detailed view of the economic impacts of road improvment. A model of this kind was used to forecast the 1990 effects of three alternative future highway systems, respectively, called the Extended Primary (designed to serve the needs of small cities not served by the Interstate System), the Economic Development (designed to reduce transport costs to economically depressed areas) and the Urban System (designed to reduce urban congestion, especially in large metropolitan areas). The results compare the effects of the three systems against the basic completed Interstate system; For major size classes of city the results are always within 5 per cent of each other and usually within 1 per cent and for individual economic areas the results are also very similar. These conclusions hold both for population and for income projections. The results suggest that the total economic impact of new highway systems is somewhat limited.

The **LEITCH REPORT (opcit)** also reviews a number of studies of the impact of the increase in accessibility on the location decisions of business managers which have been conducted in Italy, France, Germany and in Scandinavian countries. The results are disappointing. Transport does not seem to be an important factor for location decisions. A similar result is found in the study of the impact of Severn Bridge in United Kingdom. It was found to have very litle effect upon the location of businesses, probably as a result of the short time-scale. The impact of transport costs is also relatively low. The difference in transport costs for 'footloose' industries between the most accessible and the least accessible areas was as low as 2 per cent. Those industries with the highest proportionate transport costs tend to be those such as mining and quarrying, whose location is governed by the availability of raw materials.

Reviewing these impacts Gwilliam (**LEITCH REPORT, opcit, p 206**) concludes that in already developed regions, 'There is neither theoretical nor empirical reason to suggest that investments in transport infrastructure will cause radical changes in the level and location of activities'. The review points to the relative unimportance of transport costs as determining factor in industrial location decisions in developed countries such as Britain. These findings support findings in the U.S.A., which show that the role of transport is relatively small in regional development (**KRAFT et al, 1971, pp 91-92**). The conclusion can be drawn that the provision of roads does not yield significant economic development. The only exception is likely to be where new construction links connect previously seperate regional or national networks giving very large reductions in generalised costs.

None of the above aspects has been considered in relation to the experiences in developing countries. As has been explained above most of the studies on transport and development which have been conducted in developing countries are based on before and after type studies. **HOWE and RICHARD (1984)** suggest that it might be necessary to complement the 'before and after study' with a 'with and without investment study (=counterfactual situation)'. However, this approach cannot be implemented in most developing countries since data for that purpose are either not available of a questionable quality.

One study using the counterfactual situation approach has been conducted in U.K. by **BOTHAM (1983)** who examined the impact of accessibility on shifts of employment at the regional level in U.K. He constructed various models of accessibility combining the transport costs model and the interzonal flow of industrial products within the region. To systematically examine the role of accessibility, five sets of equations were estimated using a combination of proposed variables in the study. Within each group the equations are estimated by stepwise regression. Estimates of the impact of the road programme on the spatial structure of the economy vary with the factors taken into account in predicting the counterfactual situation. The impact appears marginal, if, in the absence of road investment, it is assumed that transport costs remain constant overtime. However, if congestion is assumed to increase costs, the impact is more substantial. It is tentatively concluded that the road programme has encouraged spatial concentration.

Another study using a counterfactual approach has been conducted by **GWILLIAM and JUDGE (1978)**. They examined the effects of the M62 motorway opening on traffic generation. One could argue that the level of generated traffic may also represent the performance of development levels in a particular region. A large scale increase in traffic generation may indicate that a motorway has stimulated regional growth. In that study, the counterfactual situation is estimated by assuming that, without the motorway, traffic would have grown at the national rate, 28.8 per cent, for all rural roads excluding motorways (28.8 per cent). The 'scale' of the impact on development in economic terms is not introduced since 'development' is defined as 'the increase in traffic generation'.

LEITCH REPORT (1977) defined generated traffic as one element of potential traffic. Generated traffic is the traffic which would be generated as a direct result of the provision of new or improved roads. This includes journeys by persons using their own vehicles, if, before the development of the roads, they used public transport. This would also include the extra journeys made by private transport as a result of increased convenience and easier travelling conditions. More journeys may also be made by goods vehicles because of the reduced journey times and increased industrial and commercial activities in the area. Other elements of potential traffic for new or improved roads are reassigned traffic, redistribution traffic and normal growth traffic.

This definition presents problems for inter-city transport in Indonesia. In Indonesia most people rely on public transport since the level of car ownership is relatively low. This therefore make it virtually impossible for people to change transport mode. They do not have any other option other than public transport. The number of trips per person is also very low (**KODYA MEDAN, 1986**). This suggests that the impact of transport improvements in terms of changing the spatial pattern of demand for seperate modes is likely to be very very limited. Therefore it is likely that the increase in traffic as the effects of extra journey and modal split is not significant in the region of study.

The Leitch Report also distinguishes between current and normal traffic. Normal traffic arises only as a result of the increase in motor vehicle ownership, land use, population and investments.[8] Current traffic is made of two types of movement, reassigned and redistributed traffic. Reassigned traffic is traffic which immediately use the new road by transferring from roads it was designed to relieve. Redistributed traffic is traffic which reorientate the destination because new road improved the attraction of the present destination.

It is likely that in developing regions, traffic is mainly normal traffic since the role of roads themselves in generating traffic is rather permissive particularly where the road system is still at a relatively early stage of development. Traffic is generated mainly by the economic potential of the zone in question at least in the short term. Therefore. generated traffic, a term, which will be used in this study is defined similar to the normal traffic of Leitch Report.

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8. The Leitch Report's definition is limited to the increase in vehicle ownership and land use. The regional Highway Traffic Model (RHTM) adopts population and employment is as the potentiality of zone to generate traffic. It might be in developing countries, investments in a particular zone may work as a potentiality of the zone to generate traffic.

II.5 Evaluation

The description of 'development' in most of the third world studies which have been reviewed has been interpreted in many ways such as cultivated area, land use pattern, investment, and only rarely in terms of farmers income. In studies which discussed the effect of transport on farmers income, there is no evidence to show that it had either a direct or an indirect impact.

The impact of the provision of roads differs among regions and can be explained by the variation of their regional characteristics. When Sabah's population was increased, cultivation of new land was stimulated and it resulted in agricultural expansion. In El Salvador, more corn planted land was devoted to planting cotton and output increased significantly before the completion of the highways. These two examples illustrated that provision of roads is as a response to pressure generated by the growing population and the rising commodity prices.

The increase in population in Highland Bolivia did not induce the people to migrate to the Lowland. The Lowlands which were sparsely settled, were difficult environments for habitation. One of the reasons was inaccessibility. Physical condition was one of the barriers to migration. The role of transport in this area was to attract people and to create more demand for previously uninhabitated areas.

The findings of two studies in Thailand, Rigo in New Guinea and the Sunauli-Pojhara Highway in Nepal show that easily exploitable natural resources are a necessary prerequisite for development following completion of highways. The East-West Highway links to Pasak Valley were rich with potential economic resources such as timber production and hence the traffic volume increased considerably. The traffic volume on the Friendship Highway also increased. It was the result of the increase in agricultural production from the area along the highway.

These areas were suitable for agriculture. A similar situation occurred with respect to the Sonauli-Pojhara highway and the Rigo Road.

Yet the outcome seen along the Rigo road did not occur along another road, Okapa road, in the same country. The dearth of natural resources along the Cochabamba-Santa Cruz in Bolivia and Okapa Road in New Guinea led to a failure in traffic generation. A similar situation may have existed in Blair's study in Siera Leone.

Although studies in Thailand show that the cultivated areas can be increased, the expansion of land use is not followed by changing land use pattern. Studies by Hirsch in El Salvador showed that the increase in agriculture is accompanied by a changing land use pattern. Additional evidence from Bolivia shows that the land use pattern is influenced by the distance from the market centre. This result supports Thunnen's traditional theory of land use **(VON THUNNEN, 1826;** See also **TARRANT, 1974).**

The rise in traffic along a new road generally shows an increase in total mobility, not merely a diversion from other roads or other modes. Most local traffic uses trucks instead of other modes available except for some kinds of commodities which are heavy, bulky and low-volume. These types of commodities are carried by railroads if they exist. Railroads are still the dominant means of carrying commodities over long distances.

Studies of the effect of new roads in Latin and Central America generally show that transport costs are reduced sharply for both freight and passengers. For this to occur, it is necessary for demand to be stimulated. In most cases, travel time is reduced.

Findings in Edward's and Matin's studies show that the road improvement leads directly to land consolidation and the creation of more landless people. Road improvement in Bangladesh and Nepal has no benefit on poverty alleviation and welfare distribution. Blaikie's study indicates that road investment induces the declining yields of food grain. Another 'negative' finding is the tendency of the young to migrate in Siera Leone.

The development potential of roads may be latent without providing "supporting investment in other sectors of economy such as irrigation, drainage, public health, power, education and guided resettlement" **(KLEIN, 1966, pp 85)**. Externally stimulated activity such as entrepreneurship is needed to lead to development. This argument is supported by **STANLEY (1971)**.

STANLEY (1971: pp 371-400) stated that in general new roads caused the value of the production from surrounding land to rise in direct proportion to its proximity to the road and the changing structure of the population. He found that not only roads but also externally stimulated activity, such as entrepreneurship led to 'development'. The development response was faster to road provision or improvements in more developed rather than less developed agricultural systems.

Boney's study showed that earth roads do not bring economic change because such roads require high transport costs which sharply reduces the farmers's income. The value of production falls off sharply in areas of more than 5 miles from market. Road improvements do not reduce transport costs to the same extent as new construction as shown by the outcome of Miller's study in Argentina. Both studies conclude that the quality of roads is important as an inducement to economic change. Bouchart's study in New Guinea supports this finding. The outcome in India is different. There, any kind of road appears to be more important rather than their quality.

Comparison between developing country's policy and developed country's policy can be concluded in two perspectives. The first perspective in a whole economy appears to be that the transport policy is to attempt to stimulate the input side of developing the country's economy but it is to strengthen the demand side of developed country economy. In the second perspective in the transport sector itself, it is likely that provision of roads in developing countries is to focuss how to create traffic demand but provision of roads in developed countries is to consider at which level of road capacity should be provided to foster the present and future demand since demand already exists.

At the micro level, it seems that in the developed countries where economies are based on industry, the effect of transport costs on the price is limited but in developing countries where economies are based on agriculture, the proportion of transport costs in the price may be still considerable. The volume of traffic in developed countries may be less sensitive to the increase in zonal potentiality size of a region (for example population which is considered in RHTM) than in developing countries. In developed regions, roads themselves have a considerable contribution to the increase in volume of traffic, as the effects of modal split and extra journeys. The problem in the developing countries is how to identify the most significant economic potentiality of the region to generate traffic; land use, population, car ownership or investments.

The evidence above shows that the impact of roads are still contradictory on some development factors. If interregional mobility exists the primary questions becomes whether the movement of goods, comodities, and people is stimulating dispersion or assisting polarisation. Most of the previous studies also do not provide useful input to transport policy. For example, if the impact of roads on development is negative in a certain area, of course, it does not mean that roads should not be provided in that area[9]. So the secondary question is what policy should be implemented in order to

9. Transport should be provided to any areas because transport is a prerequisite of development. The transport policy is coordinated with other public policies "to make the best use of a set of national and regional resources which will result in an integrated and growing economy" **CHOUGILL (1982: pp 1).**

achieve a certain level of regional development. These are the issues that the present study will address in depth.

Most of the studies reviewed here, based as they are on short term changes, have attempted to measure longer term effects through retrospective studies made several years after the investment. None of the studies focussed on 'before' and 'after' effects of road provision. The studies when they are trying to collect income data, use on household or farmer interviews. Respondents are often unprepared to deal with the precision of the information requested.

The measurement of development change needs to be taken annually for several years for the following reasons **(HOWE and RICHARDS, 1985, pp 80)**:
"1) the long gestation period before certain developments emerge; 2) other complementary investments that need to be accurately monitored, and
3) the need to allow for inherent fluctuation in such
areas as migration and agricultural production."
This is the reason why this study attempts to use data ten years' data in the analysis.

HURST (1974) stated that the impact of roads on development causes not only dispersion or polarisation, positive or negative but it may have a neutral effect[10]. He defines the positive impact where new, directly productive activities are the direct result of providing transport facilities. The negative impact is defined where transport facilities eliminate directly productive activities and effectively reduce the level of economic growth. The neutral effect itself is where transport facilities do not themselves call forthly productive activities and subsequent increases in the level of

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10. The classification of this impact is based on the economic point of view. **APPLEYARD (1986)** introduces a list of negative impact of transport investment related to the sociological aspect. **WILSON et al (1966)** do not support the argument that transport may have a neutral effect on development. They classify the negative impact into 2 groups. The first one is the effect of misallocating scarce resources and the second is to lead a decline in per capita income.

economic growth. The studies which have been reviewed classify the types of impact but they can not provide clear indication of whether the role of transport is generative or permissive in terms of development.

II.6 Conclusion

Almost all of the studies which have been reviewed in this chapter investigate local development before and after transport improvements. There are some disadvantages of this approach. Firstly, it is difficult to prove whether the development that takes place in the area is the product of tranport improvement or other factors rather than transport. The 'before and after studies' which have been conducted in many developing countries often involve a short time period. In that period, the impact of transport improvement may not have emerged. Secondly, as **JUDGE (1983)** argued that attempts to detect development effects at the local level of the individual project may ignore the impact of other developments elsewhere in the region as a whole. The potential of the transport network to redistribute development activities around a region needs to be studied at the regional level. Thirdly, almost the studies in developing countries do not consider the long term impact of with and without transport improvement on development.

The review in this chapter shows that the relationships between transport and development are strong although the interpretation of 'development' varies and the relationship in many cases shows contradictory impacts, either positive or negative. It is therefore necessary to review theories of development and to understand the framework between transport and development in greater depth. The relationship between transport and development provides the starting point for more precisely defining the objectives and hypotheses of this study. An approach at the regional level instead of the local level analysis will be considered. These issues are investigated further in the next chapters.

III. METHODOLOGICAL FRAMEWORK

III.1 Introduction

This chapter reviews the definition of development and examines the links between transport and development. The more detailed objectives and hypotheses of this study are introduced at this stage based on the experiences from the other developing countries. The last section of this chapter sets out the approaches to the analysis which will be used in this study.

III.2 Definitions of Development

The previous experiences of other countries shows that there is a strong relationship between transport and development although 'development' is defined in different ways. Therefore, before the analysis proceeds further, the term 'development' must be defined. It is difficult to define 'development' although this term is widely used in literature. Social scientists suggest that "development is a multi dimensional concept" **(ISLAM, 1985, pp 217)**.

Using the economy's output level as an index of the stage of economic development, **ADELMAN (1963)** analysed in detail the long run dynamic behaviour of the economic system as seen by Smith, Ricardo, Marx, Schumpeter and the Neo-Keynesians. He presented a rather general theoretical framework for explaining the growth pattern of various economic systems.

Adelman states that at a given level of the state of technology (S_t) and the institution and socio-cultural environment of the community (U_t), the production function represents the maximum amount of output obtainable with each combination of the physical inputs. The production function which represents the economy's output level can be represented as,

$$Y = f(K_t, N_t, L_t, S_t, U_t) \quad .... \quad (III.1)$$

where K_t denotes the amount of the services of the economy's capital stock employed at time t, N_t stands for the rate of use of national resources, and L_t represents the employment of the labour force.

Neo-classical theory believes that if the regional growth is the objective, it can be achieved by maximizing the production of the economic inputs as formulated in (III.1). It shows that this model is oriented to the supply side of economies. Investments in economic inputs are required to stimulate the economic progress. This model requires that there is continous full employment of the capital stock. It is a consequence from the assumption that production factors are substitutable. The other necessary assumption is factor prices are perfectly flexible.

This school of thought also assumes that investment is equal to full savings. The rate of interest may be an instrument for this purpose. The rate of growth in equilibrium condition is equal to the rates of growth of capital, as follows,

$$y=k=(T/(1-a))+n \quad .... \quad (III.2)$$

where y= rate of growth of output,

k= rate of growth of capital,

n= rate of growth of labour,

T= rate of technical progress.

The growth, according to this school of thought, attributed from transaction and exchange of the economic inputs. This transaction and exchange are based on what is called factor of endowment. Factor endowment assumes away inherent differences in relative labour productivity by postulating that all countries have access to the same technological possibilities for all commodities. The concept of comparative advantage of a region was rooted to theory of factor of endowment.

The modern theory of inter-regional trade is based on the concept of comparative advantage. This concept focusses on the rate at which the economy can increase its output of one good by giving up the production of another, assuming that all resources in the economy are fully employed. A region will specialise in those goods for which it has a particularly favourable resource endowment in term of two factors of production, capital and labour[1].

Todaro states that "the Hechser-Ohlin neo-classical factor endowment approach also enables one to describe analytically the impact of the economic growth as the trade pattern and the impact of trade on the structure of regional economies on the

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1 This approach is based on the classical theory of inter-regional trade,Eli Hechser and Bertil Ohlin take into account differences in factor supplies (land, labor, and capital) as inter-regional specialization (CHAMBERLIN, 1936).

differential return or payment to various factors of production." (**TODARO, 1985, pp 378-379**).

Macro-economic theory[2] based on demand side provides a model which determines the national output and employment in terms of the level of aggregate demand in relation to an economy's potential output. In its simplest form aggregate demand for a 'closed economy' comprises three essential components: the total demand for all goods and services by private consumers (C), the total demand for investments goods by private industry (I), and the demand for goods and services , both consumption and investment by the government (G).

The level of national income or GNP (Y) is then defined as

$$Y= C+I+G \quad \ldots\ldots\ldots\ldots\ldots \quad (III.3)$$

which is in the full employment economy in the equilibrium condition. The level of national income is assumed uniquely associated with a different level of employment.

For an 'open economy' with foreign trade, to the model can be added exports (E_x) and imports(I_m). The difference constitutes either a surplus balance of trade (export > import) which stimulates the national growth, or a deficit trade balance (import > export) with lower national income. Therefore for an open economy, the previous model can be written as

$$Y = G+C+I+E_x-I_m \quad \ldots\ldots\ldots \quad (III.4)$$

2. See **DORNBUCH** and **FISHER** (1984) and **PERKIN** and **BADE** (1983). The first explains USA macro economy while the second one describes UK macro economy.

where Y, output of the region

G, Government expenditure

C, Consumption

I, Public or Government Investment

E_x, export from region to 'the rest of the world'

I_m, import from 'the rest of the world' to the region.

Macro-economic models illustrate that at full employment level everything depends on the level of total aggregate demand. This model's prescription to cope with unemployment by increasing aggregate total demand through direct increases in government expenditure or by government policies that indirectly encourage more private investment. The government policies include low interest rates on business loans, tax allowances, investment subsidies. A new equilibrium will be achieved with higher levels of employment.

The multiplier of a macro-economy model can be calculated. The multiplier is the amount by which equilibrium output changes when autonomous aggregate demand increases by one unit. In some cases rate of growth is preferred to the multiplier. Harrod-Domar as a Keynesian demand-oriented theory provides a model to explain the rate of growth of a national economy. The model has been formulated as follows,

$$y= (s/v-(E_x/Y))/v \quad .... \text{(III.5)}$$

where y = steady growth is equal with the labour force
growth in an equilibrium,
s = a constant propensity to save,
v = the capital output ratio.

A macro economic model of a Indonesia's economy have been developed by **SCHYDLOWSKY (1980)**. He constructed his model based on his experience during 1971-1972. He predicted that the model was valid for 1973-1976. The increase in oil price in 1979 may reduce the possibility of the model to implement. He stated that if demand for imports was not over infrastructure of imports, the structure of the model was still relevant although some parameters should be recalculated. There are three bases which determine Indonesia's macro-economic system and as the main input to the Schydlowsky's model. He admitted that the three bases he introduced are also valid to other developing countries which are in the first stage of development, small and open economy without strong stock-market.

The first base is the availability of sectors of the same categories but a different mechanism in inducing production level. The first mechanism is the sectors determined by stock which cover almost all production for export and agricultural production with industry foreign goods competetive. The second one is determined almost by production of service sectors and non-trading goods. The Keynesian multiplier is adopted for the second one and the first one is treated by the neo-classical approach. The behaviour of the second one is infinitely elastic because the level of unemployment is very high. This assumption is still valid to the model as long as the model is used for long term objectives.

The second basis of the model is the interaction between real variables and monetery variables in determining the level of economy. The level of expenditure and new credit, to create money supply and foreign capital inflow would increase the level of expenditure over the level of revenue.

The openness of Indonesia's economy is the third basis of the model. Commercial goods prices are determined by the economy outside Indonesia although the increase in nominal wages could affect the increase import tariff and distribution of commercial goods. The propensity of margin to import is very high. Exogenous expenditure flew straight out of the country through the balance of payments, except that which was prevented by higher real production in the service sector and wealth accumulation in the banks.

A possible approach to the theory of regional growth is to adapt originally developed for national economies as explained previously to a regional context. The objective is balanced growth. There are two interpretations for that term which are (1) in the long run the output between regions are equal, (2) the rate of growth between regions are equal. The second interpretation is considered in many theories of regional growth (RICHARDSON, 1969).

The equilibrium in Neo-classical theory and the Harrod Domar model are always referred to, to explain how the inter-regional economic linkages work. Both models come to the result that disparities in real wages and the rate of return on capital will automatically be eliminated by the self-correcting nature of the economic system. If regional differences in factor prices emerge, the classical equilibrating mechanism can restore equilibrium as workers migrate from a low wage to a high wage region and as capital moves in the opposite direction. According to this theory, regional differences in factor prices would disappear provided there were no further disturbances to the balance of demand and supply for factors of production in each region.

There are some criticisms to this theory. The important source of regional growth is resource shifts between industries within a region not because the difference of price levels among regions to explain why regions grow at different rates. Many studies show that the real world does not follow the mechanism of equilibrium as the theory explained. In reality, labour moves from less developed regions to highly developed regions and capital moves in the same direction. The inequality which exists between regions will lead to divergence for the long run equilibrium[3]. The flow of capital and labour in the same direction generate a disequilibrium situation as shown in **LASUEN (1962:pp 169-189)**. **AZIS (1985)** constructed a model which explains whether the movement of capital is equilibrium or disequilibrium between regions if the existence of the inter-regional of capital can be assumed.

PERROUX (1950) employs the concept of 'polarization' to describe the attraction of production and trade factors to a certain area. This attraction results in an increase in the growth concentration in some areas at the expense of others. He concludes that government policy should establish counterpoles to those which have been established in factor growing region through the forced working of the market.

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3. The model examples are provided by the Harrod Domar theory of growth (**ARMSTRONG and TAYLOR, 1983: pp 23-30**) or as provided by the Cobb Douglas Production Function (**ARCHIBALD and LIPSEY, 1985: pp 227-238**).

MYRDAL (1957) like Perroux states that the free working of the market mechanism promotes an imbalance in regional growth. Labour and capital will be attracted to the area in which the economic growth initially began.

Imbalance in regional growth, as Myrdal stated,will come into inequality among regions. Exemplary of the relative inequality approach to regional growth is the work of **KUZNETS (1955, 1965, 1966a and 1966b)**. Other influential contributions are those of **WILLIAMSON (1965), ADELMAN and MORRIS (1973), CHENERY et al (1974), AHLUWALIA (1974, 1976a and 1976b)** and **PAUKERT (1973)**.

Kuznets concluded that the level of economic development as measured by GDP per capita is a major determinant of the extent of income inequality in a country. The characteristic of this phenonmenon is an inverted-U hypothesis, which illustrates that relative inequality rises during the early stages of development, reaches a peak and then declines in the later stage.

WILLIAMSON (1965, pp 3-43) states that there is a correlation between 'stage of development' and the level of inequality within regions[4]. He found that a group of regions with an intermediate level of per capita income has the largest regional inequality whereas highly developed regions and limited economic growth regions show relatively the opposite result.

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4. **GILBERT** and **GOODMAN** (1976: pp 118) admit that Williamson's study "remains the most comprehensive study of regional disparity available"

HIRSCHMAN (1958) supports this view and adds that the imbalance can be removed only by government intervention in the field of regional development. Myrdal is more pessimistic. He does not believe that intervention by government can bring the existing condition towards convergence[5].

Williamson and Kuznets discuss the relationship between stage of development and inequality, however, both have not provided clear definition by what they mean by 'stage of development' **ROSTOW (1971: pp 4-5)** identify all societies, in their economic dimension, as lying within one of five stages of development: the traditional society, the precondition for take-off, the take-off, the drive to maturity, and the age of high mass-consumption.

FIELDS (1985) summarizes the evidence on growth experience and inequality change in more than twenty less-developed countries and comes to a conclusion which differs from Williamson's finding. Field's finding concludes that the relationship between Gini Ratio and GDP shows the lack of any pronounced pattern. There is no systematic relationship among these variables. Growth itself does not determine a country's inequality cause. The increase or decrease in inequality appears not to be associated with such economic conditions as the initial level of inequality, the level of economic development, or the rate of economic growth.

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5. In the urban-rural context, **RONDINELLI** and **RUDDLE (1978: pp 160-161)** agree that government intervention can stimulate more balance between urban and its hinterland by improving their linkages. The linkages are expected to transform and integrate urban and rural areas in developing areas and contribute to regional development by putting scarce resource to more productive use and by distributing more widely the factorof production. A complete set of linkages which were introduced were physical, economic, technological, social linkages and population movement, service delivery, and political, administrative, and organizational patterns.

'Development' in the assertion above is nearly always seen as an economic phenomenon. This assertion is not idle speculation nor the description of a hypothetical situation. As a multidimensional process, development has a multidimensional nature, including non economic as well as economic components. This study focusses in the economic components because of data availabality , some non economic indicators such as education will be taken into account.

Based on the review above, two kinds of indicators might be used to reveal the existence of 'development':

1. indicators showing regional growth,
2. indicators showing regional equality.

Because of data availability, this study will adopt regional GDP and export/import from/to the study region as basic indicators of regional growth. Government activities, such as government expenditure, as a regional growth indicator based on macro-economic model, will also be analysed if it has been influenced by the provision of roads. Government activities are ones of policy variables following Seatac's term.

Regional equality can be analysed from Gini coefficients of GDP, coefficients of variation of GDP and the ratios of income between the centres of growth and their hinterland. To provide an insight into 'economic development' itself, land use and private investment will be used as indicators. The interconnection between transport and development is discussed in the next chapter.

III.3 The Interconnection Between Transport and Development

The aim of this study is to investigate the role of transport in promoting the development of a region in Indonesia. The particular region which is selected as a case study is the province of North Sumatera. The overall objective of the investigation is to attempt to identify the relationship between the highway network and regional development. The theory of development has been reviewed briefly in the previous section.

The theoretical relationship between transport and regional economic development has been explored in terms of interregional trade, the regional economic and location theory. The interregional trade approach assumes the growth of a region is dependent on the comparative advantage of one region to another. The regional economy approach deals with the economic capacity of a region and how to stimulate interregional trade with other regions. This depends upon the quality and quantity of resources in the regions where they serve. The location theory approach explains the mechanism of interregional flows of goods and commodities using the transport cost structure as a variable. This approach is often called the least costs approach. When combined with central place theory this approach introduces the concept of the market centre, the market area and the city hierarchy which are influenced by transport costs.

The Ministry of Public Works of Indonesia uses a regional development criteria for selecting roads to be developed. This concept is similar to the least transport cost approach in the locational theory and the market area of Central Place theory. The least transport cost approach pioneered by WEBER (**BASKIN, 1929** and **WEBBER,** 1972). Palander (SMITH, 1971, pp 75-79) followed by ISARD (1960) introduced the concept of market area into theory of location. If the location theory is to find the suitable location of industries in terms of optimal profit or minimal cost, the Public Works approach is to designed to facilitate to access to a particular region[6].

Some authors criticise the least transport cost theory because the theory does not take into account diminishing returns of economies scale (HOOVER, 1963) and demand (GREENHUT, 1964 and 1967; HOTELLING, 1929). Christaller (KING, 1984) and then LOSCH (1954) adopted market area concept into their Central Place theory. RUSHTON (1971, pp 140-156) stated that the market area in central place theory does not follow the behaviour of consumer. WEBBER (1971, pp 27) states that the theory cannot be tested. The same criticism can be addressed to the concept of Ministry of Public Works[7]. However, there is no other alternative approach to explain hierarchies of urban centres in the context of regional economies, interegional trade and locational theory. Any empirical work to investigate the relationship between transport and development in the respect of interregional trade and locational theory is hardly found. One of those is KRESGE and PAUL (1971).

As FROMM (1965: pp 226) stated that if there is a relationship between capital formation and economic growth, there must be a relationship between important

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6. This concept was formulated by **PURNOMOSIDHI (1978)**. Purnomosidhi was Minister of Public Work from 1978-1983. He recognized the size of market areas in conjunction with the hierarchies of their urban centres. More discussion on this topic can be found in **BERRY and GARRISON (1958)**, **BERRY (1961)**, **BERRY (1965)**, **BEAVON (1977)**, **PARR and DENIKE (1970)** and **BROMLEY (1983)**.
7. **HOLAND (1976: p 12)** argues that transport cost does not work as the smooth mechanism of location adjustment to be found in **WEBER (1929)** and **LOSCH (1954)**, but as factors reinforcing the imperfections and frictions in interregional trade.

components of capital formation and growth. Transport, no doubt, is an important component of capital formation. Transport is not only a component of capital formation, but can be put as same level as other economic factors, including capital formation itself, following Adelman's description. **GLASSON (1978)** has proposed a model as a combination of economic and transport indicators as the independent variables and regional output as the dependent variables. Interregional trade or balance of payment is not considered in the Glasson's model. Macro-economic model also suggests the importance of the balance of the payment as the effect of inter regional trade. If transport investment has a relationship with economic growth, this type of investment should also have relationship with economic inequality.

The analysis of the role of roads on development is a difficult task. It is not clear whether improved effeciency in inter regional transport will stimulate dispersion or polarisation as **RICHARDSON (1973: pp 58)** stated that,

> "....raising the potential mobility of factors of production lower transport costs can stimulate polarisation towards fixed location due to immobile resources similarly, lower transport costs for commodities may expand markets and promote the exploitation of scale economies."

> "On the other hand, lower transport costs may widen locational choice and through their impact on resource mobility reduce the effects of an initially unequal spatial distribution of resources; these factors will promote despersion".

> "We can not say a priori whether inter-regional transportation improvements will tend to raise or lower the growth rate of a particular

> region. On the other hand, intra regional transportation improvements always raise growth potential unless resources are diverted into transportation from more productive uses."

Experiences from U.S.A. shows that transport affects are likely to be small to further regional growth **(KRAFT et al 1971: pp 91-92)**. However, for a country which is still in the first stage of its development, **ROSTOW (1971: pp 17)** states that one of the preconditions for take off from the traditional societies is "largely a matter of building social overhead capital-railways, ports and roads ....".

An investigation of the relationship between transport and development must consider not only economic indicators, but social-economic factors as well, (for example, indicators which are much related to the policy variables suggested by Seatac's study) even though the results can not be predicted with great certainty. In this case, rather than searching for a related theory, the findings from many experiences of other studies may provide a more useful explanation of the phenomenon of transport and development. In order to gain insight on this issue, transport investment can be described in terms of the level of accessibility and/or transport networks.

Levels of accessibility are a function of transport costs or travel time and they are therefore more concerned with the economic side of transport although geographical considerations can be taken into account by constructing models of accessibility which combine transport costs/travel time and inflow/outflows of a particular potential production among regions. Transport networks are part of complex spatial systems but the simplification of that reality makes it possible to study some characteristics.

The previous findings on the issue of transport and development which have been reviewed in Chapter II suggest two possible types of impact of transport on regional development. Firstly, increasing the level of accessibility by reducing transport costs/travel time and/or expanding transport networks may generate development and economic opportunities. This also depends upon the regional economic capacity in developing countries such as Indonesia. Secondly, transport networks have both permissive and responsive roles. These roles make it possible for people or development actors to respond to economic opportunities. This, in turn, depends upon an awareness of opportunities and positive attitudes toward economic change. Limitations of available funds are also a constraint on the awareness of people and development attitudes. Which role is more dominant in any given case may be much related to the level of development of a region and the definition of development itself, but in general, at the initial stage of transport improvement, transport 'have had a permissive rather than an automatic economic impact' (**MANNERS et al, 1980**). The impact of transport may take a certain time to emerge.

Seatac's study described the structure of socio-economic indicators which include land use, investment, credit, education and health. These variables are important for stimulating the economic growth of a region and the role of government actors at the national, regional and local level. The distribution of policy variables within a region is significantly influenced by the level of awareness and attitudes of the government actors. If transport networks have a positive relationship with population size or the size of the influnced areas, a connection between transport networks and policy variables should also exist. This may not be a product of direct causal effects but may reflect the extent to which transport can stimulate positive attitudes and awareness of the development actors to the economic opportunities which are opened by transport improvement.

Increases in the level of accessibility and/or expanding transport networks may generate developments and, in some cases an impact of transport provides a positive stimulus to economic growth. However such development may also have negative impacts on economic growth in the interregional context. For example, transport improvement may make one region more competitive to other than before. The effects of this competition are either backwash or spread effects from one region to other ones. In almost all cases, the first one serves to blunt the second. In some cases, transport improvement may actually lead to a relative decline in the regional output of one region. Another example of the negative side of transport improvements is the impact on less productive investment which may be more efficiently employed elsewhere. This also involve the awareness and attitude of development actors.

The description of transport investment in terms of the level of accessibility and transport networks may make it possible to identify the effect that transport investment has compared with other kinds of investments. **WILSON (1977)** ranks investment projects, not only by their productive activity, but also by their effect on attitudes. Another significant difference between these two extremes is in terms of the numbers of people affected by the investments. Transport investment occupies an intermediate position on the scale. Transport investment has also a wider geographical dimension than almost any other investment. Transport is 'not only can be used directly by many people but when extended into rural areas can bring a greater proportion of the most traditional aspects of a society into direct contact with new phenomenon' **(Ibid, pp 199)**.

In most economic relationships, economic behaviour in any period is to a great extent determined by past experience and past patterns of behaviour. As stated previously, in general, the role of transport is permissive at the initial stages and generative after a certain period of time. This characteristic is similar to other economic relationships. Lagged values of transport as well as economic variables therefore are important explanatory variables in the regional output and transport system relationship.

Unlike developed countries, in developing countries, the benefits from road construction are almost entirely in the form of new development from the traffic which the new road will generate. Many transport models such as RHTM which is introduced in developed countries consider the generated traffic is a function of population and employment. That is not necessarily the case in developing countries. Some models use agricultural land use as an indicator of the potential of one region to generate traffic (**AHMED et al, 1976**). However, **TENNANTS (1975)** experience in Kenya suggests that agricultural land use has no significant relationship with generated traffic. If income is one factor of trip production in urban areas it might be true that economic growth factors are significant in generating traffic among cities. Experiences from previous studies support this case. Generated traffic, for example in the Thai case, is strongly related to the impact of new investments (**JONES, 1960**).

Although experiences from many countries show that in many cases transport influences significantly the local economy, this conclusion is still tentative. One reason is that there is a question whether the local economy is only affected by transport or whether other factors have also influences on the economy when transport improvement is provided. The latter seems to be true. Transport can not stand alone. Other possible factors which influence the regional economy should be considered. The conclusions which are drawn from this analysis are still tentative for two reasons. Firstly, only a limited range of impacts can be sought. Secondly, increased disaggregation and the addition of more and more variables to represent additional sectors of economy may be misplaced effort (BOTHAM, 1983).

Although in many cases, as shown in the review of studies in Chapter II, the impact of transport can be either positive, neutral or negative, but no doubt if regional growth and equality is the objective of the development, transport is the prerequisite to be provided to achieve it.

Growth factors in the neo-classical approach at a given level of the state of technology and socio-cultural environment are classified into regional resources such as agricultural land use, capital accumulation and employment. Non-economic factors such as education, housing and health facilities should also be considered. Their provision cannot only rely on the market forces. The intervention of government may be necessary. This situation still occurs in Indonesia. It shows that government activities are an essential element to promote the regional growth. Keynesians and Neo-Keynesians agree that the inter-regional trade is another key element to stimulate economic growth. It is speculated that the role of transport is essential to promote interregional trade.

The knowledge of development and the lesson from the other countries' experiences is a background to breakdown the aim of the study into some objectives. Some hypotheses can be proposed to achieve the objective(s). The hypotheses are built by the interaction between indicators of development as mentioned above and indicators of roads. The indicators will be proved that they have correlation with the provision of transport in the study area. The methodology which will be used is described in the next section.

III.4 Objectives and Hypotheses

The objectives of this study are as follows:

to identify the impact of road network on regional development and to provide inputs to the transport policy regarding the most effective ways in which road investment can be used to broaden social and economic benefits at a provincial level. Regional developments are indicated by fourteen indicators of agricultural sector, twenty-six indicators of inter-regional trade, fourteen indicators of the social sector and twelve indicators represent transport modes[8].

The hypotheses which form the basis of the study are expressed in term of this study's first objective:

a. road network has significant correlation with the expansion of land use area,

The impact of roads on agricultural land use expansion provides contradictory results. Seatac's study in Indonesia shows that there was an increase in farmers planting new high-value cash crops but the study does not indicate the increase as result from land use expansion or land use pattern change. In Thailand it is not clear if the increase of

8. These research hypotheses are constructed in such a way to make them easier to transform to statistical hypotheses. Statistical hypotheses are established to delineate the differences between two or more groups regarding some trait or collection of characteristics (**BLACK and CHAMPION, 1971: pp 131**) and "to be supported or refuted" (**DIRENZO, 1966: pp 126**). **GOODE and HATT (1952: pp 69-73)** provide some criteria that should be considered for judging hypotheses. **ARMSTRONG (1978: pp 406-407)** suggests to use multiple hypotheses for finding disconfirming evidence.

products by farmers as a result of land use expansion or an increase in the use of fertilizer.

Seatac's study in the Philippines and in Malaysia indicates that transport improvement only induced slight land use expansion. A similar outcome is found in Klein's study in Guatemala and Hirsch's study in El Salvador. In Sabah, Boney's experience shows that as long is the road in good quality, the role of roads in land use expansion is stimulating. This contradictory result on landuse expansion leads this study to propose hypothesis a.

> b. road network has significant correlation with private capital investment,
>
> c. road development has a significant influence on government activities in a particular area,

These two hypotheses are based on the view that the development response was faster to road provision or improvement in more developed rather than less developed agricultural systems. No doubt, private capital and government expenditure be essential to promote 'less developed' to 'more developed' regions. Seatac's study finding in Thailand found that a number of shops and small-scale manufactures were increased when transport was improved. There was not a considerable increase in vehicle ownership in the study area. A similar situation occurred in credit use. Most areas in Seatac's study show that transport improvement did not induce considerably the increase in the number of credit users. Klein's experience in Guatemala shows that the 'importance of supportimg investment' in order to exploit the development potential of roads or as Stanley stated that entrepreneurship led to development.

d. road development has a significant influence on inter-regional trade,

Bergman's study in Bolivia shows that the increase of rice and sugar production as a result of road provision affected positively the balance of payments. Imports of sugar and rice increased. It was expected to promote more balanced interregional trade in Bolivia. Experience from Seatac's study in the Philipinnes shows that the increase in palay production induced by transport improvement simultanoeusly stimulated exporting palay to other regions. Interregional trade began to take place. Experience from Uganda railway show a different situation as indicated by the failure to develop exports of banana or iron ore to market the cobalt produced **(O'CONNOR, 1965)**.

Bricknell's analysis on the market structure of chemical production in the United Kingdom demonstrated that the traffic pattern within the road network has been changing since the chemical product market structure was changed. Based on these views the above hypothesis is established to investigate if there is a relationship between road improvement within the study area and loading and unloading in the ports. There is no data available to investigate interegional trade within the province under study.

e. road development has a significant role in providing social facilities,

Indonesia's and Thailand's experiences in Seatac's study shows that a little change in educational attainment has taken place after the transport improvement. Different findings occurred in Seatac's study in Malaysia which shows an increase in the number of literate young adult including children. Transport improvement in the Philippines influenced education development. This result may come about because road provision stimulated provision of schools and stimulated migrating teachers to the study area.

Seatac's study in Indonesia illustrated that transport improvement did not change of the pattern of children born. Although it did not represent whole health system in the study area, it was likely the transport improvement did not stimulate considerable change. Malaysia's experience shows that distance from health clinic determined the frequency of health visits. Therefore provision of either schools, teachers, health clinics in an area is important to achieve health and education development based on which the above hypothesis is created.

f. road development provides a significant impact on declining in using other types of transport modes.

HOYLE (1973: pp 50-62) stated that in developing countries, since the modern road system has been built to complement the rail road system, railways have been unused and have become too expensive to maintain. Hoyle provides two countries in East Africa, Sierra Leone and Ivory Cost, as examples. He shows that road and railway had begun to disintegrate and the railway in Sierra Leone was likely being phased out as a new road program was developed. Since provision of the Atlantic Highway from Guatemala to Puerto Barrios , Klein's study shows a significant change in transport modal choice from rail road to trucks although railroads remain the most significant means of transporting bulk and longhaul goods.

This illustrates a phenomenon in developing countries, which attempts to test in Indonesia case, as **TAAFFE et al (1953: pp 514)** stated "the steady rise in the importance of road traffic, which first complements the rail road, then competes with it, and finally overwhelms it".

To test the hypotheses of the first objective this study uses Pearson's simple correlation to investigate if road network indicators have a good correlation with those five sector's indicators.

The second objective is to identify the impact of road development on regional growth. Regional GDP will be taken as representative of the term 'growth'. Ten sectors of GDP are investigated if they have a correlation with road network. The 11 sectors are GDP by agriculture, quarrying/mining, manufacturing, construction, electricity/gas/water supply, trade/ hotel/restaurant, transport/communication, bank/ financial institution, housing/dwelling rent and public expenditure.

The hypotheses which are proposed to be tested to achieve the second objective are:

a. the improvement of road network in a region has an influence on the subregional growth within the region.

This hypothesis is derived from Richardson's statement which has been revealed in the beginning of this chapter. **McMASTER (1970: pp 1-21)** agrees with Richardson's view as he stated that the diffusion of the opportunity to participate in an integration national economy may be of great benefit, but improvement in road communication may produce quite different effects at different scales of operation. The promotion of rural industry at an intermediate technological level, improved transport links between rural areas and urban-industrial growth centre may tend to increase the polarization and exacerbate the problem of the town.

b. economic factors and types of road improvement have different contribution on regional growth. Economic factors which are defined in this study are land use area, capital investment either by private enterprises or government and inter-regional trade.

This hypothesis is constructed based on the experiences in Sabah and India where results are contradictory. Boney's study in Sabah shows that the standard of roads and distance from commercial centres has a relationship between road building and the economy and social development. It seems that earth roads did not give much benefit to the producers. Bansal and Patil's study in India found that the existence of any kind of traffic routes is more important than their quality[9]. This hypothesis, similar to the previous hypotheses, is tested by regression analysis.

c. Road network has a significant influence on GDP inequality between subregions.

AZIS (1985:pp 201) derived from his interregional capital movement model the effect of transport costs upon the movement of the capital. He revealed that the attractiveness of the developed region to future investors will become stronger especially in the case of activities where the transport costs of non-ubiquitous natural resources is the prime determinant of a locational decision. **THOMAS (1984: pp 99-119)** argues that if certain areas are neglected in terms of road provision, it is likely

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9. **KRAFT (1971)** argues that if a region has a good growth potential because of the availability of raw materials, skilled labor etc but for historical or political reasons, has a poor transport system, transport investment in that region may promote its growth.

that such areas will be spared the effects of price increases generated outside and their scope for modernization and production increase will be reduced.

Before the third hypothesis is tested the subregions are classified into two groups based on their GDP level position relative to the North Sumatera GDP. The descriminant multivariate analysis is adopted to see if the two subregions have significant difference by adopting road network variables as explanatory variables. A simple product moment correlation is also used when the relationship between the road network and inequality over time is computed.

The third objective is to investigate the relationship between road network and transport demand. Transport demand is defined in this study as marketing areas which are formed by commodity flows and volume of traffic as a result of attraction and generation between two market centres. This attraction and generation may be based on the Losch's economic principle which explores "the inter-relational between demand levels, shapes of market areas and network arrangements" **(KING, 1984:pp 81)**.

As stated previously that Ministry of Public Works' market area approach is similar to Palander's analysis **(SMITH, 1971)**. The latter deals with market areas of two firms. Palander argues that lower freight charges from one firm can serve a larger area than the other one does as long as the plant price is equal. A similar analysis was proposed by **HOOVER (1963)**. Transport cost per unit length is a function of road improvement. The better the road condition the lower transport costs are expected

(GAUTHIER, 1968: pp 79-94), and the larger area will be served by the market centre[10]. The single hypothesis is proposed to support this objective as follows:

> Volume of traffic between two nodes has a significant correlation with the regional development of the market areas of the two nodes.

Traffic flows between two nodes are determined by the interaction between the level of potentiality of the two nodes. In U.K., the size of population is taken as a variable representing the level of potentiality (LEITCH REPORT, 1977). TENNANT (1975) used the land use and traffic generation principle to outline a procedure to estimate rural road traffic in Kenya. He finds that land use is not significant to generate traffics. The question may be raised whether the situation in Kenya is also valid for the area of study or not. If income is one factor influencing number of trip production in urban areas, it might also be true that economic growth factors which are related with income are also significant to generate traffics. This issue needs to be proved in this case study.

Two very simple ways to represent the road network is as the amount of budget allocated to road infrastructure assuming a certain level of productive effeciency, or the total length of roads available. The total length can be classified into state, provincial, and local roads based on the status classification, or classified into asphalt, gravel, and earth roads based on the surface condition or classified into very good, good, bad and very bad based on the structural condition.

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10. The role of a market centre is not only in the theory. HODGES (1988) shows that a market centre has a significant role even in the traditional society.

The road network is a product of transport investment. The other description of transport network includes two categories of analysis: morphological and functional. The morphological approach focusses upon those characteristics of network form which are recognized intuitively as the most important, for example, accessibility and orientation. The functional study is based upon the dominant pattern of network use (HAY, 1973, pp 35-45).

The approach which will be adopted in this study when the hypotheses are tested is a combination of cross sectional and time series analysis. The latter will be emphasised more heavily. Cross-sectional analyses are used to review and compare if differences between subregions can be explained by variations in the socio-economic characteristics of the subregions.

The different potentiality of some regions over others gives a different level of response to the provision of roads. It has occurred because of different capability of land, cultural variation or continually variation of economic landscape surface. These variations can be very local or occur on a much larger scale. Subregions based on an administrative boundary may lead to some variations being identified and being overlooked.

The result of this comparison is to indicate a new direction to pursue in transport planning but it should be realized they cannot be interpreted as definitive proof that the desired outcome can be achieved by changing the characteristics of transport investment in a certain subregion.

III.5 Approaches to Analysis

Lack of appropriate data makes it impossible to utilize several of the approaches based at the regional level which were reviewed in the second chapter of this study. For example, this study cannot follow the procedure used by Kansky and Sharif for two reasons. Firstly, the one year cross sectional data that is available can not adequately describe the actual distribution of development activities as an effect of transport network. The second reason that there is no reliable data or even a suitable map for this purpose.

Similarly, although Botham's approach seems to be a promising way for investigating the impact of transport on development, this study can not pursue this direction.[11] Firstly, there are no available consistent data of development activities at the subregional level. Secondly, there is no available model of transport costs which is suitable or calibrated for the area of study. Thirdly, limitations of time preclude the collection of the additional data required to calculate Botham's accessibility indices.

Given the problems presented by the data that are available for Indonesia it is necessary therefore to consider two main sets of methods that can be used in the analysis. These are regional transport economic models such as the economic base model and the gravity model. The main features of these models are described below.

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11. The indices which are introduced by Botham are functions of market demand, total employment, employment in a particular industry, demand of the products of a particular industry, output of a particular industry, supply of inputs used by a particular industry in a particular zone, and transport costs from one node to another node.

Regional Transport Economic Model Building

Although one of the most promising approaches to investigate the impact of transport is the counterfactual approach, most studies of transport and development do not follow this direction. Most studies investigate the contribution of transport variables on the regional output by constructing a transport-regional model which incorporate possible contributing factors to regional output. **GLICKMAN (1977)** reviews the regional economic model building. He introduces three classes of models that have been used to investigate regional economic growth. They are: economic base model, input-output model and econometric model. The three models which are described above have a blurred boundary between them.

The Economic Base Model is derived from the Macro-Economic approach. Economic Base Model recognizes that a region consists of centre and peripheral. Centre can be defined as 'a region' and peripheral is as 'the rest of the world'. There are two types of activities which are referred to the centre-peripheral linkages. First one is the basic activity and the second is non-basic activity. Basic activity is the total exports including not only commodity exports and earnings but new wage payments and property income received by the region's resident from outside as well as net transfer payments from outside. Transport models which can be categorized in the economic base are scarcely found, which includes **CHAUDHURI (1982)**.

The input-output model and its linkage to the economic base model have been demonstrated by **ROMANOFF (1974)**. The linkage as shown in Romanoff's model that the input-output model is limited only to basic and non-basic sector. In reality, a more flexible input-output model is needed to cope with the problem in which few sectors may serve either the local or export market exclusively. For more details about this model, see (**HEWINGS, 1985**).

At a national level, this model fulfils a function to assist the accounting framework. This framework is based on the macro economic theory. **RICHARDSON (1973)** illustrates the linkage between macro-economic model and the input-output model. At the national context, it is possible to construct an accounting framework as a closed system. The impact of external forces on local production flow may not be given a determining influence.

When this model is adopted on to a regional context, it needs some consideration. Inter-regional linkages are open system. The influence of national policy and regional policy has a significant impact on flows of activities. The structure of the account should be contributed in such a way it can accommodate all exogenous and endogenous factors. All structures can illustrate the interaction between national, regional and inter-regional activities.

Analysis of input output at the macro-economic level has difficulty in collecting suitable data. The benefit of such a model interpretes regional macro-economic is limited. If the transaction imposed by central government into a region is assigned in its regional framework may mislead the outcome and severely distort inter-regional comparisons.

Therefore, for regional analysis purposes, a particular purpose input-output account such as inter-industry analysis, breaks down total production and consumption by commodity, probably has a greater value than income and product accounts. The advantage of this model compared to the economic base model, that the outcome provides a more accurate coefficient for any activities under consideration in the form of regional and inter-regional tables.

The disadvantage of this model is the high cost. It is impossible to compare the impact of national and regional technologies on trading pattern and local price differences which in turn, influence the coefficient in the input-output table. **GLICKMAN (1972: pp 36)** mentioned two further problems. The difficulties "to differentiate between purchases on the current and capital accounts" may lead to a distortion of the production coefficient. Most of the tables which are estimated on an industry rather than a product basis provide a problem for a mixed product firm. "If the production pattern of those different productions differ greatly, and if the mix of product changes significantly, than the production coefficient should also be altered".

KRESGE and PAUL (1971) provided a model to compute the flow of traffic based on the gravity model and then constructed an input-output model. Supply and demand on commodities or goods are selected as 'scale of interaction' between two nodes and total demand on all nodes under observation is selected as 'distancee friction'. The model is constructed iteratively until two given constraints are fulfilled. Another study based on the input-output model has been conducted by **LIEW and LIEW (1980)**. A multiregional variable input-output model is introduced to investigate the impact of a change in transport costs on regional development and trade pattern.

Econometricians usually employ time series data in building a econometric model. The principal statistical tool used in building the model is regression analysis. The model estimates the relationship between two or more economic variables, for example comsumption and income. The economic theory is tested empirically.

Many econometric models which considers transport as an explanatory variable have been developed includes **(GLICKMAN, 1972), (HARRIS, 1974), (PERLE, 1974).**

Large scale econometric models which are principally based on multiple regression analysis, consisting of large numbers of dependent behavioural equations of macro economic structure typically forecast such variables as wages, price, income and output. These macro economic structures comprehensively describe how a national economy works. Econometrics is a combination of economic theory, mathematical economics and statistics.

In contrast to economic base and input-output models, econometric or regression models are not necessarily based upon a specific theory of regional structure, although an explicit theory of regional growth can be tested. Therefore econometric and regression models provide a more flexible approach to regional analysis than the models reviewed previously. Econometric models also appear to be a good compromise between particularly because of the amount of data needed to build them. This is the reason why this study uses regression method for the analysis in terms of the first two objectives.

For the first objective, the study uses a simple regression method to investigate whether the six indicators; land use, investments, government expenditure, interregional trade, education and health facilities and transport modes have good relationships with provision of roads. Multiple regression equations are constructed for the second objective. Landuse, investments, government expenditure, interregional trade, and 4 roads indicators are selected as the independent variables and GDP by sectors as the dependent variables. It is assumed that the 8 variables works simultanously.

It is essential to focus the relationship wanting to be tested with the application of econometric technique as the existence of a body of economic theory. It means that the hypotheses about econometric behaviour should come at first from economic theory. The hyphotheses are formulated in mathematical form as the model to be tested. It does not mean that the study restricts itself only to factors suggested by economic theory but it also depends on the objectives of the study. Factors from economic theory do not provide a satisfactory explanation of economic behaviour or the study's objectives. The study is certainty entitled to look for other factors.

In general, using econometrics is not strictly only to test hypotheses derived from a body of knowledge but it can be used to formulate the theory. If it is a case, the formulation of variables to be observed should be carefully considered because the outcome may not make sense. **KOUTSOYIANNIS (1981:pp 6)** stated that "..... one should distinguish clearly between the test of already existing theory by using observational data, and the use of observations for formulating a new theory but the new theory can not be tested against the same data for its derivation".

KOUTSOYIANNIS (1981:pp 29) also proposed that an econometric model should fulfil three desirable properties, theoretical plausibility, explanatory ability and accuracy of the parameter's estimates. Statistical criteria to test the model is classified into two groups.

The first one is first-order test and the second one is second order test. The first one includes correlation coefficients and the standard error of the estimates.

The second order test aim is to determine the reliability of the statistical criteria which use the analyses such as Multicollinearity and Durbin-Watson d statistics. When the finding is not statisfied, respecification of the model for example new variables are introduced, some variables omitted, original variables transformed it is proposed to produce a new form which meets the criteria of the model.

The Gravity Model

One objective of this study is to investigate the impact of economic growth factors on transport demand which is defined as generated traffic in this study. The generated traffic in a particular region is defined in this study is the traffic which are generated by economic potential of the region. This definition may be similar with the definition of normal traffic which was introduced by Leitch Report. The simplest way to measure generated traffic is by a gravity model. Many writers have reviewed the use of gravity models to predict traffic flow including **BLACK (1981)**. The simplistic use of the gravity model for forecasting generated traffic is subject to criticism. Gravity models are not a recognized economic model. Price elasticity coefficients can not be incorporated in the model. Therefore they can not be used to measure elasticities. However, despite these criticism, the gravity model has an undoubted attraction because of its simplicity.

Gravity models are not always used as a single approach to investigate traffic generation but are often combined with regression analysis for the following reasons. Firstly, if a study investigates traffic generation as the impact of more than one potential attraction on economic growth factors simultaneously, multiple regression analysis can help of value. Secondly, if the aim of a study is to assess the significance of economic growth factors on generated traffic, multiple regression analysis can provide estimates of the level of significance of the parameter of the independent variables.

III.6 Problems of Methodology

Certain points must be clarified before the analyses are made. The methodological framework which needs to be examined includes the conceptual approach, analytical problems of technique and data realibility.

The relationship between transport and development which is introduced in this study, is presented in a constrained way. Road networks which will be used as an indicator the whole transport system can only be represented by their length and/or density. This study can not adopt other measures of transport networks because of data availability. For example, graph theoretical measures cannot be used because are no realible maps available at the level of detailed required. Similarly, the development indicators which are selected are constrained by the availability and reliability of the data.

Nevertheless, two of the objectives of this study are satisfied by utilizing a combination of cross-sectional and time series analysis, with the emphasis on the latter. Cross-sectional analyses face problems of homogeneity of the regions since the regions which are compared are based on the administrative boundaries. These areas differ in size, population, public policy and natural resources. Another problem is the availability of data at the subregional level. Therefore, if analysis overtime using regression approach, cross sectional analysis is more descriptive explaination. Nevertheless it must be recognized that the area of study is relative large and this may lead to misleading results in time series analysis. A good correlation may occur by chance rather than due to certain relationship effects. These problems can not be avoided because, the more consistent data are available only at the provincial level.

The third objective of this study is approached by utilizing the gravity model. Only distance is considered and other possible frictions such as transport costs and travel time are not explored because of the non availability of data. The number of links can be analyzed is also limited.

These are also many problems that need to be taken into account in respect of the development indicators used in this study encounter. First, this is the question of data availability. The task is not only to formulate indicators representing development but it is also difficult to collect relevant data sets on a regional basis especially in the case of the province of North Sumatera. Much oh the data needed to describe development which are commonly used in developing countries are not available. Second, a great deal of the data are unreliable. There is also no explanation of the methods used for the collection of development indicators such as interregional trade and investment. There is also a possibility that the methods of data collection are not consistent during the period of study.

Even regional accounts such as GDP and capital formation encounter the same problems. There are four methods to compute regional accounts; the production approach, the income approach, the expenditure approach and the allocation approach. Only the production approach is used to estimate regional accounts in this case and none of the other approachs is utilized to reconfirm the findings from the production approach. Although data of Government expenditure local and provincial level are available, major problems are encountered when expenditure needs to be disaggregated into subregions. The same problems are encountered when national expenditure has to be disaggregated into provinces.

Due to data problems, the conclusions from this study must be drawn carefully. The findings of this study therefore are more indicative than conclusive. Even though they may indicate and permit an anticipation of the future role of transport, they should be interpreted more as trends and tendencies than an absolute predictions.

III.7 Conclusions

A conclusion can be drawn that this study only have a limited choice to select the proper approach because the lack of available data. The counterfactual approach which is the promising way to investigate the impact of transport can not be pursued in this study.

Transport network is used as a transport variable. The description of transport network will be discussed further in the next chapter. Development variables which are used in this study are land use, private investment, government expenditure, inter-regional trade and education/health indicators. Another aspect of development which is regional income and its distribution will also be considered. Both aspects have been constructed into the first two objectives of this study.

The third objective is to investigate the impact of transport on generated traffic which is a proxy for transport demand. Land use, private investment, government expenditure, which are selected from the previous development indicators and population in addition are taken as the factors to generate traffic.

This study attempts to investigate the relationship between transport network and development which are built in the first two objectives is by adopting time series analysis. Regression analysis is selected for that porpose. The trend of concentration and distribution of such development activities in the area of study will be investigated using descriptive method before the study of relationships in time series are pursued. This trend will be discussed in the Chapter IV and V.

The problem with the time series analysis is the instability. This problem is also rooted on the phenomenon of transport that the impact of transport take a certain time to emerge. To overcome this situation, lag time variables are considered. The discussion to approach the first two objectives will take place in the Chapter VI and VII.

The third objective is approached by using gravity model and regression analysis to find the level of significance of the relationship. This analysis will be discussed in the Chapter VIII.

IV. ANALYSIS of the REGION

IV.1 Introduction

Before the analysis can proceed, it is necessary to review the present situation in the province under study. This chapter sets out a general profile describes available transport modes and the analysis of human settlements of the province. Since the geographical condition and demography are general features of any profile of the study area, they are included in the first section of this chapter. The first section also includes a review of the provincial government planning process and road development as well the trends of regional trade in the province.

This review of the planning process is important because development actors and budget allocation procedures are crucial factors in the success of the implementation of plans. By reviewing this process, it is expected that the main constraints can be identified and the necessary recomendations made to overcome such problems. As it has also been stated in the research hypothesis that roads may have an impact on interregional trade the latter has been included in the first section as well.

IV.2 North Sumatera Profile

Geographical Condition

The province of North Sumatera consists of an area of 71.680 km2 or approximately 3.7 per cent of Indonesia's area. Sixty two per cent of the area has a slope of 0 to 25 per cent and the rest has slopes of more than 25 per cent. From the observations at the rainfall statiuons accross the province, it shows that North Sumatera has a higher rainfall intensity of 2500-3500 mm per year.

In the province of North Sumatera, there are 17 third hierarchies of local government administration (a province is the second hierarchy), 11 are districts which are called kabupatens and 6 are municipalities which are called kotamadyas. The province of North Sumatera, as an unit of development planning area, is officially divided into 4 subregions of development which are called Satuan Wilayah Pengembangan (=Regional Development Unit-the term RDU will be used in this study). Each RDU has its own central administration office which are Sibolga, P.Siantar, Medan and Kisaran for RDU 1, RDU 2, RDU 3 and RDU 4, respectively. This classification was established in 1980.

The districts, Tapanuli Tengah, Tapanuli Selatan, and Nias and one municipality, Sibolga are located in RDU1. Sibolga itself is situated in Tapanuli Tengah. The districts, Karo, Dairi, Simalungun and Tapanuli Utara and one municipality, P. Siantar, are located in RDU 2. P.Siantar is located in the district of Simalungun. In RDU 3, there are two districts and three municipalities; Langkat, Deli Serdang, Medan, Tebing Tinggi and Binjei, respectively. The rest of the ditricts, Asahan, Labuhan Batu and the municipality, Tanjung Balai are situated in RDU 4. Kabupatens and kotamadyas which are located in the province of North Sumatera can be seen in Fig. IV.1. There was no indication that the classification of the region was based on certain other criteria rather than geographical orientation.

Planning Process and Road Development

The central point of provincial development is economic progress and the main objectives of the development are to achieve the equilibrium between the agricultural sector and the industrial sector, and to fulfil the basic needs of the provincial population. The other objectives are to achieve an increase in regional income and to improve equity distribution among the people within the province. The last is to

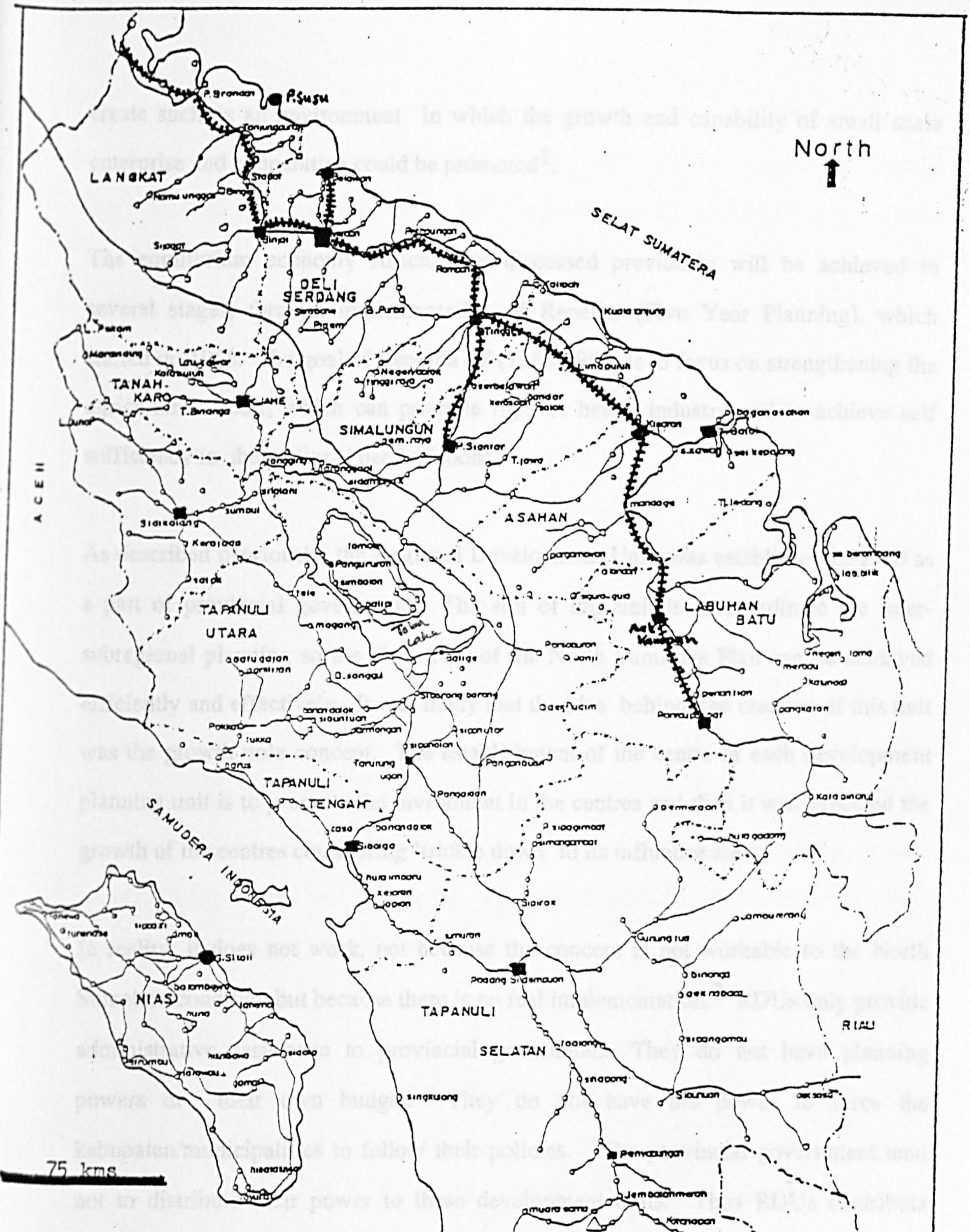

FIG.IV.1 NORTH SUMATERA

create such as an environment in which the growth and capability of small scale enterprise and cooperative could be promoted[1].

The equilibrium economy structure as discussed previously will be achieved in several stages, through implementation of Repelita (Five Year Planning), which started in 1968. The goal of Repelita IV (1983-1988) is to focus on strengthening the agricultural sector, which can promote light or heavy industry and to achieve self sufficiency in the national need of foods.

As described previously, the Regional Development Unit was established in 1980 as a part of provincial government. The aim of this unit is to coordinate the inter-subregional planning so the objectives of the North Sumatera Plan can be achieved efficiently and effectively. It was likely that the idea behind the creation of this unit was the growth pole concept. The establishment of the centre of each development planning unit is to promote the investment in the centres and then it was expected the growth of the centres could bring 'trickle down' to its influence area.

In reality, it does not work, not because the concept is not workable to the North Sumatera condition but because there is no real implementation.[2] RDUs only provide administrative assistance to provincial government. They do not have planning powers or their own budget. They do not have the power to force the kabupaten/municipalities to follow their policies. The provincial government tend not to distribute their power to these development units. Thus RDUs contribute nothing to the planning process but high economic cost.

Investments in transport, especially in land transport, were greatly improved over the last ten years in order to support the objectives of development. The investment

1. This objectives are based on The Third North Sumatera Plan.
2. An example of the failure of growth centre implementation occured in Latin America (CONROY, 1973).

resources come mainly from the central government, including foreign loans, and local government. These are allocated respectively to APBN (Anggaran Pendapatan Belanja Negara=National Revenue and Income Budget), APBD Tkt I (Anggaran Pendapatan Belanja Daerah Tingkat I=Provincial Revenue and Income Budget) and APBD Tkt II(Anggaran Pendapatan Belanja Daerah Tingkat II=District/Municipal Revenue and Income Budget). The total central government budget allocated in 1975 was Rp 24,959 billion and in 1985 this rose into Rp 164,100 billion, an increase of more than 600 per cent[3].

Road conditions have been greatly improved. Despite roads condition which depends on the weather, almost all parts of the province under study can be reached by land transport. Small parts are still isolated, particularly transmigration settlements. Land transport,in general, consists of passengers cars, buses, truck/wagons and motorcycles and the total number of these was 541,569 in 1986. The growth of each of those types of vehicle per year are 3.63 per cent, 15.90 per cent, 13.43 per cent, and 12.86 per cent, respectively, and the growth of total vehicles per year is 11.54 per cent during the period 1973-1986.[4] It shows a significant increase in the number of vehicles.

The figure shows that the highest trend of growth is with buses and trucks, followed by motorcycles. The growth of passenger cars is relatively small. In 1986, the numbers of buses and trucks increased nearly seven times and five times, respectively, compared to the figures in 1973. The increase in motorcycles is nearly five times and passenger cars have doubled. The total increase of vehicles, excluding the motorcycles, has nearly tripled and if motorcycles are considered in the calculation, the total increase of vehicles in North Sumatera has quadrupled during the period 1973-1986.

3. The information is reviewed from APBN 1975 and 1985.
4. The information of vehicles are collected from Traffic Transport Road Service.

If the figures discussed above are compared to the total increase in length of the highway network per year there is more than 10 per cent difference; or, the growth of the road is about only 0.54 per cent per year during the same period, which brings the vehicles-highway network system to an imbalance. This condition will be worse if the passenger car equivalent coefficient of bus and trucks which is from 3-7 according to the terrain of the roads, and of motorcycles that is from 0.33 to 0.5 are considered **(AASHTO, 1965)**.

As stated previously, the increase of vehicles on the highway/roads is higher than the increase of road length built, causing an imbalance within the transport system. This imbalance can be seen very clearly in urban cities, such as Medan, by congestion and the low speed of vehicles. Beside this, the transport system still faced other problems, which are:

a. Changing standards. By the old standard, roads/highway were divided into classes based on the quality of road construction and consequently, roads were prohibited to vehicles whose weight was beyond the class of the roads. The new standard, which was proposed by Bina Marga in 1979, is based on the volume of traffic, the proportion of vehicle types and the number of lanes. The new standard permits all vehicles to pass through all roads. However, there are still many links based on the old standard. This circumstance caused more deterioration in highway/road construction,

b. shortage of equipment and skilled labor in districts/municipalities caused the improvement needed on some links to be always delayed,

c. natural disasters such as floods damaged road construction,

d. social impact, such as land acquisition for road right of way still created problems,

e. limitation of budget to allocate to highway/roads.

Table IV.1 Length of State, Provincial, Districts/ Municipalities Road Condition in North Sumatera in 1986 (kms)

Road Status	Road Surface			
	Good	Sufficient	Bad	V.Bad
State	692	154	-	-
Province	393	2,033	21	164
Districts	2,979	2,754	1,580	4,345
Municipalities	920	456	329	52

Source: Public Work Service of North Sumatera

Despite the inadequacies of the data, Table IV.1 shows the construction conditions and their length based on the status of roads. It can be seen that the roads of district status are the longest, but they are distributed within 11 districts. The increase in the district road length was approximately 8.47 per cent during 1981-1986. During the last ten years, there is no increment of the roads under state and provincial responsibilities but the construction conditions have greatly improved. The conditions could have been achieved because of an intensive program in maintenance and improve which was financed almost entirely by foreign loans.

The percentage of the budget allocated to the road sector was approximately 15-16 per cent per year over 1975-1985. The total provincial government budget was Rp 8,117 billion in 1975 and Rp 26,219 billion in 1985. This was an increase of more than 300 per cent. The percentage of this budget allocated to the road sector was about 47 per cent and 23 per cent, in 1975 and 1985 respectively. Although there was a decrease in the percentages it shows that the total amount budget allocated in road sector increased. Kabupaten/municipality budget plays a minor role in the development, contributing around 5-10 per cent of the total budget allocated in its subregion. This amount of the transport budget which has been allocated from either central or provincial government is not enough to cope with inaccessibility of many villages. Only about 63 per cent of the total number of villages in the district in the province under study can be reached by vehicles in all weathers.[5]

Demography of North Sumatera[6]

The population of North Sumatera was 9,444,097 in 1985 and the population density, 132/km2. Compared to 1975, there was an increase in the number of population of 2.60 per cent per year. The distribution of population in 1985 among subregions[7], can be seen in Table IV.2. Table IV.2 shows that the highest density in the province, after Medan, is Deli Serdang. The lowest density of population is Tapanuli Selatan.

The rate of population growth in North Sumatera was 2.92 per cent and 2.52 per cent in the period 1961-71 and 1975-85, respectively. The rate of growth of the population among subregions is shown in Table IV.2. The rates of population compared between the two periods was only slightly lower. Only 4 subregions' rates of growth in the period 1975-85 are lower than their rates in the period 1961-71. There is no significant difference between the two rates of growth using t test at 5 per cent level of significance. It seems that the road improvements during 1975-85 in the province might not have had an influence in the rate of population growth.

In 1985, there were 5 subregions whose rates of growth are higher than North Sumatera's. They were Nias, Tapanuli Tengah, Labuhan Batu, Dairi and Medan. The rates of growth in Nias, Tapanuli Tengah and Dairi are as a result of the births rate. In Labuhan Batu and Medan the rate of population growth is more likely to

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5. This information is collected from The Public Work of North Sumatera.
6. The term 'North Sumatera' is used to represent the province of North Sumatera, province under study. Northern Sumatera means the region in which North Sumatera and 3 other provinces are located (Aceh, Riau and West Sumatera).
7. The term 'subregion' is different from 'district'. A district including the municipality located in the district is defined as a subregion.

Table IV.2 Population and Density Among Subregions in North Sumatera in 1985

Subregions	Population	% - tage of Total Pop.	Area (km^2)	% - tage of Total Area	Density pop/km^2	Growth 75-85 (%)	Growth 61-71 (%)
N i a s	540,755	5.73	5,318	7.42	102	2.86	1.65
Tap.Selatan	873,380	9.25	18,897	26.36	46	2.45	2.41
Tap.Tengah	262,258	2.78	2,198	3.07	119	2.84	2.47
Tap.Utara	740,076	7.84	10,605	14.79	70	1.32	1.06
Lab.Batu	622,507	6.59	9,323	13.01	67	3.80	3.47
Asahan	900,413	9.53	4,649	6.49	194	2.43	3.65
Simalungun	984,280	10.42	4,439	6.19	222	1.59	2.62
Dairi	276,524	2.93	3,146	4.39	88	2.90	2.94
Karo	246,028	2.60	2,127	2.97	116	2.18	2.12
D.Serdang	1,520,872	16.10	4,393	6.13	346	1.32	3.88
Langkat	854,910	9.05	6,320	8.82	135	2.55	4.12
Medan	1,622,094	17.17	265	0.37	6,121	4.53	2.87
T o t a l	9,444,097		71,680		132	2.52	2.92

Source: North Sumatera in Figures, 1985
North Sumatera Office of Statistics

have been affected by the rate of migration. The rate of migration for the two subregions were expected 1.28 per cent and 2.01 per cent, respectively[8].

The quality of life in North Sumatera is identified by introducing some indicators such as, for instance, estimating life expectancy, infant mortality rates, average calorie and protein consumption per capita, and the extent of illiteracy among over-ten-year-olds in the population. A rough indicator of the quality of life in North Sumatera as compared to some other provinces in Sumatera island is presented in Table IV.3. Although quality of life in North Sumatera is still lower than in western countries, its position compared to other provinces in the same island or to Indonesian figures are better[9].

Compared to the middle 1980s, infant death rate per 1000 babies declined from 120 and 100 in that time for male and female, respectively to 97 and 81 in 1984. This considerable improvement was the result of government expenditure to provide more clinics in rural areas. A similar situation has occurred in literacy. Compared to 1975, the number of people above 10 years old who could not read also decreased from 31 per cent to 16 per cent in 1985. It is speculated that this decrease was induced by the distibution of schools and teachers to many parts of the province.

The above statistics were obtained from the North Sumatera Education Authority (Kanwil PDK). Unfortunately there was no explanation of the data collection procedures in the statistics. Despite the problems encountered with the collection of data, this study attempts to determine whether the distribution of clinics, schools and teachers is correlated to the provision of roads. The trend of the social indicators during the period of study is presented in Table IV.4.

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8. There is no migration data available. These figures are estimated by taking the difference between the actual rate in the region and the actual in the province. This was quoted from Statistical Section, Bappeda Tkt I North Sumatera.
9. Quality of life of some western countries can be found in **TODARO (1985)**.

Table IV.3 Indicator of Quality Life
in Some Provinces in 1984

Provinces	Indicators						
	Life Expetency		Baby Death Rate		Average Food Quality per Person		Population Age >10 Years Old Can Not Read %
	Male	Female	Male	Female	cal/day	prot/day/gr	
	(Year)		Per 1000				
D.I.Aceh	54.20	56.50	99	82	2,188	55	25
North Sum.	54.40	57.70	97	81	2,043	49	16
West Sum.	48.30	51.30	132	112	2,056	44	18
Riau	49.90	53.00	123	103	1,923	46	23
South Sum.	52.80	54.00	106	89	2,027	47	18
Bengkulu	51.10	54.20	116	97	2,065	44	25
Lampung	52.80	56.00	106	89	1,948	42	22
Indonesia	50.90	54.00	117	98	1.793	43	29

Source: North Sumatera Provincial Plan 1984
North Sumatera Provincial Planning Board

Table IV.4 Trends of Education and Health Services in North Sumatera, 1975-1985

Year	No. of Schools Elementary	Junior High	Senior High
1975	na	na	na
1976	5628	784	314
1977	5798	915	339
1978	6318	931	379
1979	6952	940	413
1980	7356	977	446
1981	7383	1061	490
1982	8009	1088	513
1983	8615	1253	518
1984	8885	1326	627
1985	8915	1504	716

Year	No. of Students Elementary	Junior High	Senior High
1975	na	na	na
1976	1074000	198300	93182
1977	1250000	220600	110800
1978	1333000	229700	119700
1979	1494000	259500	139800
1980	1552000	306800	155600
1981	1604000	351400	188500
1982	1686000	354800	193200
1983	1736000	411800	202000
1984	1772000	442100	243200
1985	1776000	503700	249800

Year	No. of Teachers Elementary	Junior High	Senior High	No. of Health /Clinics
1975	na	na	na	na
1976	40052	9344	5832	na
1977	41380	11371	6916	58557
1978	43909	12246	7501	67175
1979	46536	13712	8583	88198
1980	53955	15226	9345	91919
1981	61433	16262	10110	208800
1982	61700	16404	11102	137400
1983	66806	21474	11894	218700
1984	70456	23707	15272	227900
1985	70624	28229	16491	212200

Source: North Sumatera in Figures (1985 and Various issues)

Inter-Regional Trade

The trade sector also has an important role to promote the regional growth in North Sumatera. The trends of trading activities are analyzed in the context of export and import volumes, international and interinsular, which are measured by the loading and unloading volumes. The export volume in 1984, shows a figure of 1,595,711 tons, which decreased approximately by 4.3 per cent per year compared to year 1979. In 1982, the largest proportion of the volume passed through the port Belawan and Pangkalan Susu, which handled 51.4 per cent and 45.3 per cent of the total export of the province. The last figure showed only the oil exported by the province, which went through Pangkalan Susu. The local transport used were pipes, therefore there was no influence in daily traffic volumes on highways[10].

Although the tonnage volume of exports decreased, the export value in the same period increased from 1979-1984. Export value was $ 731,283,000 in 1982 and there was an increase of approximately 8.1 per cent per year compared to the year 1978. Within the same period, the was an increase of 0.6 per cent and 32.3 per cent per year in the ports Belawan and Pangkalan Susu, respectively.

In 1981, the most important export commodities from North Sumatera were oil (38.80 per cent), rubber (19.50 per cent) and palm oil (12.0 per cent). The largest proportion of the export volume was to the U.S.A. (38.8 per cent), to Europe (19.5 per cent) and to ASEAN countries (20.00 per cent). North Sumatera Pelita IV Book illustrates some important figures. Rubber was the highest export volume and it was followed by palm oil, which were 1,669,120 tons and 901,925 tons. Rubber also provided the highest contribution of US$ 1,722,795 to the export value. It was followed by coffee

10. The figures of inter-regional trade are calculated from North Sumatera Statistical Book (1985 and various issues).

which contributed US$ 535,303. Both commodities and two other commodities, palm oil and tea, were the potential commodities in promoting the provincial income which took about 78 per cent of the total export value.

Nevertheless, despite the inadequacies of the data, Table IV.5 shows the export and import volume and value through some ports and and airports in the province under study during 1980-1986. Although there was a slight increase in the physical volume of exports, the value shows a slight decrease from US$ 1,210x106 to US$ 1,135x106 in 1980 and 1986. This was a result of the decrease in oil prices in the world market. This view was supported by export volume and value figures through Pangkalan Susu which is the only oil port in the province. The export volume from Pangkalan Susu, mainly oil, declined only slightly between 1980 and 1986 but the value dropped by more than a half. A pipeline system is used for transporting oil from oil station to the port.

As stated previously regional planning policy in North Sumatera is attempting to stimulate growth in 4 centres: Medan, Siantar, Sibolga and Kisaran. The ports to support them are Belawan, Sibolga itself and Tanjung Balai. Thus, any development proposal, including road construction, in the province should support the aim of this policy. The trends of export and import through these ports seem they do not support the aim, as will be explained in the next paragraph.

Belawan, which took a half of the North Sumatera export volume in 1980, took 65 per cent of the exports in 1986. On the other hand the export volume in Sibolga dropped drastically from 302,100 tons to 12,552 tons in the same period. Tanjung Balai, which was an unimportant port in the 1970s, grew after 1980, with an export volume larger than Sibolga. Belawan and Tanjung Balai are located on the eastern coast of North Sumatera.

Table IV.5 Export and Import Volume (Ton)/Value (US$) from North Sumatera's Ports (1980-1986)

ai. export value (US$)

Year	North Sum. (000.000)	Belawan (000.000)	P.Susu (00.000)	Sibolga	T.Balai	G.Sitoli
1980	1,210.0	999.2	2,348	31,733	9,123	1,492
1981	926.5	619.3	2,833	8,578	5,069	2,200
1982	848.3	558.0	2,566	3,439	25,546	2,677
1983	1,088.0	736.9	2,120	815	133,400	4,177
1984	1,119.0	779.7	1,234	1,267	211,300	3,384
1985	1,179.0	848.1	0,567	2,659	268,300	3,290
1986	1,135.0	828.8	1,024	2,789	201,200	3,940

aii. export volume (ton)

Year	North Sum.	Belawan	P.Susu	Sibolga	T.Balai	G.Sitoli
1980	2,537	1,246	864	302,100	1,771	1,694
1981	1,873	809	922	73,284	1,050	3,034
1982	1,864	959	845	23,956	17,564	3,561
1983	2,157	1,226	845	5,611	99,598	4,930
1984	1,596	948	491	4,690	146,000	4,303
1985	2,251	1,738	245	11,162	253,400	3,957
1986	2,861	1,851	803	12,552	189,700	3,775

Table IV.5(Continued)

bi. import value (US$)

Year	North Sum. (000.000)	Belawan (000.000)	P.Susu	Sibolga	T.Balai	G.Sitoli
1980	739.7	706.8	18,865	2,713	32	11,288
1981	1,040.0	1,013.0	16,289	0	56	10,594
1982	1,188.0	1,068.0	60,289	887	47,845	10,286
1983	976.7	829.4	18,289	211	100,500	6,854
1984	727.4	504.5	97,420	371	107,800	7,716
1985	492.8	371.3	43,001	0	111,100	5,752
1986	407.1	325.9	46,960	0	192,200	3,936

bii. import volume (ton)

Year	North Sum. (000.000)	Belawan (000.000)	P.Susu	Sibolga	T.Balai	G.Sitoli
1980	1,386	1,375	9,413	1,079	5	427
1981	1,563	1,551	11,713	0	14	370
1982	2,329	2,244	18,179	4,356	62,493	315
1983	2,304	2,059	7,858	2,894	222,300	304
1984	1,526	1,077	3,801	626	442,800	269
1985	1,359	893.4	2,319	0	4,614,000	8,295
1986	1,130	702	1,967	0	4,131,000	2,924

Source: Directorate General of Navigation
Representative Office I

Export volume and value in Tanjung Balai show that the trend of export volume is in the same direction with the trend of export value. The increase in exports from Tanjung Balai was a result of the increase in export volume. On the other hand the decrease in export value in Sibolga was a result of a decrease in export volume. Belawan's figures show a different situation. The increase in export volume in Belawan was followed by the decrease in export value. Since Belawan handled more than 50 per cent of export volume of North Sumatera to the world market, it shows that the potential export commodity price declined during that period of study. It supports Schydlowsky's macro economic model description that Indonesia commodity prices are greatly dependant on world market prices (**SCHYDLOWSKY, 1980**).

Table IV.5 also shows that there was a decrease in import volume through all ports in North Sumatera. In 1980, almost all imports of North Sumatera were handled through Belawan. In 1985 Belawan only shared 62 per cent of total imports of North Sumatera. It seems that INPRES 5/1985 had an influence on the distribution of unloading imported goods. Sibolga did not show an important role in handling imported goods. Pangkalan Susu import volume also declined. Only Tanjung Balai illustrates the increase in import goods. The import value decreased as a result of the decrease in their volume. It is expected that roads also play important role in inducing the change of pattern of export and import through North Sumatera ports[11].

11. Inpres 4/85 (President Instruction no 4/1985) was issued in 1985 which permits any ports to serve any inter-regional cargoes despite their origin/destination and the port hierarchy. **NETHERLANDS MARITIM INSTITUTE (1981)**'s study proposed the traffic flow system according to the port hierarchy system. Belawan is one of the four gates. Funds have been allocated to many ports to improve their facilities to support the port hierarchy system. The system has no oppurtunity to be seriously implemented until INPRES 4/85 was issued which goes different line. INPRES 4 was as result from external pressure such as World Bank on Indonesian Government in order to reduce high economic cost. See **SASTROMIHARDJO, 1985: pp 3-13**).

IV.3 Transport Mode

This study focusses on the role of roads in stimulating regional development. This discussion is not completed without considering other transport modes. In North Sumatera, it is likely that the competitors to the road mode are river transport and railways. The role of both modes have declined significantly in recent years. Sea transport is complementary to the road mode in the national transport framework. The aim of this section is to describe the trends of transport in the province under study and these trends will be investigated in more depth in Chapter VI to see if they have correlation with the provision of roads in North Sumatera.

Similar to the social and educational data, data collected for transport mode do not have any explanation of data collection procedure. Therefore, the conclusion to be drawn from this data should be taken with more care.

Sea Transport

The first mode that will be discussed is sea transport because this mode plays the most important role in Indonesia's communication as a connecting link between inter and intra-national ports. The important ports are Belawan, Sibolga, Tanjung Balai, Gunung Sitoli and Pangkalan Susu and Kuala Tanjung. Belawan, Sibolga, Tanjung Balai and Pangkalan Susu have been discussed previously to some extent.

As described previously, three of these ports, Belawan, Sibolga and Tanjung Balai, are expected to play an important role in promoting RDU development. Besides those ports there are approximately 28 smaller ports, such as Labuhan Bilik, Tanjung Tiram, Teluk Dalam, Lahewa and others. The latter ports are mainly used as fishery ports or inter settlement transport. The location of these ports can also be seen in Figure IV.1.

Belawan is the biggest port in the province and takes 65 per cent of the total export/import volume of North Sumatera in 1986. The role of this port is not only to serve the province of North Sumatera but also draws trade from to neighbouring provinces such as Aceh, Riau, and West Sumatera. It means that all regions in Northern Sumatera to some extent are served by Belawan. Therefore their geographical marketing orientation is influenced by this port. The impact of Belawan, which is only 24 kms from the city of Medan provides a great influence to promote the role of the city as a centre of growth to its surrounding regions.

The number of visiting ships in 1985 was 3025 units of 15,522,000 DWT/Weight and the average growth of the number of ships and DWT/Weight are 1.00 per cent during 1982-1986. The number of ships visiting decreased over the period 1978-1982 by 3.12 per cent but there was an increase in the growth of DWT/Weight from 3.05 per cent over the two periods of time. This shows that the sizes of the visiting ships to Belawan are .getting bigger within[12].

The volume and number of unloaded/loaded goods and arrival/departure of passengers in Belawan was 6,765,998 tons goods and 159,555 passengers in 1986. The growth was 5.5 per cent and 7.7 per cent during 1982-1986 period, respectively. The average growth during the period 1978-1982 was 9.46 per cent for loading/unloading goods and 15.69 per cent for passengers. This figures shows a drastic drop compared to both periods.

The second port that should be considered is Sibolga. Sibolga is situated in Tapanuli Tengah as a central administration office of the RDU 1 which covers the municipality of Sibolga itself, Tapanuli Tengah, Tapanuli Selatan and Nias. The location of this

12. The information on the port facilities and loading/unloading are collected from Directorate General of Navigation Representative Office I.

port is in the western part of North Sumatera, opposite Belawan which is situated in the eastern part of the province.

The number of visiting ships to Sibolga in 1986 was 2114 units of 812,000 DWT/Weight and the average annual growth is 8.65 per cent and 12.06 per cent during 1982-1986 respectively. The average annual growth was 4.42 per cent and 14.91 per cent in 1978 and 1982, respectively. Similar to Belawan, it seems that in Sibolga the sizes of ships which visited Sibolga were bigger in the current years but still relatively small compared to the sizes of the ships visiting Belawan, being less than one-tenth the average size.

The growth of loading/unloading goods and arrival/departure passengers during 1982-1986 are 9.49 per cent and 7.63 per cent,respectively. The volume of loading and unloading goods were on average 12,552 tons. Unloading take 60 per cent of this total volume. Nearly a half of 40 per cent of loaded goods on Sibolga ports are delivered to Gunung Sitoli. It shows that the role of this port on interregional input-output either interinsular or import/export was less important during current years. The regulation to prohibit the export of timber logs may also have affected the role of this port.

Tanjung Balai is one other port which is expected to take an important part in developing its hinterland region. Tanjung Balai is located in Asahan, and in the past this port served the district of Asahan, a part of the district of Simalungun and the district of Labuhan Batu. This role increased considerably during the period of study.

The number of visiting ships in 1986 was 2196 units of 179,000 DWT/Weight and the average growth of the ships from 1982 to 1986 increased 30.89 per cent, and the DWT/Weight increased 9.76 per cent. It appears that the DWT/Weight of ships visiting the port is relatively small. It is about 82 DWT per ship on average. In the same year, the volume of loading/unloading was 84,904 tons and arrival/departure passengers was 69,443. Average growth of loading/unloading goods and arrival/departure passengers since 1982 to 1986 decreased 18.77 per cent and 52.09 per cent, respectively. These figures show that this port is a prospective port for development. Another advantage of this port is the shorter distance to Singapore than from Belawan. Exports to Singapore from North Sumatera are 45 per cent of the total export volume.

Another port which will be discussed here is Gunung Sitoli, as the capital city of the district of Nias, an island situated in the Indonesian Ocean, in the western part of North Sumatera. The transport used to connect the main island to Nias is an airplane which takes 12 passengers once week from Medan, and a ship which sails twice a week from Sibolga.

The number of visiting ships in 1986 was 1213 units of 283,000 DWT/Weight. The average growth of visiting ships was 14.94 per cent annually and of DWT/Weight was 4.10 per cent during period 1982-1986. The volumes of loaded and unloaded goods are 64,000 tons and passengers were 76,000, and the average growth rates were 6.90 per cent and 24.39 per cent, respectively.

Pangkalan Susu is a special port for oil transport in North Sumatera. The volume of ships visiting the ports was 430 units of 955,000 DWT/Weight in 1986. It means that the decline of visiting ships and of DWT/Weight were -38.41 per cent and -18.80 per cent, respectively, during year 1982-1986. The volume of loading and unloading in this port is 861,493 tons in 1986. The decrease on oil price in the world market also had an influence on the volume of loading and unloading in Pangkalan Susu.

Railways

Railways in North Sumatera play an important role, particularly for transporting plantation production to Belawan for export. Eighty per cent of the volume transported by rail is plantation production and sixty per cent of it consists of palm oil. The plantation production is one of the valuable commodities for the region, since the agricultural sector shares the biggest percentage in regional income. In Pelita III, some links have been reoperated such as Medan-Belawan (1981) which have not been in operation since 1942.[13]

Since 1930, North Sumatera has had rail links which cover Ulee-ulee in Banda Aceh (province of Aceh) in the northern part of Sumatera and Rantau Parapat in the southern part; it is approximately 1017 kms long. Since the infra-structure is in very poor condition, only a part of the link is in operation. The main links in operation are Medan-Belawan, Medan-Tebing Tinggi-Rantau Parapat, Medan-Tebing Tinggi-Pematang Siantar, Medan-Tebing Tinggi-Tanjung Balai of 357 kms total length. The links which are not in operation are Ulee-ulee to Besitang 495 kms long, Lubuk Pakam-Petumbukan 15 kms long, and Besitang-Pangkalan Susu 10 kms long.

Table IV.6 Volume of Commodities are Carried by Train (Ton)

Commodities /Goods	Year 1981	1982	1983	1984	1985
Plantation	4,696	3,670	4,007	4,255	4,770
Quarrying	0.869	1,169	1,250	1,096	1,824
Fertilizer	10,776	948	180	1,274	2,139
Cement	13,553	1068	0	154	216
Forestry	11,399	3734	1,286	3,485	2,190
T o t a l	6,480	5,204	5,476	5,808	7,184-

Source: North Sumatera In Figures (1986)

13. This information is collected from Railway State Company.

Despite the problem possibly encountered with the data, Table IV.6 shows that the volume of plantation produce carried by train was constant during 1981 to 1985. This situation occurred because almost all plantation products which are produced by state enterprises are forced by state policy to use the train as the mode for transporting them to Medan or Belawan. Quarry products carried by train increased during 1981 to 1985. Quarrys are mainly found in Langkat, Labuhan Batu and Asahan. Quarrying product are delivered to Medan by train. Roads link railway stations to quarry sites.

Indonesia exported fertilizer amounting to 1,007,300 metric tons in 1981 and the volume of export decreased by 377,200 tons in 1985. This decrease was not because of the decline in using fertilizer but due to the effort of government to establish a succesful factory for import substitution. Fertilizer used in the province has been increased from approximately 13,000 tons in 1980 to 23,000 in 1985.

Seventy-five per cent of this fertilizer use was carried by train in 1980 but the percentage drastically dropped down in 1985, when it was only 9 per cent. The percentage was only 9 per cent. Fertilizer was much used by State Plantation and Big Plantation. Fertilizer was not widely used by farmers in many subregions such as in Tapanuli Selatan and Tapanuli Tengah. It is estimated that eighty per cent of fertilizer was used by plantation enterprises.

Indonesia also imported cement in the amount of 366,000 metric tons of cement in 1981 and this volume dropped to 16,400 metric tons in 1985. This drop was due to the domestic production of cement factories which have been established by government for import substitution. Cement needs in North Sumatera come from Padang in West Sumatera and from Banda Aceh in Aceh.

Cement from Padang comes through Sibolga and it is distributed to subregions: Tapanuli Selatan, Tapanuli Utara, and Tapanuli Selatan. The other subregions are supplied by distibution from Medan. There is competition between railway and roads to distribute cement for subregions: Deli Serdang, Simalungun, Kisaran and Labuhan Batu. According to interviewees in this study with some distributors in Medan, it appears that the use of cement is still limited to municipalities and kecamatan towns. Table IV.6 shows that the railroad does not play an essential role in carrying cement.

It is expected that the expansion of accessibility to many parts of the province tends to increase the production of forestry. From Table IV.6 can be seen that railroads carrying forestry product declined during 1981 and 1985.

River and Lake Transport

There are many rivers and one lake in North Sumatera. Previously they were used to carry goods and passengers, but recent years, the use of river transport as a means of daily transport is rare, particularly since highway networks has greatly improved. However, according to the 1983 data, 169 of 5446 villages still depended on sea or lake transport. This is about 3.10 per cent of the total villages in North Sumatera. Government still promotes this type of transport, but only in Lake Toba do they still operate regularly. The growth in the number of ships operating on the rivers and lakes has decreased during the period 1982-1986 as shown in Table IV.7, despite the possibility of inaccuracy encountered the data. This mode of transport is managed by one government agency, called Dinas Lalu-Lintas Angkutan Sungai dan Penyeberangan (=River and Ferry Transport Authority).

In 1986, the number of ships visiting piers was 92,384, handling 1,101,459 passengers and 85,747 tons of goods. Table IV.7 shows a decrease compared to the figures in 1982, where the number of ships visiting piers was 104,018, which managed

1,401,838 passengers and 89,499 tons goods. The proportion of ships operating was: 67.61 per cent river ships with machine; 20.56 per cent boat with machine; 6.48 per cent speedboat, and the rest small boats and rafts. The biggest decrease is the boat with machine, from 725 in 1982 to 146 in 1986.

Table IV.7 Number of Ships, Passengers and Goods Using Inland Waterways

Year	No of Ships	Passengers	Goods (Ton)
1982	104,018	1,401,838	89,499
1983	114,944	1,582,761	108,819
1984	104,004	1,475,443	95,291
1985	92,183	1,199,274	73,084
1986	92,384	1,101,459	85,747

Source: Representative Office II, Directorate General Land Transport

Air Transport

In North Sumatera, there are three airports; namely, Polonia in Medan,Binaka in Gunung Sitoli and Pinangsori in Sibolga. Polonia is not only the main gate to the province from other parts of Indonesia, but also one of the main gates to Indonesia from abroad. Polonia is classified as a first class airport. It can cater for big aeroplanes such as Boeing 747s. It has a runway length of 2900 meters. Binaka is a fourth class airport and a branch of Polonia. Pinangsori has not been used in recent years.

The numbers of passengers which departed and arrived in Polonia are 326,376 and 347,617 in 1986, respectively. In 1982, these figures were 116,781 and 125,356, respectively, which means that there was an increase of 179.48 per cent and 177.30 per cent, respectively in 4 years. The loading and unloading of goods through in 1986 was 3,166 tons and 5,109 tons and in 1982 it was 3,485 tons and 6,693 tons,

Table IV.8 Numbers of Passenger Arrival Departure in/from Polonia Port in Medan, 1980 - 1985

	Year					
	80	81	82	83	84	85
i. Arrival						
from Sibolga	620	290	134	131	0	45
from Meulaboh	2458	3122	3349	1906	778	385
from B.Aceh	16219	19222	24475	22743	18487	12680
from P.Baru	1139	15074	15212	13979	9940	1118
from abroad	87130	1089×10^5	1131×10^5	89422	94326	88504
from Jakarta	1912×10^5	1920×10^5	2321×10^5	2299×10^5	2160×10^5	2096×10^5
ii. Departure						
to Sibolga	608	272	138	113	0	41
to Meulaboh	2162	2927	3030	1671	562	342
to B.Aceh	21109	32147	25892	21670	20743	19581
to P.Baru	11484	15174	16227	14053	9871	893
to S'pore	92230	1117×10^5	1194×10^5	93236	95696	87496
to Jakarta	2008×10^5	2050×10^5	2197×10^5	2296×10^5	2202×10^5	2183×10^5

Source: North Sumatera in Figures 1985

respectively. There was therefore an increase of loading and unloading goods of 10.07 per cent and 31.01 per cent, respectively.

These figures show a great increase in the number of passengers using aeroplanes for their travels. Despite some inaccuracy possibly encountered the data, the trends in this increase in passengers using airways from Polonia can be seen in Table IV.8. In handling goods, the proportion which goes from Polonia is only small, being approximately 1 per cent compared to loading/unloading goods in Belawan. This means that, up to 1986, the role of air transport to carry goods was still not important, particularly for the export of goods.[14]

It can be concluded that the role of air and sea transport is compelentary to regional roads in forming national transport system. The competitor of roads in the region under study are river/ lake transport and railways. It shows that the role of the two modes in promoting goods and passenger movement are not significant. Both modes are only used to a limited extent in some subregions and the role river/lake transport mode is very small during the period of study.

IV.4 Analysis of Settlement

The previous section has described the transport mode other than roads. One of the objectives of transport provision is to provide accessibility to settlements in a region. It is expected that accessibility stimulates the provision of facilities of services and utilities in that region. The growth of setlements in a region is also influenced by their level of accessibility as stated that "strong relationship exists between the transport system and the spatial structure of human settlements" (UNCHS, 1984: pp

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14. POND (1968) describes briefly the development of transport modes in Indonesia since 1945. See also SUTTER (1959).

11).[15] It shows that discussion on transport of a region is not complete without considering the role of the settlements in that region. Therefore, before studying the interrelationship between roads and the regional development proceeds, the development of setlements in the area of the study is investigated.

Considerable evidence exists which shows that linkages of settlements and roads are important to stimulate regional income and development (See **KANSKY, 1963** and **SHARIF, 1985**). Anderson's study in Sierra Leone also found that migration is also induced by the provision of roads. The migration influences the population of urban towns. This section attempts to describe the proportion of urban population and the level of accessibility of villages in the province under study during the period of study. It is speculated that the proportion is affected by the provision of roads and the level of accessibility of villages induces the regional income.

There are three methods used when a settlement system needs to be analyzed, they are:

a) morphological classification, that analyzes the settlements system based on demographic and physical characteristics,

b) population size classification, which categorizes settlements into metropolitan areas,cities, towns and villages based on the number and density of residents within their boundaries; and

c) functional classification,that attempts to distinguish among settlements on the basis of the types, combinations and diversity of social and economic activities located in them.

The functional classification analysis focusses heavily on the functional characteritics of communities and described a region as a pattern of human settlement, defined by

15. Experience from Hong Kong shows that the less attractive of new towns to private housing development is a partly a reflection of the transport network which has lagged behind the growth of the new towns (**YEH, 1987**).

both population and functional features. This approach is concerned, primarily, with the social and economic functions that specific communities perform, and how, in combination, they form a pattern or system that can influence economy and social development.

The social and economic function information, together with the analysis of spatial linkages, can describe how the pattern of settlement and the level of development in the region are related. This information provides the level of accessibility that people in different settlements can have to reach various services, facilities, infrastructure and organizations, and decide if functions are sufficient or deficient. It assists the judgement in deciding where the location of new investment takes place to increase the capacity of communities to provide the access that people living in rural areas need to get to town-based services, facilities and infrastructures.

Morphological and Population Classification Analyses

The approach which determines which settlements are urban or rural, based on the population size and physical characteristics, is called morphological and population analysis. These analyses usually use population size to determine the pattern of settlements, the level settlement hierarchies and the degree of urbanity. This approach provides little information about the social and economic characteristics of the community, but still offers an easier way to identify the settlement patterns.

Another problem encountered in the analysis of urban settlements is in data collection procedures. Problems usually arise when the data on urban settlements are collected in terms of urban and rural areas. The data here is collected on the basis of administrative units. In fact, in some areas classified as urban, population densities are so low, that they can be classified as rural areas. Therefore any evaluation of this data in terms of population status should be considered carefully.

Except municipalities (Ind.term: kotamadya), other settlements located in districts (Ind. term: kabupaten) could be categorized as either urban or rural places and the percentage of population in the province living in urban and rural settlements could be roughly estimated. If the definition of urban areas is for all settlements. (in this case, the smallest unit of official government hierarchy is desa (=village) are taken into account) having a population density of at least 1000 persons per km2, the number of the population living in urban areas were 3,328,251 in 1985, or approximately 35.81 per cent of North Sumatera total population.[16]

Morphological and demographic analyses provide some insights into the size classes of settlements and changes in them over time. Table IV.9 indicates that within 10 years there was an increased number of the population living in the urban areas, from 21.92 per cent in 1975 to 24.41 per cent in 1985. The urban population is dominated by people living in Medan, which had 12.62 per cent of the total North Sumatera population in 1975 and 14 per cent in 1985. If the percentage of population growth in Medan which was 2.13 per cent within 10 years is compared to the total growth of North Sumatera, which was 3.86 per cent within the same period, it could be found that the growth in urban areas other than Medan, has considerably increased.

Although the population growth was relatively small, it is predicted that the growth will continue to increase in the future and, without careful consideration in selecting policy and regulations to support the urban development, the region will face problems in the future, particularly to cope with increased demands and limitations of

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16. There is no clear definition of the size of urban settlements in Indonesia. The figure in the table is based on the size of urban settlement is 5000 or more. The percentage of urban settlements became 31.94 per cent in 1985. This figure was closed to Portugal in 1980, but higher than India and Mali in 1980 which were 22 and 20 per cent, respectively, and much lower than other western other countries (exclude Portugal) which range was 58 per cent in Ireland to 91 per cent in U.K. In socialist countries, this range was 42 per cent in Yugoslavia and 77 per cent in East Germany. See **BOURNE and SINCLAIR (1984)**.

Table IV.9 Percentage of Urban Population in North Sumatera 1975 and 1986

Districts/ Municipalities	Total Population		Urban Population		Urban %-tage of Total Population	
	1975	1985	1975	1985	1975	1985
1. Nias	412900	533729	9211	12500	2.23	2.34
2. Tap.Selatan	700250	859480	63164	87172	9.02	10.14
3. Tap.Tengah	151494	191853	2570	3719	1.70	1.94
4. Tap.Tengah/Sibolga	209294	254353	60270	66219	28.81	26.03
5. Tap.Utara	656627	724940	33390	43796	5.08	6.04
6. Lab.Batu	398075	630130	56028	90931	14.07	14.43
7. Asahan	627654	841879	60510	110980	9.64	13.18
8. Asahan/T.Balai	674124	898089	106980	167190	15.87	18.62
9. Simalungun	701228	814602	29268	39439	4.17	4.84
10. Simalungun/P.Siantar	840428	997602	168468	222439	20.04	22.30
11. Dairi	202845	272605	17710	25500	8.73	9.35
12. Karo	195516	239738	37291	41000	19.07	17.10
13. Deli Serdang	1169720	1364210	62094	74670	5.31	5.47
14. Deli Serdang/T.Tinggi	1253550	1476110	145924	186570	11.64	12.63
15. Langkat	549411	765319	43700	75961	7.95	9.92
16. Langkat/Binjei	603101	860919	97390	171565	16.15	19.93
17. M e d a n	1350430	1908600	1350430	1908600	100.00	100.00
North Sumatera Total	7497140	9656297	2344398	3328251	21.92	24.41

Source: National Urban Development Strategy (1987), Directorate General Urban and Housing facility provision. The government has been aware of these problems at the national level. To finance the increased facilities, a new system of tax was introduced, Building and Land Tax, replacing Land Property Tax. In the old system, the income from land property tax was paid to the provincial revenue fund and was allocated into the Provincial Expenditure and Receipt Plan. In the new system the biggest proportion, 85 per cent of this kind of tax revenue, is considered as income in the Regency/Municipality Expenditure and Receipt Plan.

The other policy was to propose a program to provide urban infrastructure, such as roads, sewerage and water supply in some selected urban settlements. Neither provincial nor local governments could finance the program, therefore the program budget was allocated in the APBN (=National Expenditure and Receipt Plan) which is aided by foreign loan.

There are two problems which could be faced; These are,

1. The programme will be limited in providing urban facilities, either by quantity or quality, if it depends greatly on the national budget without creating local urban resources to be self-supporting. It should be studied carefully how far the Building and Land Tax could overcome the problems.

2. Except within municipalities, there is no local agency of government available to deal with the special task of managing urban settlements in kabupaten (=regencies). Urban managers are needed. The Mayors of municipalities (there are six municipalities in North Sumatera) are still acting as politicians rather than as a managers of their cities.[17]

The growth of population in urban cities in North Sumatera as a whole has been increased but this increase is not distributed within regencies. For example, in

17. Director General of Urban and Housing revealed this problem when he gave a key note in the Seminar 'Urban Problem' in Medan, October 1987.

Kabupaten Karo, the percentage of the population living in urban settlements in Karo decreased from 19.07 per cent in 1975 to 17.10 per cent in 1985. This circumstance was the result of the following possibilities:

a) migration from urban settlements in Karo, such as Kabanjahe, to Medan did exist rather than migration from rural areas to urban settlements within Karo itself,

b) statistical figures showed that Karo's income greatly depends on the agricultural sector, 51.32 per cent of the total GDP. This can not promote the growth of industrial sector, which is only 18.4 per cent of total GDP. The industrial sectors, which are normally in urban settlements, can not create the great number of jobs needed to attract workforces from rural areas.

The increase in the industrial contribution is relatively big in relation to Karo but this still cannot promote the growth of urban settlements. Some possible causes of this are:

a) the percentage of the industrial sector contribution might be big in relation to its subregion, but the amount of the contribution is relatively small within the province.

b) the industries are not distributed throughout the urban areas in the subregions, but they are concentrated in one urban settlement.

Urban settlements in Tapanuli Tengah itself have only very small percentages of population compared to the total; that is 1.70 per cent in 1975 to 1.94 per cent in 1985, which shows only a slight increase. The regency development has promoted the industrial sector contribution to the GDP from 11.94 per cent in 1975 to 14.73 per cent in 1983. This was followed by reducing the agricultural sector contribution from 40.81 per cent in 1975 to 37.25 per cent in 1983.

The percentage of the urban population in Tapanuli Tengah will be decreased if Sibolga is taken into account. The figures were 28.81 per cent in 1975 and 26.03 per cent in 1985. This evidence showed that Sibolga economy tended to decline. In the past, Sibolga was a centre of growth in the western region of North Sumatera and this port had a significant role in stimulating the sub-regional progress. Since a highway network connecting the western and eastern parts of North Sumatera was greatly improved, the role of Sibolga as a port and centre of growth has declined steadily. This argument is supported by the rate of population growth in this municipality, which was 3.96 per cent during 1971 to 1980 and which declined to 1.42 per cent during 1980 to 1986.

The other regencies gave evidence that during the period 1975-1985, there was migration from rural settlements to further urbanize urban settlements. The regency most affected by this migration is Asahan, whose urban population percentage increment was 3.54 per cent within 10 years and if Tanjung Balai is taken into account, the percentage increment is 2.75 per cent. It means that the rate of urbanization in Asahan (excluding Tanjung Balai) was higher than in Tanjung Balai itself. Again this figure shows that Tanjung Balai can not compete as a centre of distribution with such an urban city located in Asahan.

Table IV.9 shows that the increment of the percentage of the urban population in subregions during 10 years (excluding Karo) is in the range 0.67-3.54 per cent or 2.49 per cent in North Sumatera as a whole. Those figures are relatively small and it proved that in North Sumatera, the urbanization factor does not create problems yet, at least not within the foreseeable future. However, in general, when the two sets of the figures in 1975 and 1985 are tested using a t-test it is found that both are significance difference at 5 per cent level of significance. The roads which had not had an influence on the change of the number of total population, it was likely that they were significant on the change of the number of urban population. It shows that roads may have a significant role to stimulate urbanization.

If the urban percentages of the subregions in 1985, in which the five municipalities are located, are compared, they rank in order from the highest: Tapanuli Tengah (26.03 per cent), Simalungun (22.30 per cent), Langkat (19.93 per cent), Asahan (18.62 per cent), Deli Serdang (12.63 per cent). The above figures show the percentages if municipalities in each subregions are taken into account, otherwise the rank order would be: Asahan (13.18 per cent), Langkat (9.92 per cent), Deli Serdang (5.47 per cent), Simalungun (4.84 per cent) and Tapanuli Tengah (1.94 per cent). These figures are evidence of the fact that the greatest population imbalance among urban settlements are in Tapanuli Tengah and Simalungun.[18] In other words, Sibolga in Tapanuli Tengah and Siantar in Simalungun, whatever the cause, prevented other urban settlements in its subregion from growing. This phenonmenon can be approached by what is called, degree of primacy.[19]

Degree of primacy is the identification of an urban settlement pattern, which, as a figure, could be from 0 to infinity. The higher the degree of primacy of a town indicated the higher is the urban settlement urbanization. The degree of primacy is measured by the four-city primacy index, or, the ratio of the population of the largest city to the combined population of the next three largest cities in the subregions,

$$Pr = P1/(P2+P3+P4) \quad \ldots\ldots. \text{(IV.1)}$$

Pr; degree of primacy,

P1; population in the first largest urban settlement,

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18. Term 'imbalance' here is used to show that the proportion of population in the biggest town and the other towns are not well distributed or the pattern of population size distribution of a system of urban settlements in a region does not follow the rank-size rule. Perhaps the best known rank-size rule is Pareto distribution. For more discussion of rank size distribution can be found in **PARR (1976)**, **TABUCHI (1982)**, **BERRY and GARRISON (1985)** and **PARR (1985)**.
19. The definition of the Degree of Primacy follows **RONDINELLI (1985)**. The aim of this approach is similar to the rank-size rule. This one is only limited into 4 biggest towns in a region. The higher the degree of primacy the higher is the imbalance of the population size among subregions.

P2; population in the second largest urban settlement,

P3; population in the third largest urban settlement,

P4; population in the fourth largest urban settlement.

Table IV.10 presented the degrees of primary among subregions in North Sumatera and North Sumatera itself. The table gives evidence to support the phenomenon which was described previously as the most imbalanced among urban settlements, were in Tapanuli Tengah and Simalungun, although within 10 years there was a slight decrease in the imbalance. It is interesting to find that many subregions decreased in their degrees of primacy, except Tapanuli Selatan, Asahan, Deli Serdang and Langkat. This phenomenon could have occurred because of the subregional income improvement.

The degree of primacy in North Sumatera was slightly increased shiftly from 4.81 in 1975 to 4.89 in 1985, but this figure shows that the urban settlement population imbalance was relatively small. Except for Tapanuli Tengah, in general, it could be said that the imbalance were relatively small. Although the degree of primacy in Tapanuli Tengah was relatively high, it dropped sharply from 22.67 in 1985 to 16.30 in 1985.

Two possibilities were presented by those figures:
Firstly, the Tapanuli Tengah sub-regional policy was implemented succesfully to promote the urban settlement growth in the region. Secondly, the Sibolga economy declined. There were two factors which did not support the first possibility. There was only a slight increase in the GDP of the region, which will be shown in next chapter, and no considerable increase in population growth in urban settlements. It shows that the decline of Sibolga economy gave an influence on the decline of the degree of primacy.

Table IV.10 Degree of Primacy of Urban Settlements in 1975 and 1985

Subregions	Towns	Total Urban Population 1975	1985	Degree of Primacy 1975	1985
1. Nias	G.Sitoli	9210	12500		
	T.Dalam	2630	4100	1.85	1.62
	Sirombu	1350	2050		
	Lahewa	1010	1540		
2. Tap.Selatan	Sidempuan	48068	67940		
	Sipirok	6230	7500	2.64	2.68
	P'bungan	6130	9186		
	G.Tua	5820	8676		
3. Tap.Tengah	Sibolga	5770	62500		
	Barus	1195	1290	22.67	16.30
	Sorkam	750	1125		
	Lumut	600	920		
4. Tap.Utara	Tarutung	9760	12500		
	Balige	8370	11000	0.65	0.61
	D.Sanggul	3975	5555		
	Porsea	2700	4040		
5. Lab. Batu	R.Parapat	20600	30624		
	A.Kanopan	11970	20081	1.18	1.08
	K.Pinang	2750	4190		
	L.Bilik	2750	4300		
6. Asahan	Kisaran	46470	85000		
	T.Balai	44230	56200	.80	1.08
	T.Tiram	8130	12870		
	Indrapura	5660	9780		
7. Simalungun	P.Siantar	139200	183000		
	P'gangan	12300	15225	6.99	5.62
	Parapat	4270	10150		
	S.Dolok	3355	7210		
8. Dairi	S.Kalang	15540	22500		
	T.Lingga	3900	6200	2.49	2.32
	Salak	1200	1800		
	T.Pinem	1135	1700		
9. Karo	Kabanjahe	22317	27500		
	Brastagi	11140	13500	1.41	1.37
	T.Binanga	2960	3980		
	T.Nderket	1740	2550		
10. D.Serdang	T.Tinggi	83830	111900		
	L.Pakam	12324	15306	2.89	3.20
	P'baungan	8730	10248		
	Firdaus	2940	8910		
11. Langkat	Binjei	53690	95600		
	P.Brandan	18020	28624	1.33	1.49
	T.Pura	10070	17925		
	Stabat	12090	17500		
12. North Sum.	Medan	1350430	1908600		
	P.Siantar	139200	183000	4.81	4.89
	T.Tinggi	83830	111900		
	Binjei	57700	95600		

Source: National Urban Development Strategy 1987

The degree of primacy and its increase within 10 years showed that the rate of urbanization in North Sumatera within that period was relatively small. Both figures of degree of primacy in 1975 and 1985 are not significant difference at 5 per cent of level of significance. It shows that roads do not induce the regional degree of primacy. Compared to the figures of urban percentages in 1975 and 1985 which has been tested significant difference illustrates that population growth in intermediate towns in any subregions in North Sumatera are higher than their primate towns of the subregion.[20] It is likely that the role of roads is significant to stimulate the population growth of the intermediate towns. Roads have an impact on urbanization of the intermediate towns.

Table IV.11 shows the town ranks, as stated previously, in decreasing order based on the population numbers in 1975 and in 1985. The table only shows the urban settlements in which population numbers are above 5,000, because it was identified that in urban settlements of under 5,000 inhabitants, there was no change in rank order. The table shows that there were 14 towns which were moved down from their ranks, between 1975 and 1985. On the other hand,there were 12 towns which moved to higher ranks, within the same period. Of the twelve towns which moved to higher ranks, 7 of them are located in Asahan and in Labuhan Batu, 3 of them are located in Langkat and the rest distributed between Tapanuli and Nias. If this result is compared to the result of the degree of primacy in Table IV.10, it shows roughly that there is a correlation between the change in the degree of primacy and the movement to higher ranks of settlements. The ranks in 1975 was not significantly different with the ranks in 1985 at 5 per cent. It again shows the provision of road during 1975 and 1985 did not influence the mobility of settlements in the rank.

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20. The term 'primate' and 'intermediate' is used here as identification of the biggest town in a subregion and the medium size towns in the subregion.

Table IV.11 Urban Settlement Rank Based on Number of Population in 1975 and 1985

No.	Name of Towns	Pop. 1975	Name of Towns	Pop.1985
1.	Medan	1350430	Medan	1908600
2.	P.Siantar	139200	P.Siantar	155000
3.	T.Tinggi	83830	T.Tinggi	111900
4.	Sibolga	57700	Binjei	95600
5.	Binjei	53690	Kisaran	85000
6.	P.Sidempuan	48068	P.Sidempuan	67940
7.	Tanjung Balai	46470	Sibolga	62500
8.	Kisaran	44230	Tanjung Balai	56210
9.	Kabanjahe	22317	Rantau Parapat	30624
10.	Rantau Parapat	20608	P.Brandan	28624
11.	P.Brandan	18020	Kabanjahe	27500
12.	Sidikalang	15540	Sidikalang	22500
13.	Lubuk Pakam	12324	Aek Kanopan	20081
14.	Perdagangan	12300	Tanjung Pura	17925
15.	Stabat	12090	Stabat	17500
16.	Aek Kanopan	11970	Lubuk Pakam	15306
17.	Galang	11460	Perdagangan	15000
18.	Brastagi	11140	Brastagi	13500
19.	Serbelawan	10500	Galang	13393
20.	Tanjung Pura	10070	Tarutung	12500
21.	Tarutung	9760	Gunung Sitoli	12500
22.	Gunung Sitoli	9210	Tanjung Tiram	12500
23.	Perbaungan	8730	Serbelawan	12210
24.	Balige	8370	Aek Batu	11300
25.	Tanjung Tiram	8130	Balige	11000
26.	Firdaus	7940	Perbaungan	10748
27.	Tanjung Beringin	7860	Kota Pinang	10198
28.	Air Batu	6750	Indrapura	9500
29.	Tanjung Morawa	6400	Firdaus	8910
30.	Gunung Tua	6370	Tanjung Beringin	8871
31.	Sipirok	6230	Gunung Tua	8500
32.	Indrapura	5660	Tanjung Morawa	8410
33.	Pulau Batu	5440	Sipirok	7500
34.	Kuta Pinang	5310	Pulau Batu	6757

Source: National Urban Development Strategy 1987, Directorate General Urban and Housing.

In 1975 the Kisaran (Asahan) was ranked 8th, and was followed immediately by Kabanjahe (Karo),but in 1985, Kisaran jumped to the 5th rank and Kabanjahe slipped down to 11th. This occurred because there were two settlements which were under the Kabanjahe rank in 1975 also moved to 9th and 10th ranks in 1985. The two settlements were situated in Labuhan Batu and Langkat, respectively.

Villages and Accessibility

Despite the inadequacies of the data, Table IV.12 shows that the highest percentages of villages which have accessibility throughout the whole year, despite the weather are in Asahan, Karo and Simalungun. The highest percentages of villages have no accessibility at all are in Nias and Tapanuli Utara. It shows that there is no correlation between the distance of subregions from Medan and the percentages of villages have accessibility. There are 1808 villages which can only be reached depending on the weather. It is 33.19 per cent of the total villages in the province under study.

Tapanuli Tengah which had the highest degree of primacy in 1985, it has a moderate percentage of villages which can be reached through the whole year. On the other hand, Nias which has the lowest percentage of villages which can be reached through the whole year, is one of the subregions which has the lowest degree of primacy. It shows that the degree of primacy in a particular subregion is not affected by the percentages of its villages with or without accessibility through the whole year. It is expected that the provision of roads is not significant in inducing the degree of primacy of a subregion. It is speculated that the level of accessibility of villages has a more significant role in stimulating regional income which will be discussed in the Chapter VII of this study.

Table IV.12 Number of Villages With Access to Roads in 1985

Subregions	Whole Year Accessibility	Access Depend on Weather	No Access At All
Nias	150 (22.83)	455 (69.25)	52 (7.90)
Tap. Selatan	925 (57.20)	649 (40.14)	43 (2.66)
Tap. Tangah	114 (63.33)	63 (35.00)	3 (1.67)
Tap. Utara	599 (68.85)	234 (26.90)	37 (4.25)
Lab. Batu	143 (74.09)	24 (12.44)	26 (13.47)
Asahan	193 (87.33)	25 (11.31)	3 (1.36)
Simalungun	188 (87.03)	25 (11.57)	3 (1.39)
Dairi	98 (62.42)	56 (35.67)	3 (1.91)
Karo	239 (87.23)	33 (12.04)	2 (0.73)
Deli Serdang	643 (76.37)	198 (23.51)	1 (0.12)
Langkat	212 (75.80)	46 (21.00)	7 (3.20)

Note: ( ) Percentages from Total Villages

Source: North Sumatera Public Work Office

IV.5 Conclusions

Although the evaluation in this chapter is constrained by data problems, a number of conclusions can be drawn from the analysis. Road provision during 1975-1985, was dominated by central and provincial government budgets which mainly linked Medan to kabupaten towns and kecamatan towns. The road condition between urban settlements has been significantly improved but on the other hand, the linkages to villages are not seriously considered. The role of kabupaten/municipality budget is less significant on the road sector than the central and provincial government budget. More than one-third of villages in the province do not have whole year accessibility.

During 1973-1985, it was likely that the total population growth, the degree of primacy and the town ranks were changed slightly but the change is not significant, except for urban population growth. It appears that roads may have an influence on the urbanization or migration but they may attract people more into intermediate towns than into the primate ones in the subregions. Road improvement may be neutral to the rate of urbanization.

The increase in educational and health facilities was very significant. Despite the lack of educational facilities in Medan and its hinterland (RDU 3), the provision of these facilities was a better distribution in 1985 than in 1975. It is speculated that better distribution is induced by road provision.

The trend of inter-regional ship movement through North Sumatera's ports shows that, except in Pangkalan Susu and Sibolga, export volume increased. On the other hand, the value decreased except in Tanjung Balai and Gunung Sitoli. This was because the market price of commodities from North Sumatera declined, except for some comparative advantage commodities from Tanjung Balai and Gunung Sitoli, such as coconut oil. Except in Tanjung Balai and Gunung Sitoli, all ports show that there is a decrease in import volume except in Pangkalan Susu and Tanjung Balai, the import value decreased as well. There is no disaggregate data to identify kinds of commodities or goods make this situation occurs.

The role of sea transport is complementary to the road network in the whole national transport network. The other mode which competes with roads in the province is railway and river transport. This analysis shows that the use of both modes declined during the period of study. This decline may have been due to the increase in road length and condition. This speculation will be investigated in Chapter VI of this study.

V. ANALYSIS OF ECONOMIC GROWTH FACTORS

V.1 Introduction

As discussed previously, the primary economic growth factors are agricultural land use, private investment, and government expenditure. This chapter describes in more detail how these economic factors work in the province under study. To provide a context for the analysis, the position of North Sumatera in the Indonesian economy as a whole is investigated. The aim of this investigation is to understand the economic environment of the province under study in which the economic growth factor development took place. The next stage is to study the subregional economy as well as to identify the comparative advantage by sectors which belong to any of the subregions. The outcome of this investigation and the overall trend of the economic growth factors will be analyzed to see if they have correlations with road provision during the period of study. This analysis will take place in Chapter VI, VII and VIII of this study.

V.2 Inter and Intra Province

Indonesia Economy Environment

The main purpose of this section is to identify the position of North Sumatera in the Indonesian economy as a whole in the terms of its GDP. As stated in the Chapter III.6 the computation of GDP in North Sumatera is only based on the production approach. The added value which is used for this computation is calculated from the difference between gross output value and intermediate costs. Output value is the value of goods and services which are produced by production activities in a certain period while intermediate costs are the expenditures spent for the activities including wages and salaries, land rent, capital interests, profit and depreciation.

The available data sources has impose severe constraints on the analysis. Firstly, the census or administrative registration areas of some ministries have different boundaries from those of the government administration at the regional level. This makes systematic data collection and presentation for a particular region difficult. Secondly, the accounting systems of national or multi national companies are generally centralized. This makes it difficult to calculate the contribution of private entreprises at the regional level with a high accuracy. Thirdly, many surveys which are used as inputs for GDP computation are conducted to achieve national objectives. Therefore most sampling schemes are not based on regional interests. Fourthly, the volume of trade between regions within a country is more difficult to compare than those between countries. As a result, the added value from trade which belongs to certain regions are difficult to identify accurately.

Although many problems are encountered in computing regional GDP, the government has improved the procedures of data collection. However, the lower the hierarchy of government administration level, the less reliable the GDP figures. These problems imply that the findings of the analysis must be treated with some caution.

Table V.1 shows the composition of the GDP based on industrial origin either in the Pelita III (1978-1983) or in the beginning of Pelita IV (1983-1988). From the table it can be seen that in Pelita III, industry provided the biggest contribution to the GDP growth distribution which was 34.29 per cent. This was followed by agriculture and transport/comunication which were 23.75 per cent and 11.23 per

Table V.1 Growth Rate of GDP by Industrial Origin in Two Periods 1978/1983 and 1983/85

Industrial Origin	GDP in Billion Rps At 1973 Price 1978	1983	At 1983 Price 1983	1985	Rate of Growth Yearly % 1978/83	1983/85	Distribution of GDP % 1983/84	1985/86	Distribution of Growth % 1978/83	1983/85
1. Agriculture	3134.8	3710.6	17696.2	19209.0	3.43	4.19	24.01	24.04	23.75	24.35
2. Mining/Quarrying	1048.8	940.4	13967.9	13980.5	-2.20	0.04	18.95	17.49	-4.47	0.20
3. Industry	1176.5	2007.8	8211.3	10579.1	11.28	13.51	11.14	13.24	34.29	38.11
4. Transport/Comm.	490.1	762.5	3978.0	4481.8	9.24	6.14	5.40	5.61	11.23	8.11
5. Elec./Gas/Water	55.3	5286.2*	524.3	594.9	7.79*	6.52	0.71	0.74	35.20*	1.14
6. Trade	1530.9		12009.4	12363.0		1.46	16.29	15.47		5.69
7. Bank/Financial Inst.	164.6		2039.2	2430.6		9.18	2.77	3.04		6.30
8. Ownership of Dwelling	287.6		1961.8	2145.2		4.57	2.66	2.68		2.95
9. Public Administration	767.9		5711.5	6438.5		6.17	7.75	8.06		11.70
10.Services	296.9		3000.8	3180.2		2.95	6.24	5.64		-1.44
T o t a l	9482.3	12707.5	73697.6	79910.8	6.03	4.13	4.07	3.07		2.89

* 5,6,7,8,9,10.

Source: Indonesian Statistical Book (1978, 1983 and 1985) cent. In Pelita IV, the figures showed a more detailed description. The highest contribution to GDP growth distribution was still from the industrial sector, 38.11 per cent, and followed by agriculture, which was 24.35 per cent. The third highest constribution was from public administration, 11.70 per cent, and followed by transport/communication, 8.11 per cent. The figures gave information that, the role of transport/communication decreased and its place was taken by public administration. This meant that the role of government was increased in promoting the national economy growth.

Comparing the two periods of time, it is seen that the rate of growth declined from 6.03 per cent in 1978/1983 to 4.13 in 1983/85. In 1982, the rate of growth was 2.25 per cent[1]. It showed that Indonesian economy was weakened during the study period. The weakened economic situation arose since the rate of growth fell to 2.25 per cent in 1982, from an average of more than 7 per cent per year in 1970. This meant that it was the first time since 1967, that the rate of economic growth was below the rate of population growth which was 2.32 per cent per year. This economic situation became worse as a result of the biggest trade deficit at the beginning of 1983, equivalent to US$ 5 .5 billion.[2]

The trade deficit was much influenced by the world economic condition. The volume and amount of exported commodities decreased but, on the other hand, the volume and amount of imported commodities increased. The demand for Indonesian exported commodities, both oil and non-oil decreased rapidly. The unit

1. It is not shown in Table V.1. The economic growth increase 1967 reached the peak 7 percent 1970 and dropped gradually to 2.25 per cent in 1982. It was the first time since 1967, the rate of growth was below the rate of growth population which was 2.32 per cent per year.
2. **ASMARA** (1986: pp 2-3) investigates the Indonesian trade balance of payment during Pelita III.

price of the export commodities such as coffee, rubber, palm oil and copper, could not remain stable and it decreased between 3 and 30 per cent. In this situation, the import/export balance surplus decreased to US$ 1.9 billion in 1982, yet in the previous year it was US$ 6.8 billion. On the other hand, the structural deficit in service balance didn't show much change. It was US$ 7.4 billions. As a result, in total, the running transaction deficit which was increased could not be avoided[3].

Foreign loans and other capital movements, which were received in 1982, after subtracting the loan repayment and interest, were used to make balance of the deficit of US$ 5.8 billion. The addition to the rest of the deficit was taken from government's foreign currency saving, US$ 1.9 billion which was the biggest amount which had been spent. This meant that the available government's foreign currency saving at the end of December 1982 became US$ 4.1 billion or decreased by, approximately 32 per cent compared to the year 1981.

The fall in oil demand caused a decrease in oil production as well, from 1.6 million barrels per day in 1981 to 1.3 million barrels per day in the year 1982. The decrease in oil production and export had a great influence on government income. On the other hand, the public use of oil was subsidized by government, and it spent Rp 962 billion in 1982 for this purpose. Beside the oil subsidy, goverment also subsidized fertilizer by Rp 420 billion and food by Rp 1 billion. The amount of subsidy was bigger than Indonesia's loan repayment in that year[4].

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3. The information concerning with the balance of payment from **ASMARA (1986; pp 2-3)**.
4. Indonesia's long term-loan in 1982 was US$ 21.715 million and the short-term was US$ 3.274 million. See **NASUTION (1987; pp 3-13)**

Based on the growth of the economy in the Pelita III(1978-1983) which have been described above, Indonesia took off from the year 1982 and continued in 1983, which was the beginning of Pelita IV (1983-1988). The economic policy which was proposed for the subsequent five years was based on the experiences from Pelita III. The expected rate of GDP growth which was achieved in Pelita IV (1983-1988) was 5 per cent and the shares of industry, agriculture and transport/communication were 10.2 per cent, 3.4 per cent and 8.2 per cent, respectively. In fact, within 1983-1985, the rate of GDP growth was 4.13 per cent and the share of industry, agriculture and transport/communication were 13.51 per cent, 4.19 per cent and 6.14 per cent, respectively. Although there was an increased share of agriculture and in particular an increase in industry but they could not promote the growth expected.[5] This circumstance occurred because the original industrial growth rate, rather than agriculture and transport/communication, could not be promoted high enough to support the expectation.

Another interesting finding was that the distribution of GDP within industrial regions was still dominated by agriculture either in Pelita III or Pelita IV, yet the rate of growth had only slightly increased. Industry shared approximately 11.40 per cent in Pelita III and increased considerably to 13.24 per cent in Pelita IV. As discussed previously, this increase could not promote the national growth because the economic environment could not stimulate the industry as well. Although the rate of growth in mining was very small, its share was still considerable in the total GDP, 18.95 per cent in Pelita III and 17.49 per cent in the beginning of the Pelita IV. The figures show that the rate of growth of this sector decreased. Transport/communication had only small proportions in the total GDP, 5.40 per

5. It is expected that the rate of industrial growth should be 15 per cent if the rate of total growth was expected of 7 per cent. See **ASMARA (1986: pp 38).**

cent in Pelita III and increased to 5.61 per cent in the beginning of the Pelita IV. The role of these GDP sectors decreased, and it was shown that their rate of growth fell from 9.24 per cent in Pelita III to 6.14 per cent at the beginning of the Pelita IV.

Position of North Sumatera

Table V.2 illustrates the GDP per capita of provinces in 1979 and 1984, and gives the rank position for each province in terms of the GDP per capita. The higher the GDP per capita each province had, the higher position the province was placed in the rank. The highest GDP per capita were East Kalimantan and Riau in 1979 and they were still in that position in 1984. The three provinces' potentiality was in oil production. Although the oil price has decreased, the share of this sector was still large, being approximately 19 per cent in the total GDP. Irian Jaya was in rank 4 in 1979 and moved down to rank 5 in 1984. Irian Jaya's potentiality was mining (non-oil).

Jakarta, the capital of Indonesia, was in the third position in the years 1979 or 1984. Jakarta's GDP was largely based on manufacturing industry which was located in the city itself and in its hinterland. This hinterland was located in the province of West Java. It meant that the province of West Java was greatly influenced by Jakarta's growth. West Java was in the 16th position in 1979 and moved up to 14th position in 1984 rank. The provinces of East Java and Central Java were in the 15th and 22nd position in 1979 and in the 15th and 20th position in

Table V.2 Province Rank Based on the GDP Percapita

No.	1979 Provinces	1979 GDP (Rp)	1984 Provinces	1984 GDP (Rp)
1.	East Kal.	1711050	East Kal.	3787980
2.	Riau	1496275	Riau	3131484
3.	Irian Jaya	470266	Aceh	1742941
4.	DKI Jakarta	462306	DKI Jakarta	1226192
5.	DI Aceh	439912	Irian Jaya	704091
6.	South Sumatera	386168	South Sumatera	684648
7.	Central Kal.	273243	Central Kal.	519484
8.	Maluku	240356	North Sumatera	469822
9.	North Sumatera	218269	West Sumatera	433268
10.	Jambi	204439	South Kal.	430219
11.	North Sulawesi	191570	Bali	419673
12.	South Kal.	171231	Maluku	405114
13.	West Kal.	160576	East Java	401419
14.	South Sulawesi	159221	West Java	387529
15.	Central Sul.	153576	North Sulawesi	353906
16.	East Java	152718	West Kalimantan	347400
17.	West Sumatera	150868	S.E. Sulawesi	344611
18.	West Java	150299	Jambi	320228
19.	Bali	147085	Bengkulu	319111
20.	Bengkulu	133688	South Sulawesi	311565
21.	Lampung	131186	DI Yogya	308614
22.	S.E. Sulawesi	124006	Central Java	307233
23.	Central java	123435	Central Sul.	293277
24.	DI Yogya	119024	Lampung	213851
25.	West Nustra	93691	West Nustra	211585
26.	East Nustra	86558	East Nustra	203051

Note: Kal. : Kalimantan
Sul. : Sulawesi
Nustra : Nusatenggara
East Timor is not included in the list.

1984. These figures showed that province of East Java was still in the same position but, in contrast, Central Java moved up to 20th position.

If the position of a province was considered in terms of the total GDP, the position of provinces were different. The highest total GDP based on the 1975 constant prices were East Java, followed by West Java, Riau, Central Java, Jakarta, East Kalimantan and North Sumatera. In 1984, the position slightly changed, although the highest positions in the rank were still held by East Java and West Java. In the next position was Jakarta instead of Riau and this was followed by Central Java, East Kalimantan, North Sumatera, and Riau. The figure show that, within 5 years, Riau moved down of third position in 1979 to seventh position in 1984. This was the result of the decreased rate of GDP growth in the mining sector, on which Riau greatly depended.[6]

The sequence of positions in GDP per capita and GDP total were considerably different because of the difference of population numbers in each province. Provinces in Java island which have nearly 60 per cent of Indonesia's population have the highest total GDP but the position comes down to the middle of the rank if the position is analyzed in term of GDP per capita.

The province of North Sumatera, the study area, was in the 7th position in 1979 and moved up to the 6th position in 1984, in terms of the total GDP. The position moved from 9th position in the 1979 rank to the 8th position in 1984, in terms of GDP per capita. If the results of the two approaches are compared, it can be

6. The source of this information is the Central Bureau of Statistics.

interpreted that the rate of population growth within 5 years has led to this circumstance.

In terms of the GDP growth rate, Bali was highest in the period 1979-1984, followed by Aceh, Jakarta, Bengkulu, Riau and East Java. North Sumatera was ranked 22nd. All figures show that there was only a low correlation between rank in terms of growth rate and rank in terms of either GDP per capita or total GDP. The provinces of Jakarta and Riau were placed in the fifth highest position in the three ranks. North Sumatera dropped down from the 10th highest in the GDP ranks to 22nd position in the ranking in terms of its GDP growth rate. It meant that if a province placed in the highest position in either GDP ranks, this did not guarantee that the province would take a higher position in terms of rate of growth as well.

Table V.3 shows the GDPs classified by a comparison of industrial origin between Indonesia as a whole and the province of North Sumatera, at current price, in 1977 and 1985. The table again shows that in 1977 the four industries with the most potential shares in Indonesia's total GDP were agriculture, mining, trades and manufacturing. The fifth potential share came from public administration and services. This rank still had the same sequence in 1985 although the amount contributed by each source changed. The agriculture share in total GDP decreased and in contrast, manufacturing showed an increase of about 50 per cent, from 9.56 per cent to 13.45 per cent. Trade was slightly down from 15.56 per cent to 15.41 per cent. It was evident that the growth in the industrial sector could not promote the trading sector. It could be concluded that trade was still much based on the agricultural commodities.

Table V.3 GDP at Current Price by Industrial Origin, Billion Rupiahs

	1977					1985				
	Indonesia		North-Sumatra			Indonesia		North-Sumatra		
	GDP	% of the Total	GDP	% of the Total	% of the Indo.	GDP	% of the Total	GDP	% of the Total	% of the Indo.
1. Agriculture	5905.700	31.06	416.445	40.76	7.05	22412.000	23.72	1492.773	31.96	6.66
2. Mining/Quarrying	3599.700	18.93	67.886	6.64	1.86	15403.600	16.30	253.294	5.42	1.64
3. Industry	1816.900	9.56	68.935	6.75	3.79	12713.300	13.45	731.625	15.66	5.75
4. Transport/Comm.	105.600	0.56	5.649	0.55	5.35	781.300	0.83	42.870	0.92	5.50
5. Elec./Gas/Water	1023.300	5.38	53.739	5.26	5.25	5301.800	5.61	174.878	3.74	3.30
6. Trade	2459.000	15.56	155.462	15.21	5.25	14561.400	15.41	646.450	13.84	4.44
7. Bank/Financial Inst.	820.600	4.32	86.034	8.42	10.48	6149.000	6.51	495.975	10.62	7.73
8. Ownership of Dwelling	236.400	1.24	13.267	1.30	5.61	2802.400	2.97	293.663*	6.29*	5.60*
9. Public Administration	542.200	2.85	39.976	3.91	7.57	2443.000	2.58	-	-	-
10.Construction	1394.200	7.33	86.417	9.05	6.20	7925.100	8.39	538.781*	11.54*	13.48*
11.Services	607.100	3.19	27.950	11.19	4.60	3998.600	4.23	-	-	-
Total	19010.700	100.00	1021.760	100.00		94491.500	100.00	4670.309		
			(5.37 % of Indonesia)					(4.94 % of Indonesia)		
Population	133940200		7754627			165154000		9444097		
			(5.79 % of Indonesia)					(5.71 % of Indonesia)		

* 8 in 1985=8+9 in 1977
10 in 1985=10+11 in 1977

Source: Indonesian Central Bureau of Statictics

The ranks, in terms of total GDP shares in North Sumatera in 1977 were: agriculture (40.76 per cent), trade (15.21 per cent), public administration (11.98 per cent), transport (8.42 per cent) and industry (6.75 per cent). The rank sequence was different compared to Indonesia's rank. Industry in North Sumatera stood in the fifth position from the top. The interesting point is that, within 8 years, the manufacturing sector had much improved so the sector stepped up to the second position in North Sumatera. The top position was still agriculture. The agricultural sector showed that the total GDP which was 40.76 per cent in 1977 dropped down to 31.96 per cent in 1985. The growth of the manufacturing share in the total GDP increased more than 100 per cent, from 6.75 per cent in 1977 to 15.66 per cent in 1985. Trade in North Sumatera decreased from 15.21 per cent in 1977 to 13.84 per cent in 1985. It could be concluded that current trade in North Sumatera is greatly influenced by agricultural commodities, which is similar to Indonesia's trade characteristic.

The GDP per capita in Indonesia was Rp 572.141,- in the year 1985 it was higher than GDP per capita in North Sumatera which was Rp. 494.521,- in the same year. The rates of Indonesia GDP growth as a whole was 8.54 per cent and 5.67 per cent within the period 1975-1980 and 1980-1985 respectively. In the same periods, the rates of North Sumatera GDP growth were 9.71 per cent and 5.45 per cent respectively. These figures show that in the period 1975-1980, the GDP growth rate in North Sumatera was higher than Indonesia's average but in the period 1980-1985 it was smaller. This circumstance occurred because in the period 1980-1985 the trade in agricultural commodities declined since the province, as discussed previously, depended much on the agricultural sector[7].

7. Indonesia GDP in 1976/79 was 6.94 per cent and in 1979/83 was 6.03 per cent. See SOELISTYO (1986; pp 68-74)

The shares of North Sumatera within the national GDP as a whole can also be seen in Table V.3. In 1977 the population of North Sumatera, was 7,497,140 or 5.60 per cent of the total Indonesian population, and in 1985 it was 9,656,297 or 5.85 per cent of the total population. The figures in the table show that agriculture, transport/communication, and banking/ownerships of dwelling gave a considerable share to the Indonesia's total GDP. In 1985, there was a slight change in which the role of banking/ownerships of dwelling took place by public administration/services. The other two sources still remained as they were in 1977 but the scale of sharing was decreased. There were two conclusions which could be deduced. Firstly, the North Sumatera economy had a higher growth rate compared to Indonesia's average during 1978-1985[8]. Secondly, North Sumatera's economy, which depended much on the agricultural sector could not promote the growth of the trade sector although there was evidence that the manufacturing sector had increased considerably.

This situation provided an inconvenient environment for banking/financial institutions including the ownership of dwellings. The other impact of this situation was the role of public adm/services which was more important in promoting North Sumatera growth. This fact was supported by the figure which showed that 13.48 per cent of the total North Sumatera GDPs was public administration/services sectors. The figure was the highest among sector shares in North Sumatera.

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8. During 1978/85, Indonesia GDP growth was 5.48 per cent and North Sumatera GDP growth was 6.55 per cent. It is calculated from Indonesia Statistical Book and North Sumatera Statistical Book, various issues.

Table V.4 presents the North Sumatera GDP within the years 1975-1984. In 1975 constant prices were divided into 11 industrial sources. The figures in the table show that the growth rate in the agricultural sector was relatively small, 6.92 per cent within 9 years. The highest rate of growth was in the electricity, gas and water supplies, which were 19.55 per cent. Their share in the total GDP was 0.05 per cent in 1975 and this increased to 0.83 per cent in 1984. Despite the rate of growth, the agricultural sector had 40.96 per cent and 34.99 per cent, in 1975 and 1984 respectively. The manufacturing sector (which was 6.33 per cent in 1975 and 10.00 per cent in 1984) had a relatively high rate of growth of 12.39 per cent.

The other sector which had a considerable portion in the North Sumatera GDP after agriculture, was trade. This sector was 16.17 per cent of total North Sumatera GDP in 1975 and decreased to 13.97 per cent in 1984. Mining and quarrying declined from 9.10 per cent of North Sumatera GDP in 1975 to 8.32 per cent in 1984. Transport/communication which had a rate of growth of 10.07 per cent, increased their share in the NorthSumatera's GDPs, from 9.06 per cent in 1975 to 12.82 per cent in 1984. This sector was in the third position after agriculture and trade, in terms of its share of the total North Sumatera's GDP. The figure concluded that the two sectors, industry and transport/ communication, grew considerably in their shares of the total North Sumatera GDP. Since trade was still the biggest share, after agriculture, in the North Sumatera GDP, this tended to decrease as the share in agriculture decreased. This fact supports the previous conclusion that trade activity in North Sumatera is still greatly dependent on agricultural commodities rather than industry.

Table V.4 Gross Regional Domestic Product of North Sumatera By Industrial Origin at Current Market Price 1975-1984 (Rps Billion)

Industrial Origin	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	Growth
1. Agriculture	279776.84	345396.27	416444.91	536397.19	690162.18	901210.75	1014446.93	1095382.76	1237640.30	1499754.77	
	(100.00)	(111.18)	(115.10)	(124.28)	(139.52)	(142.13)	(154.30)	(159.33)	(161.59)	(182.68)	6.32
2. Mining/Quarrying	62173.71	82895.54	67886.04	126490.95	218112.69	421036.61	404354.02	389800.82	386315.55	356569.69	
	(100.00)	(123.16)	(94.99)	(120.87)	(168.22)	(176.10)	(157.07)	(136.47)	(117.97)	(108.29)	0.90
3. Industry	43282.10	54189.18	68935.17	87665.53	119417.51	151196.66	177529.85	207359.31	310338.40	428990.70	
	(100.00)	(106.96)	(122.23)	(140.95)	(145.59)	(152.46)	(170.20)	(184.71)	(257.59)	(286.18)	12.39
4. Construction	19667.37	21156.19	53739.41	60224.97	80580.12	106891.63	126529.36	106602.37	116968.70	117829.78	
	(100.00)	(101.22)	(247.39)	(261.10)	(270.47)	(297.82)	(326.80)	(255.16)	(250.94)	(235.62)	9.99
5. Elec./Gas/Water	3204.44	4505.19	5649.11	7194.31	9315.39	14624.89	17162.69	20054.93	25338.58	35804.63	
	(100.00)	(118.56)	(137.44)	(174.09)	(224.21)	(330.07)	(362.87)	(404.02)	(458.55)	(491.33)	17.26
6. Trade	110486.87	135258.56	155462.23	198950.00	260220.24	342496.66	404305.37	450952.95	535875.64	598966.08	
	(100.00)	(107.88)	(112.81)	(128.12)	(136.15)	(142.67)	(149.06)	(155.55)	(177.06)	(185.24)	6.02
7. Bank/Financial Inst.	61889.02	75417.00	86033.93	102952.62	131411.33	197246.79	241394.78	330960.95	434291.86	549584.93	
	(100.00)	(108.60)	(112.92)	(127.74)	(135.09)	(165.37)	(193.43)	(212.06)	(227.28)	(248.98)	9.77
8. Ownership of Dwelling	9973.01	12122.58	13266.60	20106.05	24991.89	36545.29	52569.98	80143.33	110270.31	134324.75	
	(100.00)	(106.34)	(111.98)	(163.72)	(163.85)	(201.66)	(267.57)	(350.08)	(424.38)	(466.89)	18.67
9. Ownership of Dwelling	27964.41	34545.87	39976.02	43175.57	54792.03	71055.88	78670.13	88693.84	109847.50	128582.15	
	(100.00)	(103.10)	(106.14)	(109.23)	(113.11)	(116.60)	(118.58)	(120.13)	(123.04)	(128.31)	2.81
10.Public Administration	47879.45	58049.53	86417.31	104339.39	134905.97	175445.27	223971.53	264419.57	298035.41	322271.63	
	(100.00)	(105.29)	(138.93)	(159.93)	(165.37)	(177.97)	(203.00)	(224.56)	(226.00)	(233.10)	9.86
11.Services	17004.12	23577.10	27949.63	31413.81	40796.96	53517.16	62701.11	73304.70	84827.04	113818.02	
	(100.00)	(120.18)	(129.53)	(138.95)	(145.12)	(173.59)	(186.77)	(191.24)	(207.99)	(226.02)	9.48
T o t a l	683121.34	847113.82	1021760.36	1318910.39	1764703.71	2471267.59	2803635.75	3107675.53	3645749.30	4286497.18	
	(100.00)	(110.39)	(118.68)	(132.95)	(146.94)	(158.96)	(168.96)	(173.42)	(183.96)	(198.32)	7.45

( ) Growth Index at 1975 Market Price

Source: North Sumatera in Figures (1984 and various issues)

Districts/Municipalities Within The Province

As described previously (based on official administration), the province of North Sumatera was divided into 17 second hierarchies (11 kabupaten or districts and 6 kotamadya or municipalities). Two administrative municipalities, and 202 third hierarchies (kecamatan or subdistricts) with 5,633 villages in 1985. The number of the North Sumatera population in 1961, 1971 and 1980 were 4,964,734; 6,621,831 and 8,360,894; respectively. These figures were based on the population census. The population numbers for the rest of the years were collected by conducting population registration.

Table V.5 shows the trend of GDP per capita based on the 1975 constant prices which were calculated within three periods of time: 1975-1980, 1980-1985 and 1975-1985. The municipalities were not calculated individually since they would be influenced by the districts in which they were located or vice versa. Therefore, the municipal GDP per capita will be calculated together with the district's GDP percapita and they are refered to as 'subregions'. The figures in the table show that, although the trend of the rate of GDP growth in some subregions is upwards and in others downwards in the two periods of time but the North Sumatera trend seemed to decline from 6.25 per cent in 1975-80 to 3.69 per cent in 1980-85. The GDP percapita, which were shown in the table, excluded petroleum.

Petroleum is excluded from the table for three reasons:

a. petroleum is only found in one subregion, that was Langkat so it is more reasonable if the subregions are compared with each other without considering petroleum;

b. the petroleum revenue and taxes go to the central government and therefore they provide only a small portion in real GDP per capita terms;,

c. this study is concerned with looking at the correlation between transport in terms of highways and petroleum movement uses pipelines.

From table V.5 it can be seen that there were 4 subregions, where their GDP per capita growth increased, if they are compared between the period 1975-80 and 1980-85. The rest of the subregions showed that their GDP per capita growth dropped such as Medan, the capital of the province, from 3.13 per cent to 2.92 per cent within the same period. North Sumatera itself showed that the growth of GDP per capita was 6.75 per cent for 1975-80 and 3.69 per cent for 1980-85. These figures were higher than the population growth which were 2.63 per cent and 2.35 per cent within periods 1971-80 and 1980-86, respectively. Although the figures were not related to each other, but they gave a good indication that North Sumatera still had a considerable growth despite the decrease in the rate of GDP growth within the two periods.

One technique which could be used to identify the relative specialization of areas in particular activities or characteristics is location quotients. This technique is especially useful for determining the relative industrial or occupational specialization, using employment as a surrogate for production. A location quotient is basically a ratio of ratios. Originally, the location quotient is defined as the ratio of employment in a given industry or occupation in a municipality to employment in all industries in that municipality, to the ratio of employment in

Table V.5 GDP Per Capita Within Subregions in North Sumatera Based on Current Price (excl. petroleum) (Rp.)

Subregions	1975	1980	1985	Yearly Growth (%) 75-80	80-85	75-85
1. N i a s	59710	63631	72799	1.28	4.04	2.00
2. Tapanuli Selatan	67925	112501	193416	10.61	11.45	11.03
3. Tapanuli Tengah	89925	122251	130640	6.33	1.33	3.80
4. Tapanuli Utara	64182	105237	160100	10.39	8.75	9.57
5. Labuhan Batu	109380	140804	171789	5.18	4.06	4.62
6. Asahan	94765	132842	196710	7.22	8.17	7.69
7. Simalungun	95567	117463	150666	4.21	5.10	4.66
8. D a i r i	55618	75815	85540	6.39	2.44	4.40
9. K a r o	86240	128996	160067	8.39	4.41	6.38
10. Deli Serdang	53625	85388	113391	9.75	5.84	7.78
11. Langkat	82805	117537	135914	7.26	2.95	5.08
12. M e d a n	139103	162310	187407	3.13	2.92	3.03
North Sumatera	85097	117973	141416	6.75	3.69	5.21

that industry in a larger reference area[9], such as the subregion to all industrial employment in that region. The formula is as follows:

$$LQ = (E_{ij}/E_{it})/(E_{nj}/E_{nt}) \quad \ldots\ldots\ldots \quad (V.1)$$

where E_{ij} = GDP by sectors in subregion

E_{it} = total GDP in subregion

E_{nj} = GDP of sector i in the region

E_n = total GDP by sectors in the subregion.

A location quotient of a GDP's sector with a value greater than 1.0 indicates that the subregion is more specialized, or that subregion has a comparative advantage to another subregions in that sector. The location quotient implies that the subregion may be engaged in a potential activity provided by a certain GDP's sector product. A location quotient of less than 1.0 implies that the subregion is less specialized in that GDP's sector.

Table V.6 presents the characteristics of subregions in North Sumatera based on the location quotient of industrial sector and this characteristics are presented in Fig V.1 in which 'x' shows the location quotient is bigger than 1.

Table V.6 shows that 7 subregion in North Sumatera has a comparative advantage in services and only Medan has a comparative advantage in trading. Only two subregions had the comparative advantage in manufacturing in 1983 and this number decreased from five regions which had the advantage in 1975. Except

9. Also see Formula III.8. This formula is adopted in this study but GDP by sectors is considered as variables rather than employment.

Table V.6 Location Quotients within Subregions in North Sumatera Based on 1975 and 1983 Current price

Subregions	Agricul - ture		Mining/ Non Oil		Industry		Elec/Gas/ Water		Construc- tion		Trade/ Hotel		Transport /Com.		Bank/Fi - nance		Ownership of Dwell.		Public - Adm.		Services	
	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83
1. N i a s	1.46	1.31	0.36	1.35	0.16	0.15	0.06	0.14	0.38	0.58	0.69	0.90	0.06	0.13	0.69	0.77	0.99	1.32	1.21	1.98	1.39	1.91
2. Tap. Selatan	1.37	1.47	1.56	1.50	0.24	0.18	0.23	0.15	0.34	0.01	0.76	0.13	0.39	0.49	0.98	0.74	1.70	1.61	0.68	1.13	1.22	1.17
3. Tap. Tengah	0.94	0.93	0.27	0.92	1.23	0.95	0.77	0.67	0.45	0.09	0.81	0.90	0.90	1.00	1.49	2.48	0.83	0.85	1.94	1.27	0.95	0.98
4. Tap. Utara	1.33	1.31	0.47	0.70	0.05	0.05	0.18	0.16	0.39	0.44	0.68	0.65	0.39	0.59	1.53	1.42	1.10	1.11	1.48	1.92	1.29	1.35
5. Lab. Batu	1.42	1.54	0.91	1.02	1.27	0.97	0.17	0.25	0.29	0.35	0.50	0.53	0.58	0.68	0.30	0.48	0.79	0.92	0.67	0.05	0.76	0.90
6. Asahan	1.46	1.32	1.33	1.16	0.97	2.73	0.40	0.27	1.04	0.64	0.46	0.32	0.45	0.45	0.53	0.40	0.78	0.62	0.56	0.54	0.88	0.72
7. Simalungun	1.20	1.11	0.52	0.52	1.73	1.35	0.65	0.72	0.83	0.64	0.53	0.59	0.71	0.93	0.79	1.22	0.83	0.92	0.88	1.14	0.88	1.02
8. Dairi	1.09	1.03	1.27	1.25	0.01	0.02	0.11	0.13	0.25	0.38	0.83	0.88	0.75	0.97	1.73	1.45	1.30	1.34	1.93	2.00	1.49	1.58
9. Karo	1.14	1.27	1.34	1.22	0.03	0.05	0.51	0.36	0.37	0.34	0.59	0.52	1.04	1.14	2.48	2.08	0.82	0.77	2.03	1.53	0.96	0.92
10.Deli Serdang	1.14	1.35	2.85	2.29	0.45	0.35	0.48	0.30	2.49	2.31	0.78	0.62	0.50	0.55	0.48	0.89	0.78	0.64	1.27	1.17	1.53	1.21
11.Langkat	1.01	1.18	1.80	1.59	1.69	1.20	0.31	0.57	0.88	1.47	0.55	0.61	1.45	0.90	0.38	0.51	1.13	0.59	0.89	0.86	1.01	1.04
12.Medan	0.15	0.09	0.03	0.06	1.35	0.97	3.06	3.00	1.30	1.26	2.25	2.25	2.19	2.04	1.67	1.20	1.09	1.17	0.90	0.70	0.68	0.77

Tapanuli Tengah and Medan, all subregions had a comparative advantage in agriculture, and there was no change between 1975 and 1983. These figures give evidence that during the 8 years between 1975-1983, the policy could not bring the structural change of the North Sumatera economy from agriculture to manufacture.

There were 6 subregions which had a comparative advantage in public administration, either in 1975 or 1983, and only two subregions had the advantage in 1983. The first ones were Nias, Tapanuli Tengah, Tapanuli Utara, Dairi,Karo and Deli Serdang. The last ones were Tapanuli Selatan and Simalungun. Table V.5 shows that Tapanuli Selatan, Tapanuli Utara, Asahan, Karo and Deli Serdang had a GDP percapita growth which was higher than the North Sumatera average.

These upward or downward mobilities of a subregion should have an influence on its total GDP. But in fact, as stated before, there were only 4 subregions whose rates of GDP growth were increased compared to the figures in 1975/80 and 1980/85 as illustrated in Table V.5. They were Tapanuli Selatan, Asahan, Simalungun and Nias.

Tapanuli Selatan's comparative advantage in 1975 was agriculture, mining and ownership of dwelling and in 1983, public administration was added. The same cases occurred in Simalungun and Nias in which the number of GDP's sector increased from two in 1975 to four in 1983, respectively. Asahan seemed not to change in the number of its comparative advantage but the advantage moved from construction to manufacturing. This figure shows that except for Asahan, there was no upward mobility of GDP's sector in the other subregion GDP. Identification on the Figure V.1 illustrates the upward or downward mobility of GDP by sectors of the subregions during the study period.

	Nias		TapSel.		TapTeng		TapUt.		LabBatu		Asahan		Simalungun		Dairi		Karo		DelSer		Langkat		Medan	
	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83	75	83
1. Agriculture	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
2. Mining (non Oil)		x	x	x						x	x	x			x	x	x	x	x	x	x	x		
3. Industry					x		x					x	x	x							x	x	x	
4. Elec./Gas/Water																							x	x
5. Construction											x								x	x		x	x	x
6. Trade/Hotel																							x	x
7. Transport/Com.						x											x	x			x		x	x
8. Bank/Financial Inst.					x	x	x	x						x	x	x	x	x					x	x
9. Ownership of Dwelling		x	x	x			x	x							x	x					x		x	x
10.Public Administration	x	x		x	x	x	x	x						x	x	x	x	x	x	x				
11. Services	x	x	x	x			x	x						x	x	x			x	x		x		

Fig V.1 Subregional Characteristics in North Sumatera
Based on Location Quotients of Industrial Origin
1975 and 1983

With reference to Figure V.1, it can be found that there is an evidence that some GDP's sectors were increased but among those subregions in North Sumatera only four that had influence on their rate of growth. Figure V.1 illustrates the position of Medan as the centre of growth within the influenced subregions in the province of North Sumatera. One important thing was that the Medan growth was not influenced by public expenditure, mining, agriculture and services. Among the subregions Medan was the only region having a comparative advantage in trading and the electricity/gas/water.

relative
Industry was on the decline in Medan if the figures between the two periods of time, pre and post 1975 werecompared. It looked as if the subregions close to Medan such as Langkat, Simalungun and Asahan took the advantage from Medan in industrial activity. From this evidence it can be concluded that the role of Medan as a centre of growth within the province greatly depended on its trading.

Only three subregions had the comparative locational advantage in transport/communication in the pre and post 1975 studies. These were, Karo, Medan and Langkat had the advantage before 1975 but, after 1975 this advantage no longer existed in Langkat. In 1983, Tapanuli Tengah had this advantage. Karo had the highest ratio of road length per unit area among subregions in the province. The roads serve almost all of the entire human settlements in the subregions. Medan and Tapanuli Tengah (including Sibolga) had the locational advantage because the subregions had ports to connect the province with the rest of the world. The Medan port (Belawan) is situated in the eastern part of the province and Tapanuli Tengah port (Sibolga) is situated in the western part.

The subregions identified were based on the GDP per capita and their rate of growth was compared to North Sumatera figures, then they were classified into 4 groups, which were:

a. less developed subregions, in which the GDP per capita and the rate of growth were smaller than the North Sumatera figures,

b. developing subregions, in which the GDP percapita was higher but their rate of growth was smaller than the North Sumatera figures,

c. developed subregions, in which their GDP percapita was smaller but their rate of growth was higher than the North Sumatera figures, and

d. highly developed subregions, in which the GDP per capita and the rate of growth were higher than the North Sumatera figures.

The groups which were established were dynamic, not static. The position, at a certain time, of a group is only relative to other subregions and is not an absolute characteristics. They may move to another group within a period of time. Therefore this classification was only used as a tool to analyse the position of a subregion within its region at a particular time. The results of identification are presented in Fig. V.2.

Fig. V.2 illustrates the groups of subregions which were classified according to their GDP per capita and their growth compared to North Sumatera as whole average figures within two periods, before and after 1975. The illustration shows that from 1975 to 1980 Asahan/Tanjung Balai and Karo were the highest developed subregions in the province and from 1980-1985, 2 subregions from developing subregions and 2 subregions from developed subregions shifted to the highest developed subregions. One subregion, Langkat/Binjei, shifted from a developed subregion and another one, Tapanuli Tengah, shifted from a developing subregion to

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                  % GDP growth
                  (NS average=6.75 %)

                        ^GDP
 Tap.Tengah/Sibolga  I  Asahan/T.Balai
 Labuhan Batu        I  Karo
 Simalungun/P.SiantarI
 Medan               I
                     I
                     I                          GDP Percapita
 ------------------------------------------->  (NS average=
 Nias                I  Tap.Selatan   Growth  Rp 117,972.61)
 Dairi               I  Tap.Utara
                     I  D.Serdang/T.Tinggi
                     I  Langkat/Binjei
                     I
                     I
                     I
                         a. Period 1975-1980


                  % GDP growth
                  (NS average=3.69)

                        ^GDP
 Medan               I  Tap.Selatan
                     I  Tap.Utara
                     I  Lab.Batu
                     I  Asahan/T.Balai
                     I  Simalungun/P.Siantar
                     I  Karo                    GDP Percapita
 -------------------------------------------->  (NS average
                     I                 Growth   =Rp 141415.80)
 Langkat/Binjei      I  D.Serdang/T.Tinggi
 T.Tengah/Sibolga    I
 Nias                I
 Dairi               I
                     I
                     I

                        b. Period 1980-1985
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Fig V.2 Classification of the Subregions Based on the GDP Per Capita and Its Growth During 1975-80 and 1980-85 a less developed subregion. From these figures it can be concluded that, within the last period there was mobility in the position of subregions in the province under study.

That the improvement of GDP per capita within a subregion would result in a higher degree of disparity among regions, can be seen by calculating the standard deviation of GDP to the North Sumatera average figures in the two periods. In the period 1975-1980, the standard deviation of GDP per capita among subregions were Rp. 24078.35, Rp. 27130.22 and Rp 39098.23 in 1975, 1980 and 1985 respectively. It meant that there was an increased disparity of 12.67 per cent between 1975-1980 and 44.11 per cent between 1980-1985. The gaps between the highest GDP subregions and the lowest were 56.59 per cent, 45.99 per cent and 55.22 per cent of the GDP per capita of North Sumatera for the same three periods as above. These figures presented evidence that although the scale of disparity was relatively low but it has increased within period 1975-1985.[10]

Identifying more factors about the disparity could be done by analyzing the GDP percapita ratio between the center of growth and its subregion as shown in Table V.7. The table only presents the situation in four subregions because information

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10. TODARO classified countries into 4 groups based on their GDP: low income, lower middle income, upper middle income and high income. In 1982, the ratio of difference between GDP per capita of the highest GDP per capita and the lowest to the average within the groups are 1.01 to 1.23, 0.52 to 0.79, 0.62 to 0.91 and 0.38-1.70, respectively. This ratio for high income European countries is 1.70, but if only the countries which adopt free market economy are selected, those are 15 countries, the ratio decreased to 0.92. This ratio for the world shows 8.45. It can be concluded that countries have the ratio less than 1.0 can be classified into the low inequality countries. These figures are computed from TODARO (1985: pp 47-59).

Table V.7 The Ratio of GDP Per Capita of Growth Center to Its Subregion at Current Prices (Rp) Excl. Oil

Municipalities/ Districts	1975	1980	1985
Medan	139103.02	338435.51	703834.20
North Sumatera	85097.24	247742.52	470901.97
Medan/North Sumatera	1.63	1.37	1.49
Sibolga	140756.61	397505.47	594545.96
Tap.Tengah	74746.35	221984.29	372947.35
Sibolga/Tap.Tengah	1.88	1.79	1.59
T.Balai	126196.12	304972.32	676414.47
Asahan	92866.55	264006.55	584095.01
T.Balai/Asahan	1.36	1.15	1.16
P. Siantar	101205.72	294663.04	623137.12
Simalungun	95465.79	228935.72	445150.18
P.Siantar/Simalungun	1.06	1.29	1.40
T.Tinggi	113717.20	187906.32	601448.89
D.Serdang	52581.46	194665.43	393154.18
T.Tinggi/D.Serdang	2.16	0.96	1.53
Binjei	65368.72	219588.11	370671.21
Langkat	85565.25	262274.96	416156.66
Binjei/Langkat	0.76	0.83	0.89
Medan	139103.02	338435.51	703834.20
D.Serdang	52581.46	194665.43	393154.18
Medan/D.Serdang	2.64	1.73	1.79

It is calculated from North Sumatera in Figures (1975, 1980 and 1985).

regarding the growth center of the rest cannot be found. The figures in the table showed that the highest disparity between Medan and Deli Serdang is followed by that between Sibolga and Tapanuli Tengah. The disparity decreased in the period 1975-1980 but it slightly increased in the period 1980-1985. Except between Medan and Deli Serdang, the average disparity between town centres and their subregions was not high enough to suggest that the imbalancing of the economy, as discussed above, was witnessed by the medium scale towns.

This section has explained the macro-economic situation in North Sumatera which is illustrated by GDP levels and its growth, comparative advantage of a subregion which is presented by its GDP by sectors and its mobility during the period of the study and the position of a subregion in the province based on its GDP level and growth. As described in the beginning of this section, Chapter VII will analyze to see if this macro-economic situation of the province has been induced by the provision of the roads during the period of the study.

V.3 Analysis of Land Use

As stated in the previous chapter, North Sumatera consists of 17 secondary administration offices which are called Dati II. The Dati II are classified into districts and municipalities. A district is an area consisting of many settlements and rural hinterlands and has its own local governments and its local People's Representative. Municipalities, towns which are considered as having economic potentiality, are independent from the local government of the regency in which they are located. They have their own local government and local People's Representative. The districts are called kabupaten and the municipalities are called kotamadya. The heads of kabupaten and kotamadya local governments are called 'bupati' and 'walikota'. They are coordinated by governors of the provinces.

Kabupaten and kotamadya are the lowest administrative hierarchies in Indonesia which have their own budgets, other than national and provincial budgets. There are 11 kabupatens and 6 kotamadyas in North Sumatera. The 17 dati II consists of 200 kecamatan which are third level administration offices. 5,648 villages are located within 200 kecamatan. The villages are the smallest unit among the official administration office. The number of kecamatan and villages which belong to a dati II can be seen in Table V.8. The 17 dati II, 11 kabupaten and 6 kotamadya can be classified into 12 subregions by considering the kotamadyas as a part of the districts in which they are situated.

From Table V.8 it can be seen that the characteristics of the kecamatan in the regencies are different from the kecamatan in municipalities. The range of density among the regencies are from 47 persons/km2 in Tapanuli Selatan to 222 persons /km2 in Deli Serdang, and the range among the municipalities are from 3068 persons/km2 in Tebing Tinggi to 21457 persons/km2 in Tanjung Balai. Tanjung Balai was in the 8th position in the population rank and it had the highest density in North Sumatera in both 1975 and in 1985. On the other hand, Tebing Tinggi which was in the 3rd position in the rank had the lowest density. These figures showed that there was no correlation between population size and the density within settlements in North Sumatera.

In its topography, North Sumatera consists of both highlands and flat low lands. The land use which is suitable for agricultural purposes, has a slope of 0 to 40 per

Table V.8 Population Density and the Growth Among
Districts and Municipalities in 1985

RDU	Districts/ Munipalities	Area (km2)	Number of Sub-Districts	Number of Villages	Population (1985)	Population Density (Pop/km2)	Population per Village	Population Growth (%) 1971-1980
I.	Nias	5318	13	657	540755	102	823	2.60
	Tap. Selatan	18896	17	1609	873380	46	543	2.07
	Tap. Tengah	2198	4	180	196245	89	1090	2.39
	Sibolga*	11	-	11	66012	6001	6001	0.80
II.	Tap. Utara	10605	27	871	740076	70	850	1.01
	Simalungun	4440	17	216	828530	187	3836	1.51
	Dairi	3146	8	157	276524	88	1761	3.00
	Karo	2127	10	274	246028	116	898	2.06
	P. Siantar*	12	-	29	155750	12979	5371	2.77
III.	Deli Serdang	4658	30	1423	1423253	306	1000	1.55
	Langkat	6319	15	219	774471	123	3536	3.37
	Tebing Tinggi*	31	3	21	155750	5024	7417	2.93
	Medan*	265	11	116	1622094	6121	13984	3.52
	Binjei*	17	-	19	80439	4732	4234	5.94
IV.	Asahan	4648	15	221	855883	184	3873	2.98
	Labuhan Batu	9323	12	192	622507	67	3242	4.70
	Tanjung Balai*	2	-	4	44530	22265	11132	1.92

* Municipalities

Source: Demografi Sumatera Utara 1985,
North Sumatera Statistical Office

cent, and above the slope it can not be used for that purpose[11]. Based on this approach, the total area of North Sumatera with a 0 to 40 per cent slope, is 5,142,835 Ha or 72 per cent of the total area. Table V.9 shows the area of land which can be used for agricultural purposes in 11 subregions of North Sumatera.

Tapanuli Selatan is the largest area, being 1,889,650 ha, but the land which can be used for agricultural purposes is only 1,027,272 ha or 54.4 per cent of the total area. Tapanuli Tengah is the smallest area of 219,779 ha and the area which can be used for agriculture is 66.90 per cent of the total area, or 147,116 ha. The most effective subregion, based on the percentage of land which can be cultivated, is Deli Serdang. Approximately 96 per cent of the total area of this subregion can be used for agriculture. It covers 447,026 Ha. This subregion is followed by Simalungun which has a total area of 443,960 ha and 93.30 per cent of which can be used for agriculture. The total land use in North Sumatera in the year 1985 is presented in Table V.10.

Table V.10 shows that the area of settlements, either rural or urban were 696,611 ha and 19,572 ha respectively, which was nearly 10 per cent of the total area of North Sumatera. The table also reveals that the agricultural areas which were 742,822 ha, 596,472 ha and 776,057 ha consisting of farming, small holders and big plantations. This figures show that the use of land, classified into the three catagories, is 29 per cent of the total area or 41 per cent of the effective area. Forestry and land used for other purposes still form a considerable area, being 3,618,459 ha or 50.24 per cent of the total area. These figure show that the

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11. This follows The Provincial Planning Board of North Sumatera's criteria. In the further discussion, land use means only for agricultural land use.

Table V.9 Topographical Condition of North Sumatera excluded Municipalities

RDU	Districts	Total Area (Ha)	Effective Area (Ha) 0-40% Slope	Non-Effective Area (Ha) > 40% Slope	Ratio of Effective to Total
I.	Nias	531.838	498.448	33.390	0.937
	Tap. Selatan	1889.650	1027.272	862.378	0.544
	Tap. Tengah	219.779	147.116	72.663	0.669
II.	Tap. Utara	1060.530	728.675	331.855	0.687
	Simalungun	443.960	414.370	29.590	0.933
	Dairi	314.610	73.390	241.220	0.233
	Karo	212.725	137.580	75.145	0.647
III.	Deli Serdang	465.838	447.026	18.812	0.960
	Langkat	631.955	399.625	232.330	0.632
IV.	Asahan	464.840	426.470	38.370	0.917
	Labuhan Batu	932.343	842.862	89.480	0.904
		7168.068	5142.835	2025.253	

Source: Directorate of Land Use,
Province of North Sumatera

Table V.10 Landuse in North Sumatera Classified into Subregions in 1985 - (Ha)

	Rural	Urban	Farming	Small Holder	Big/ State	Mining	Forestry / Others	Total
1. Nias	24175	37	59204	60994	1031	-	386397	531838
2. Tap. Selatan	48424	400	74266	108918	41587	151250	1464805	1889650
3. Tap. Tengah	8785	178	17726	37277	65	-	156848	220879
4. Tap. Utara	35952	111	72267	41454	-	-	910746	1060530
5. Lab. Batu	95741	312	46502	118675	183276	398357	89480	932343
6. Asahan	92627	492	61965	60441	131531	79614	38370	465040
7. Simalungun	77226	1017	104684	22465	145255	64923	29590	445160
8. Dairi	17990	101	31925	24233	-	-	240361	314610
9. Karo	39897	287	47941	14351	-	-	110249	212725
10.D. Serdang	145288	2178	97352	51493	153733	82	18812	468938
11.Langkat	105640	1770	61708	56171	118442	57594	232330	633655
12.Medan	4866	12689	7753	-	1137	55	-	26500
Total	696611	19572	742822	596472	776057	751875	3618459	7201868

It is calculated from North Sumatera in Figures (1985) and Directorate General Taxational Office Data available effective land still provided the possibility of the expansion of agricultural land use.

Table V.10 also illustrates the land use within subregions in North Sumatera. It reveals that Tapanuli Utara, Dairi and Karo have no location advantage in big plantations. The incomes of these three regions depended on small holders and farming activities. The figures in the tables also show that the farming areas are larger than small holder areas in those three regions. The position of those three regions in the regional classification, as illustrated in Fig V.2 are not in the same class. Two regions, those of Karo and Tapanuli Utara, are in the highly developed regions, but Dairi is in the less developed region. It might be concluded that in the first two regions, there is a driving force other than agriculture that promotes the regional income growth.

Labuhan Batu has a location advantage both for small holdings and big plantations, which have an area of 118,675 ha and 18,276 ha respectively. Before 1982, Deli Serdang and Simalungun had the most potential for big plantations in the province. After Medan, the biggest percentage of the provincial income came from those regions. But after a good highway was built between Rantau Parapat (Labuhan Batu), Kisaran (Asahan) and Medan, in 1982, Asahan came first and was followed by Deli Serdang, Simalungun and Labuhan Batu. It is an evidence that highway improvement provides a positive impact in terms of regional income increase.

Table V.11 shows land use among subregions and the trend of agricultural land use expansion during 1975-1985. These statistical figures were provided by the North Sumatera Statistical Book which obtained them from the North Sumatera

Table V.11 Productive Area among Subregions
in 1985 and Its Growth per Year

a. Productive Area (Ha)

	Nias	TapSel	TapTeng	TapUt	LabBatu	Asahan	Sim'ngun	Dairi	Karo	DS'dang	Langkat	Medan
Rubber	14806	61893	17183	6336	145806	15725	12029	286	-	57518	74913	-
Palm Oil	-	-	-	-	110100	74813	13280	-	-	82552	21379	-
Coffee	685	3480	323	5081	231	355	3047	12372	1483	1283	1567	-
Coconut	28771	3726	3591	294	4473	29494	1257	248	541	12225	4079	-
Cocoa	-	312	-	-	-	8813	-	-	-	391	102	-
Cassiavera	-	1084	-	5	20	-	7	7	335	317	89	-
Tobacco	-	180	-	6	-	-	6	13	2670	-	-	-
Sugar Cane	-	-	19	76	42	21	-	-	49	82765	38986	-
Tea	-	-	-	-	-	-	14966	-	-	-	-	-
Clove	907	2286	1177	386	284	153	524	346	3449	627	331	-
Benzoine	-	81	-	15623	-	-	-	844	-	-	-	-
Ginger	-	-	-	-	-	-	726	5	-	-	-	-
Ko Nut	-	23	-	-	-	44	30	1512	1474	-	24	-
Paddy	26312	70320	16860	61820	45613	56938	81198	27586	30120	121493	51260	6610
Maize	3588	424	85	901	379	3082	15659	635	16544	4806	1637	235
Cassava	9443	649	454	3402	275	835	2135	186	37	2493	821	209
Sweet potatoes	9721	420	167	3261	57	172	824	139	23	635	173	116
Peanuts	90	579	115	2409	63	165	4325	2393	1047	1351	430	197
Soybeans	7	940	30	407	81	610	356	959	126	822	7062	193
Small Green Pea	43	463	15	67	34	163	187	27	44	659	325	193
Others	712	471	51	-	2	101	40	120	-	39	114	-
Total	105085	148331	40070	100074	307460	191484	150596	47678	57942	369976	20392	7753

Source: North Sumatera Statistical Book 1985

b. Growth of the Productive Area

Subregions	Wet Paddy	Dry Paddy	Maize	Cassava	Sweet Pot	Pea-nuts	Soy beans	Small Green Pea	Rubber Small Holder	Rubber Big Plant.	Rubber State Plant.	Palm Oil Small Holder	Palm Oil Big Plant.	Palm Oil State Plant.
Nias	+ 5.55	+ 0.45	+23.11	- 3.98	- 5.57	+20.79	+28.57*	-42.03	- 3.10	+8.36	-	-	-	-
Tap.Selatan	+ 4.32	-17.91	-20.16	- 4.38	- 4.14	-14.48	+ 1.21*	-58.47	- 6.15	+20.48	-	-	-	-
Tap.Tengah	+ 2.88	+ 4.01	-11.55	-22.41	-10.57	+11.08	+46.66	193.33*	- 3.83	+ 5.46	-	-	-	-
Tap.Utara	- 1.37	- 1.91	- 2.98	- 8.30	- 9.97	+ 2.49	+19.36	+ 7.35	- 9.33	-	-	-	-	-
Labuhan Batu	-12.67	+ 8.97	-17.27	- 5.96	+ 2.65	+79.86	-13.37	- 5.45	+ 3.15	+ 5.80	+ 1.33	+ 9.37	+15.84	+88.05
Asahan	- 2.62	- 0.95	+10.94	- 9.82	- 9.02	-10.73	+ 0.33	-15.26	- 6.51	+ 1.64	+ 1.33		+10.83	+ 9.65
Simalungun	+ 7.80	- 3.52	+14.10	- 9.25	+13.28	+13.40	214.00*	+ 4.65	-12.66	+ 1.87	+ 1.33	+62.67	+17.66	+ 3.43
Dairi	+ 9.34	+ 1.99	- 9.53	- 3.82	- 0.10	- 3.41	+22.33	-12.94	- 5.67	-	-	-	-	-
Karo	- 3.13	+ 2.83	+ 0.01	-40.45	-44.90	-13.72	- 4.06	+46.67	-	-	-	-	-	-
Deli Serdang	+ 7.86	+ 7.58	+ 7.51	+ 0.81	- 0.77	- 7.51	- 7.41	- 5.43	- 4.05	+ 2.01	+ 1.33	- 4.09	+ 8.89	+ 3.32
Langkat	- 2.63	+ 2.00	- 5.96	- 8.51	- 0.26	-21.17	+12.19	-14.25	- 5.06	+ 2.01	+ 1.33	+20.00	+10.91	+11.60
Medan	- 0.59	+ 6.67	-10.18	- 7.44	+ 1.82	+ 4.78	- 1.00	- 1.20	-	-	-	-	-	-

Subregions	Coffee Small Holders	Coffee Big Plant	Coffee State Plant.	Coconut Small Holder	Coconut Big Plant.	Coconut State Plant.	Coco Small Holder	Coco Big Plant.	Coco State Plant	Casiavera Small Holder	Casiavera Big Plant.	Casiavera State plant	Tobbacco Small Holder	Tobbacco Big Plant.	Tobbacco State Plant
Nias	-	-	+35.00	- 0.87	+ 1.99	-34.52	-	- 0.76	+17.11	-	-	-	-	-	+ 1.33
Tap.Selatan	-	-	+35.00	- 8.47	+ 1.99	-34.52	+29.03	- 0.76	+17.11	-14.31	-	-	- 6.81	-	+ 1.33
Tap.Tengah	-	-	+35 00	- 4.68	+ 1.99	-34.52	-	- 0.76	+17.11	-	-	-	-	-	+ 1.33
Tap.Utara	-	-	+35.00	- 4.48	+ 1.99	-34.52	-	- 0.76	+17.11	280.00	-	-	-18.18	-	+ 1.33
Labuhan Batu	-	-	+35.00	- 2.25	+ 1.99	-34.52	-	- 0.76	+17.11	-19.22	-	-	-	-	+ 1.33
Asahan	-	-	+35.00	- 8.85	+ 1.99	-34.52	+33.22	- 0.76	+17.11	-	-	-	-	-	+ 1.33
Simalungun	-	-	+35.00	-14.10	+ 1.99	-34.52	+53.85	- 0.76	+17.11	-	-	-	-23 09	-	+ 1.33
Dairi	-	-	+35.00	- 0.48	+ 1.99	-34.52	-	- 0.76	+17.11	-33.37	-	-	-12.52	-	+ 1.33
Karo	-	-	+35.00	+ 8.49	+ 1.99	-34.52	-	- 0.76	+17.11	+ 4.11	-	-	+10.71	-	+ 1.33
Deli Serdang	-	-	+35.00	- 4.02	+ 1.99	-34.52	-	- 0.76	+17.11	+35.60	-	-	-	-	+ 1.33
Langkat	-	-	+35.00	- 0.81	+ 1.99	-34.52	-50.00	- 0.76	+17.11	- 4.99	-	-	-	-	+ 1.33
Medan	-	-	+35.00	-	+ 1.99	-34.52	-	- 0.76	+17.11	-	-	-	-	-	+ 1.33

Subregions	Sugar-Cane Small Holder	Sugar-Cane Big Plant.	Sugar-Cane State Plant.	Clove Small Holder	Clove Big Plant.	Clove State Plant.	Banzoine Small Holder	Banzoine Big Plant.	Banzoine State Plant.	Ginger Small Holder	Ginger Big Plant.	Ginger State Plant
Nias	-	-	+ 7.35	- 4,78	-	-	-	-	-	-	-	-
Tap.Selatan	-	-	+ 7.35	- 8.73	-	-	-	-	-	-	-	-
Tap.Tengah	- 9.68	-	+ 7.35	- 1.18	-	-	+ 6.34	-	-	-	-	-
Tap.Utara	- 3.65	-	+ 7.35	+ 1.26	-	-	-	-	-	-	-	-
Labuhan Batu	-23.47	-	+ 7.35	-20.63	-	-	- 1.57	-	-	-	-	-
Asahan	-15.58	-	+ 7.35	-26.13	-	-	-	-	-	-	-	-
Simalungun	-	-	+ 7.35	-25.43	-	-	-	-	-	- 1.79	-	-
Dairi	-	-	+ 7.35	- 7.43	-	-	- 4.72	-	-	-80.00	-	-
Karo	- 9.64	-	+ 7.35	+21.35	-	-	-	-	-	-	-	-
Deli Serdang	-17.65	-	+ 7.35	-23.07	-	-	-	-	-	-	-	-
Langkat	+18.92*	-	+ 7.35	-17.36	-	-	-	-	-	-	-	-
Medan	-	-	+ 7.35	-	-	-	-	-	-	-	-	-

* It is calculated between two years, 1985 and 1986

Source: North Sumatera Statisical Book, Various Issues

c. Expansion of Agricultural Land Use
in North Sumatera 1975-1985 (Ha)

Year	Paddy	Maize	Cassava	Sweet Potat.	Pea-nuts	Soy-beans	Small Green Pea	Big - Plantation Rubber	Big - Plantation Coffee	Big - Plantation Tea	Small Holder Rubber	Small Holder Coffee	Small Holder Coconut	Small Holder Total	Big Plant Total
1975	477528	37330	21780	21185	13033	9961	2333	na	na	na	na	na	na	na	na
1976	497992	40504	27750	24775	16833	12764	2497	78005	na	12110	69703	55468	72	391257	240471
1977	513586	34671	24737	22352	13826	9339	3563	72978	na	10079	91692	57302	395	405683	259642
1978	530442	36702	27400	21884	14128	9103	4539	73723	na	10148	95882	59058	346	409234	240462
1979	533225	41120	27668	23199	12600	11496	4867	76366	na	10237	94705	59295	607	435664	264956
1980	562641	38363	24831	19782	13534	5846	3912	76727	na	10235	162400	54767	63020	448136	287720
1981	550793	32923	24934	19829	10293	5569	2001	77622	na	10567	337000	77677	191500	463812	312538
1982	566136	37396	23189	17123	11752	2975	3087	76749	153	10884	341700	5997	162100	467541	269745
1983	551784	42723	20878	16342	10406	4437	4315	77427	153	12525	353300	81325	220400	513562	339726
1984	583064	33848	21877	15863	11841	8054	2516	74671	42	12078	75534	25278	105700	541208	381460
1985	612350	46909	19018	14838	13082	11398	2220	73596	42	14966	51788	29304	43462	597503	361680
Growth	+2.52	+2.31	-1.35	-3.62	-0.03	+1.36	-0.49	+0.64		+2.38	-3.09	-6.84	+13.80*	+4.82	+4.64

Source: North Sumatera Statistical Book, Various Issues
* During 1980 - 1984

d. Expansion of Agricultural Land Use
in North Sumatera 1975-1985 (Ha)
(after adjustment)

Year	Paddy	Maize	Cassava	Sweet Potat.	Pea-nuts	Soy-beans	Small Green Pea	Big - Plantation Rubber	Big - Plantation Coffee	Big - Plantation Tea	Small Holder Rubber	Small Holder Coffee	Small Holder Coconut
1976	533300	43551	18610	22347	12241	11900	2333	78005	3619	12110	60389	55252	72
1977	556200	30883	18205	20161	13164	11593	2497	72978	2220	10079	80597	55302	395
1978	531800	37049	21557	19739	12007	9057	3563	73723	2516	10148	84280	57058	346
1979	570300	44078	23675	20925	10753	4316	4539	76366	2738	10237	83246	57295	607
1980	575100	37646	23262	17843	11181	3294	4867	76727	2823	10235	142700	52767	63020
1981	477300	31165	20402	17886	10438	4458	3912	77622	2001	10567	296200	47677	191500
1982	581100	44075	18478	15444	13592	7707	2001	76749	3912	10884	300000	25997	162100
1983	413700	45573	21149	14740	12702	11050	3087	77427	4096	12525	310600	21325	220400
1984	595100	34792	19474	14308	13952	9570	4315	74671	4539	12078	66394	25325	105700
1985	606100	47925	17693	13384	14837	9550	2516	73596	3529	14966	45522	23278	43462
1986	619500	58755	15027	13413	18063	12451	2220	81611	2882	9166	44047	27304	

Source: North Sumatera Agriculture Authority

Coffee is not used in the analysis because of the figures
shown in c) and d) are big difference

Agriculture Authority (Dinas Pertanian). Dinas Pertanian regularly provides estimates of anual agricultural land use for publication in the Statistical Book. The Dinas Pertanian makes adjustment when more accurate figures are available. The figures for 1975-1985 after adjustment at provincial level are presented in Table V.11d. Unfortunately, no figures after adjustment on the subregional level were available. There is also no explanation of the data collection procedures used at the kecamatan level. Despite these problems the latest figures from Dinas Pertanian have been used in in the analysis.

Table V.11b illustrates the projected growth of the agricultural productive area in food crops and other commodities which are considered as potential input to the regional growth. Five subregional areas of growth of wet paddy, which are Asahan, Tapanuli Utara,Labuhan Batu, Karo and Langkat, decreased within the last five years. The biggest figure was provided by Labuhan Batu, 12.67 per cent per year. This occurred in Labuhan Batu because of the expanded use of land for rubber and palm oil instead of paddy. The growth of rubber and palm oil areas were from 1.33 per cent to 5.80 per year and 9.37 per cent to 88.05 per cent per year respectively. Similar circumstances occurred in Asahan. Unlike in Labuhan Batu, there was expansion of dry paddy, rubber and palm oil in wet paddy areas, Asahan shifted from rubber to palm oil and decreased in dry paddy areas.

Dry paddy in Tapanuli Selatan, Tapanuli Utara, Asahan and Simalungun showed a decrease in cultivated area. Of the four subregions, only Simalungun has a paddy area of more than 80,000 ha as illustrated in Table V.11a. Therefore the decrease in cultivated paddy area in Simalungun gives a considerable reduction in production. But, in fact, as shown in Table V.11b the decrease in the dry paddy area was the result of the increase in wet paddy areas. During the last five years, Simalungun constructed a great number of irrigation linings, funded by Asian Development Bank.

Similar to Simalungun, in Tapanuli Selatan a decrease in the dry paddy area was also followed by an increase in wet paddy but the background of this increase in dry paddy area was different. The decrease in dry paddy, was a result of an increase in the rubber areas which were managed by big private plantations. The increase in wet paddy areas was the result of the intensive action instituted by local government in developing the irrigation scheme. The other commodity areas which increased, did not provide much influence on the regional income. The area of these commodities were relatively small. Both Tapanuli Utara and Asahan's dry paddy areas decreased. The decrease in these areas came as the result of the intensive peanut expansion in Tapanuli Utara and of maize in Asahan.

The maize area not only increased in Asahan but also in Nias, Simalungun, Karo and Deli Serdang. The highest potential subregions for this crop were Karo and Deli Serdang but in the near future, the role of Simalungun in producing this crop will be more dominant. Although Deli Serdang and Nias have a relativly high projected growth in maize cultivated areas, but the existing areas were relatively small compared to Karo.

On average, crop production and other agriculturally productive areas decreased during the last five years, except for rubber and palm oil. The falling of oil prices and the uncertainty of clove prices influenced both private and state businesses to be more involved than before in agricultural investment. The government also tried hard to promote a good environment for businesses including in the agricultural sector. The decrease of the crop cultivated area gives evidence that the economic role of farmers has also decreased. The decrease of this role was followed by decrease of small holders. It meant that the role of those small enterprises was taken by big private and state enterprises. Comparing the role of the last two enterprises, the role of state enterprises still dominated the regional agricultural activity. Up to now, the economic environment which was promoted by the government failed to sustain the effect to support private enterprises to take over this role.

This section has discussed the land use development in North Sumatera. The discussion suggests that during the period of study, there was a decrease in land use planted by cassava, sweet potatoes, small holder rubber and small holder coffee. The last two shows a significant decrease. Although there was an increase in land use planted by food crops such as paddy and maize in fact there was a shift of land use from crop planted area to palm oil or big plantation rubber in some subregions. It also illustrates that the role of big plantations is very dominant in the expansion of palm oil or rubber planted areas in a particular region. Chapter VI and Chapter VII will discuss this further in order to determine if roads have roles in this land use development.

V.4 Investment and Regional Development

Investment

The previous section has discussed the land use development in North Sumatera in order to investigate later in the next chapter if the development has a corelation with road provision during the period of study. This section discusses another economic factor, investment, in order to investigate the same objective with the first economic factor which has been discussed already.

In general terms, the Indonesian economic system can be classified as a mixed economy. The present Indonesian constitution, which dates back to 1959 reveals three spesific characteristics of the Indonesian economy **(ALISJAHBANA, 1981: p 180)**. Firstly, the Indonesia economy is arranged as a cooperative system. Secondly, all means of production which are important and essential for the people belong to the state. Thirdly, land, water and other natural resources belong to the state and are exploited for the benefit of citizen welfare.

From these, the position of private enterprises becomes obscure. The role of private enterprises are interpreted differently by the two regimes of government. The Sukarno regime (1959-1965) interpreted that the role of private enterprises as a means of strengthening the domestic capital in the first stage of the economy, and supporting the objective of the economic development through 'socialism'. The present government interpretes the constitution in a manner which although not mentioning private enterprises, still provides space between state intervention and cooperatives for private enterprises. The present government believes that the constitution allows for the three modes of production to work together in the economy.

Government realizes that investment in industries is very essential when the increase in national output needs to be achieved. The role of the industry can be seen in each of the five year plan which have been implemented since 1969. Repelita I (1969-1973/74) concentrated more on the industries which supported the agricultural sector through forward and backward linkages[12]. Repelita II (1974/75-1978/9) still focussed on the Repelita I policy but gave more attention and support to what are called 'indegenous Indonesia' and 'the weak economic group' development, plus a wider range of consumer goods. The next two plans, Repelita III (1979/80-1983/4) and Repelita IV (1984/5-1988/9), expanded the policy to achieve industrial diversification and backward integration.[13]

Despite what is written in the constitution, in reality, the government policy is attempting to stimulate private enterprises to play a more dominant role in the economy by providing them the first priority to invest in any vital branch of industry. Repelita I stated that "An investment plan will be worked out to make possible increased production in the respective industries........ If, after a certain period of time, no private capital is invested in a vital branch of industry, the Government will decide to make its own investment".

New Order Government which came to the power 1966 showed a remarkable change in policy towards investment. One of the first decisions introduced was the Foreign Investment Law No. 1/1967 and followed by Domestic Investment Law No.6/1968. The first one, PMA (Penanaman Modal Asing) applies to all firms with less than 100 per cent domestic equity operating in industries under the jurisdiction of the Technical Team for Foreign Investment. The second one, PMDN (Penanaman Modal Dalam

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12. Since New Order took power in 1966, before Pelita I, Government implemented some policies to rehabilitate economy and stop inflation whichwas known as 3 October policy. This policy includes policies on subsidies/prices, foreign exchange regulation and devaluation of Rupiah. See **SJAHRIR (1986; pp 13-14).**
13. This study concentrates the investment since Repelita I. Literatures of the investment in Indonesia before the time of Pelita I are very rare. Some of them are written by **PAAUW (1959)** and **SUTTER (1959).**

Megeri) are all firms wholly owned by Indonesians which are regulated by the Domestic Investment Law No.6/1968. Through Law No. 11/1970, and Presidential profits and capital Decrees No. 20/1973 and 21/1973, BKPM (badan Koordinator Penanaman Modal=Capital Investment Coordinating Board) was formally established to take over Technical Team functions.

HILL (1988: pp 29-30) stated that government offers incentives to the investors such as: "a basic tax holiday of two years for all investments in (liberally defined) 'priority' areas, and longer periods in certain circumstances; exemption from payment of import duties and sales taxes on intial machinery and equipment; a guarantee that profits and capital could be repatriated; loss carry-forward provisions; and accelerated depreciation allowance."

In 1977 BKPM issued its Investment Priority List which consisted of 831 activities and the list was expanded to 1,095 activities in 1978. In 1981, the List reserved certain areas exclusively for co-operatives. In 1982, an Export Certificate (Sertifikat Ekspor, SE) scheme was introduced. This scheme provided generous rebates on some inputs. It also began to attract a few export-oriented investment proposals.

Repelita IV provided a list of priority areas which were focussed by government in order to promote a larger capital goods industry. The list included **(HILL, 1988: pp 12)**:

a. machinery and factory equipment, for sugar, rubber, tea, and wood processing;

b. metal-working equipment;

c. agricultural equipment;

d. machinery to produce industrial components;

e. electrical machinery;

f. machinery to produce electronic components;

g. motor vehicles;

h. railroad equipment and trains;

i. aircraft;

j. ship and boats;

k. steel and structural metal products;

l. aluminium and aluminium goods.

After intensive effort to stimulate the industrial sector after 1967, manufacturing output growth increased by almost 9 per cent in 1968 and continued to grow by over 10 per cent every year until 1981. The contribution of the manufacturing sector to GDP almost doubled from 1966 to 1984. In 1975, Indonesia's exports of manufacturers totalled just US$ 85 million or 1 per cent of the total export value. In 1985, the exports of manufactures increased to US$ 1,800 or 10 per cent of the total export value (Ibid).

In 1985, there are four items which covered 82 per cent of the total of manufacture's export. This manufacturing export are dominated by plywood with a contribution of more than half. The figure of 82 per cent was increased from 9 per cent in 1975. After 1981, the industrial growth was 1 and 2 per cent in 1982 and 1983. This decline corresponded to the decline in domestic demand growth. It shows that industry heavily depends on this domestic demand. The decrease in domestic demand has been affected by the decline in real oil prices (Ibid).

Despite the considerable growth of manufacturing sector, however, the share of manufacturing is still one of the lowest in the South and South-east Asia. In 1984, manufacturing value added per capita was $ 70.00. This figure was less than one-fifth of Malaysia's figure. Compared to the agricultural output, the output of manufacturing was only a half. Manufacturing sector output contributed only 8 per cent of the total exports. This means the role of manufacturing in exports remains very low[14].

Structural change in the industry sector has also occurred. These changes are illustrated in the changing composition of industrial output from 1972 to 1984. In the early 1970s, four-fifths of industrial production came from light industry such as food processing and textiles. This share decreased but was still more than half the total in 1984. This happened as a result of the increase in the output of heavy industry, to over 40 per cent[15].

Ownership status is not much mentioned in any Repelita except for the government effort to promote more participation of 'indigenous Indonesians' who are considered as the 'weak economic group'. There is no data available to study how far the government has achieved the objective of its effort. The only data available on the ownership status are classified into seven categories: government, private, foreign, the three joint venture pairs, and establishments in which all those have equity[16].

Output by private ownership groups was increased from 50.8 per cent of the total in 1975 to 56.9 in 1983, respectively but employment shares decreased slightly from 74.5 per cent to 74.0 per cent during the same period. Foreign investment contributed to the total output and employment from 10.2 per cent and 2.0 per cent in

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14. The description of the role of industry and its development in Indonesia economy can be seen in **DONGES** et al (1980; pp 357-405).
15. See also **ZAIN** (1986; pp 3-13)
16. The information on ownership is attracted from **HILL** (1988; pp 17-25).

1975 to 1.5 per cent and 1.1 per cent respectively in 1983. The contribution of government in the total output and the total employment also decreased from 25.0 per cent and 15.8 per cent, respectively, in 1975 to 14.4 per cent and 13.0 per cent in 1983.

The other three groups of ownership: government/foreign, private/foreign, government/private/foreign showed an increase in the share of output from 2.1 to 4.2 per cent, from 10.5 to 21.1 per cent, from 0.4 to 0.9 per cent in 1975 and 1983, respectively. The contribution in employment among the three groups also showed an increase from 0.7 to 1.1 per cent, 5.5 to 9.4 per cent, 0.2 to 0.3 per cent in 1975 and 1983, respectively. The contribution of the joint venture government/private in output fell from 1.1 per cent in 1975 to 1.0 per cent in 1983 and in employment from 1.2 per cent in 1975 to 1.1 per cent in 1983.

HILL (1988: pp 151) concluded that although much of the large-scale manufacturing in the factory sector is state or foreign controlled, it is clearly quite misleading to assert that foreign investors dominate Indonesian manufacturing. He stated that ".... relatively little direct foreign investment there has been in the manufacturing sector" He added that "The important foreign contribution in manufacturing has been technology and skills rather than capital". One reason is the presence of state enterprises. State enterprises play a more significant role in Indonesia than in any developing market economy of East and South East Asia.

The amount of investment funds which have been invested by either foreign or domestic investors during 1967-1985 was US$ 1,900 million of which 59 per cent was foreign investment. Eighty per cent of the investment was located in Java and Sumatera. More than 40 per cent of the total foreign and domestic investment was concentrated in Jakarta and West Java (a province within which Jakarta is located), respectively. North Sumatera received 18 per cent of the foreign investment and 3 per cent of the domestic investment. The trends of investment in North Sumatera can be seen in the Table V.12.

Even whem allowance is made for the inadequacies of data provided by the local authorities or yearly statistical books at the provincial or subregional level, the findings of the analysis raise a number of questions which are discussed in the following paragraphs.

Table V.12 presents not only foreign and domestic investment which follows BPKM procedures but also other variables which are considered as investment indicators nsuch as cooperatives and investment in private sectors. Industry data is available only for the medium sized firm sector. No data on output or number of establishments is available in small industries. The amount of small scale loans in some sectors is taken as an indicator in this sector. The data for output or number of establishments based on ownership is also unavailable.

Domestic Investment in North Sumatera showed a significant increase from 109 establishments in 1975 to 177 in 1985. The growth rate was 5.5 per cent per year during the study period. These establishments had provided jobs for 298,578 in 1984 with the rate of growth of 4.3 per cent per year. The investment which had been allocated during 1975-1985 was Rp 930,834 million at market price or Rp 470,475 million at constant price. The former's growth rate was 20.62 per cent but the latter's growth rate was 11.81 per cent. This domestic investment was only approximately 3 per cent of the total domestic investment in Indonesia. Sixty per cent of the Indonesia's total domestic investment was allocated to Java in 1985. It illustrates that

Table V.12 Investment in North Sumatera
During 1975-1985 (Rp 000.000)

Year	Domestic Investment				Foreign Investment				Big/Medium Industry	
	No of	No of	Investment (Rp.)		No of	No of	Investment (US$)		Investment (Rp.)	
	Estab.	Empl.	Nominal	Real	Estab.	Empl.	Nominal	Real	Nominal	Real
1975	109	203913	172214	172214	40	45631	2144000	2144000	na	na
1976	112	207055	201789	182796	40	45631	2144000	2003738	na	na
1977	115	208090	216228	182194	41	45531	2144000	1880702	57019	48044
1978	126	210385	239939	180473	41	45853	2144000	1757377	89760	67514
1979	130	211328	263139	179079	44	46208	2151000	1558696	121000	82346
1980	141	241128	378616	238183	46	46311	2166000	1353750	176800	111223
1981	146	264610	412126	243919	49	46335	2193000	1238983	240700	142460
1982	154	278047	508841	293415	53	46552	2197000	1207143	206500	119075
1983	170	287859	621374	337777	na	na	na	na	385600	209611
1984	177	298578	930834	470475	57	47305	1926000	1024468	517200	261410
1985	na	na	na	na	44	51615	2185000	1156085	950200	463189

Year	Small Scale Bank Loan on Types of Sectors (Rp.)									
	Agriculture		Industry		Trade		Transport/Com.		Total	
	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real
1975	na	na	na	na	na	na	na	na	na	na
1976	857	776.3	1421	1287.2	2950	2672.3	1517	1374.2	6938	6285.0
1977	1425	1200.7	1913	1611.9	4792	4037.7	3592	3026.6	12294	10358.9
1978	2033	1529.1	2334	1755.6	6658	5007.9	3917	2946.2	16209	12191.8
1979	1940	1320.3	2990	2034.8	10634	7237.0	4508	3067.9	23468	15971.14
1980	1641	1032.3	5315	3343.6	23200	14594.9	6267	3942.5	43360	27277.3
1981	10890	6445.3	8718	5159.8	44800	26515.1	7456	4412.9	82115	48600.3
1982	17381	10022.5	11859	6838.3	63806	36792.8	8235	4748.6	172000	99181.2
1983	18178	9881.5	13658	7424.4	74394	40440.3	8540	4642.3	135200	73494.2
1984	19122	9664.9	15885	8028.8	89716	45345.5	9177	4638.4	160400	81071.5
1985	20725	10102.7	12294	5992.9	109400	53328.6	9929	4840.1	193000	94080.7

Year	No of Vill. Coop. Unit	No of All Types Coop.	Cooperative Saving (Rp 000)		Coop Member	No of Truck Wagon	No of B u s	No of Bus Company
			Nominal	Real				
1975	na	na	70865	70865.00	na	4965	2175	130
1976	na	na	273500	247757.95	na	4800	1748	125
1977	na	na	38276	32251.43	na	5755	2079	118
1978	294	1032	539800	406017.30	na	5895	2051	107
1979	308	1104	574800	391180.07	na	5932	2059	7
1980	331	1206	648400	407901.36	na	7445	2275	114
1981	356	1303	1350000	799005.68	na	8379	2891	120
1982	404	1525	3222000	1857917.20	na	8458	2785	127
1983	418	1607	5088000	2765818.70	662500	8623	3161	129
1984	435	1697	4776000	2540425.50	571600	9121	3669	146
1985	444	1741	10690000	5210999.20	568800	9859	3774	154

Source:
North Sumatera Capital Investment Coordinating Board, North Sumatera in Figures (various issues), Bank of Indonesia (Medan Branch), North Sumatera Traffic and Transport Service.

the province under study is still less attractive place for investors than other locations[17].

Foreign investment in North Sumatera was approximately 18 per cent of the total Indonesian investment in 1985. In the same year, foreign investment in Java was 52 per cent. Asahan project accounts for most of the investment in North Sumatera. In real terms, the trend was decreasing by 6 per cent per year. This phenonmenon follows the national phenonmenon as **HILL (1988: pp 151)** stated that government policy gives low priority to and discourages foreign investment.

The increase of foreign and domestic investment in nominal terms, has been attributed to be the result of the impact of the road development in the region. However, evidence shows that the road improvement in the province under study may not assist the distribution of investment either in 1985 or in 1975. In 1985, 4 per cent of the total foreign investment and 12.80 per cent of the total domestic investment were allocated in Medan. This figure was not so bad but if the districts of Medan hinterland are taken into account the situation for domestic investment becomes different. Sixty-one per cent of the total domestic establishment was in RDU 3 which accounts for fifty-one per cent of the total investment and eighty-per cent of the total jobs created in this sector in North Sumatera[18].

For foreign investment, it appears that the distribution of the investment is not concentrated in Medan or RDU 3. This figure was not as the result of good distribution of foreign investment in the province but Asahan project investment took

17. The information of the investment in North Sumatera is from North Sumatera Statistical Book, various issues.
18. The information on this investment distribution has been collected from North Sumatera Capital Investment Coordinating Board.

more than three-quarters of the total foreign investment in North Sumatera[19]. If the number of establishments is considered it shows that the 52 per cent of the total establisments in North Sumatera were allocated in RDU 3 and accounted for 63 per cent of the total investment without Asahan project being taken into account in 1985. Medan itself had 30 per cent of the total foreign establishment or 60 per cent of the total investment without Asahan projects being taken into account. It is likely that road improvements brought a more skewed distribution of the investment in the province under study. It seems that the intervention by the government activities in particular areas is necessary.

Investment in big/medium industries, in real terms, also showed a significant growth of more than 30 per cent per year during the study period. It was estimated that 80 per cent of the total investment was located in RDU 3 in 1975 and there was no significant change in 1985. It is possible that road improvements during the study period did not affect the distribution of this type of investment geographically. The contribution of Industrial output to total export value is not significant. It was only 3 per cent in 1985. This means that the role of the big/medium industry and foreign/domestic investment as well, are still at the level to serve local demand[20].

As an effect of political disturbances in 1974[21], starting from Repelita II, the government gave more attention to equality in development plans. One objective

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19. Asahan porject is a water power plant which are funded by some big Japanese firms.
20. Sources of this information is the North Sumatera Statistical Book 1985 and various issues.
21. It is known as 'Peristiwa Malari' (Malari Affair). It was a demonstration by students to protest against government economic policy at the time of the visit of Japanese Prime Minister Tanaka on 15 January 1974. They argued that the policy tended to increase the inequality and the economy was too dominated by Japanese economy.

was to promote more participation of the 'weak economy group' or 'indigenous Indonesians' in the economy. To achieve this objective, more facilities and accessibility to bank loans were provided. Some types of small scale bank loans were introduced.

In 1978, the trade sector took 42 per cent of the total small scale loans and were followed by industry, transport/ communication and agriculture which were 22.22, 21.83 and 12.35 per cent respectively. By 1985, the structure of the small scale bank loans had only slightly changed. The trade sector still dominated the use of this type of bank loan and the use increased to 57.70 per cent, more than a half of the total small scale loans. Small scale loans to industry and agriculture decreased to 6.37 and 10.74 per cent, respectively. These figures show that the availability of the small scale bank loans are more beneficial to traders. The input side of the local economy and export as well, are not strengthened by the provision of this type of loan. Traders who benefit from this type of loan are likely to be serving urban functions and are stimulated more by marketing of imported goods[22].

The other important point is that the small scale bank loan is not well distributed among subregions geographically. In 1978, Medan, RDU 3 and all municipalities received 21.81 35.20 and 51.57 per cent of the total small scale loans, respectively. It showed that big urban settlements and Medan with its hinterland benefitted most from the small scale loans.

Figures 1985 do not reveal a better distribution. Medan, RDU 3 and all municipalities received 35.93, 47 and 60.55 per cent of the total small scale bank

22. The information on small scale loan in North Sumatera is from Bank of Indonesia Medan Branch's Report.

loans. After 7 years, big towns benefitted more from small scale bank loans than rural areas. It is likely that the regional development efforts during the period of study can not significantly change the geographic distribution of the small scale bank loans.

The distribution of the small scale loans, no doubt, was also followed by the distribution of bank establishments. In 1975, the distribution of bank establishments was such that 78 per cent were located in Medan city alone, and this increases to 84 per cent when its hinterland (RDU 3) is considered. However in 1985 the situation improved in that the concentration decreased from this level, to about 44.76 in the city and 51.43 per cent in the city and its hinterland. A similar situation occurred in bank employment. In 1985, the percentage of this indicator in Medan and RDU 3 were 67.84 and 74.49 per cent, respectively.

Cooperatives and state enterprises together are supposed to form the basis of the Indonesian economic structure according to the Constitution. There is no data available on state enterprises. Despite the government's effort to stimulate private enterprises, it shows that the trend of cooperatives during the period of study is still growing over of 7.76 per cent. Village-cooperative growth, 6.07 per cent, is less than the total type of cooperative growth. Percentage of village-cooperative is 28.48 and 25.50 per cent of the total cooperative of any types in 1978 and 1985, respectively. It shows only a slight change[23].

The number of cooperative members and investment increased to 4.96 and 65.14 per cent, respectively. Although the figures showed there was an increase in cooperative

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23. The information on cooperatives is attracted from North Sumatera Statistical Book 1985 and various issues.

growth in terms of savings and unit numbers, their contribution to the total capital investment in the province was only 0.75 per cent in 1985. This was only a slight increase of 0.52 per cent since 1975.

The road improvements during the study period may provide an influence on the distribution of cooperatives. In 1978, village-cooperatives located in Medan, RDU 3 and all municipalities are 1.36, 18.64 and 2.05 per cent, repectively. In 1985, the percentages did not change significantly. They were 1.46, 19.10 and 2.65 per cent, respectively. This figure shows that village-cooperatives are fairly evenly distributed. It is speculated that this distribution was the result of road improvements during 1975-1985.

Total cooperatives of all kinds showed that in 1978, 14.58, 29.46 and 27.58 per cent were located in Medan, RDU 3 and all municipalities, respectively. In 1985, they were 15.08, 32.63 and 30.57 per cent, respectively. Although there was a tendency for more concentration in big towns or in Medan and its hinterland, the change was not significant. A similar situation occurs in the case of cooperative savings and members.

In 1985, the percentage of cooperative savings in Medan, RDU 3 and all municipalities are 27.82, 47.24 and 43.91 per cent, respectively. There was no significant change compared to 1975 which was 28.10, 46.70 and 45.10 per cent. The percentage of cooperative members was 15.98, 33.06 and 23.12 per cent in the three areas, respectively, in the same year.

There is no data available on transport investment itself except for the number of truck wagons, buses and bus enterprises. The concentration of truck wagons, buses and bus enterprises in Medan are 28.62, 41.97 and 25.48 per cent, respectively, in 1985. In RDU 3, in the same year, the concentration increased to 46.53, 50.00, 41.40 per cent, respectively. In 1975, this concentration shows that truck wagon, buses, and bus enterprises are 78.25, 69.00 and 27.10 per cent[24].

These figures show that although there was an increase in the distribution of buses and truck wagons outside Medan and its hinterland, the distribution of enterprises did not significantly change. A similar situation occurred in RDU 3. The distribution of the indicators are 81.10, 76.00 and 28.30 per cent, respectively. Although the figures show that there was no significant change during the period of study on a number of enterprises the impact on the number of buses and truck wagons was very significant.

This section reveals that the distribution of foreign, domestic and big/medium investment is concentrated in the primate city of the region in 1975. It appears that this concentration did not significantly change in 1985. A similar situation has occurred with other investment indicators. The next analysis which is presented in Chapters VI, VII and VIII is to attempt to find out if this distribution of the investment indicators were stimulated by road provision.

Government Activities

This section discusses government activities in North Sumatera. The description of these activities cannot be separated from other factors which are closely related to these activities. They are the fiscal system, the planning process and funding resources. They will be described briefly. The trend of activities which have taken

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24. Source of the information is from the report of Traffic and Transport Service, North Sumatera (1975 and 1985).

place in North Sumatera during the period of study will be discussed in depth to see if they have correlations with road provision in the province.

The fiscal system in Indonesia is classified into 3 categories which are APBN (Anggaran Pendapatan Belanja Negara=National Revenue and Expenditure Budget), APBD Tkt I (Anggaran Pendapatan Belanja Daerah Tingkat I=Provincial Revenue and Expenditure Budget) and APBD Tkt II (Anggaran Pendapatan Belanja Daerah Tingkat II=District/Municipal Revenue and Expenditure Budget). The intergovernmental financial system is an essential key to Indonesian development since Indonesia consists of a geographical archipelago, has great diversity and a long history. On the other hand, this system needs a coordinated regional planning approach in order to achieve any of the stated economic development objectives. Indonesian development planning considers districts/municipalities as the base planning units.

The relationship between the three government hierarchies in Indonesia can be seen in terms of 4 dimensions: decentralization, deconcentration and assistance function and integrated funding[25]. The main tasks of provinces or districts/municipalities when they are formed as official administrative regions have been clearly described. These main tasks are very much related to the various administrative problems in conjuction with the characteristics of the regions such as religion, social-culture and other welfare problems.

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25. **ASMARA** (1986; pp 216-219) classified the fiscal relationship among the three hierarchies of government administration into decentralization, deconcentration and assistance functions. Integrated funding has been introduced recently by central government. This fiscal relationship is an attempt to delegate more power to the local government. How it works in Indonesia is similar to Multi-Level Planning in India (See **MISRA** and **SUNDARAM**, 1980).

Central Government can delegate some of its tasks which it considers can be managed by local government.[26] By the delegation of the tasks, it means that policy, planning, implementation and finance of these tasks are under local government responsibility. This procedure is called decentralization. Decentralization activities cover various social-welfare services including activities in the agricultural, industrial, public works, road and river traffic, education and health. However, the central government can take back the power which has been delegated if it considers that the local governments cannot manage well the tasks they have been given.

Deconcentration means that almost all of the central government tasks are still managed by the cental government. These tasks are mainly related to defence and security, national ideology, foreign affairs policy, interior policy, the judiciary, trade policy, mining and other vital activities. Almost all of these activities do not have regional characteristics although, except for foreign affairs policy, they also take places in regions. These activities take place throughout the nation. Thus, formulating policy and planning, including finance, are provided by the central level of government. For implementation, central government does not delegate its power to local government but shares it with the local authority through extention of ministry offices in the regions. Local governments are only coordinators of these activities.

Assistance functions are a combination of the two previous principles. In this principle central government can not delegate its power to local government but on the other hand it does not implement the tasks in the region. In this case, formulating

26. The term of 'local government' is used here to represent either provincial or district government.

of the policy, planning and finance are in the hands of central government but the implementation is the responsibility of the local governments.

Integrated funding is a delegation of development to local government, particularly when related to local services. It means that not only planning, design and implementation of the projects which resources of funds from local government , but also all planning, design and implementation of the projects which resources of funds are from APBN. This approach is a relatively new approach to the funding mechanism in Indonesia. It started with The Regional Cities Urban Transport Projects and then it was adopted by National Urban Development Projects. The latter was established in this framework when Presidential Law (Keppres) 21/84 was issued concerning the wider delegation of authority from central government to local government.

All activities based on the deconcentration principle and assistance function are provided in APBN, and those based on decentralization are included in APBD Tkt I and APBD Tkt II. The funds for integral funding projects come from three sources of resources: central, provincial and kabupaten/kotamadyas. Activities of central government in a region through deconcentration and assistance principles are implemented in the form of sectoral projects and Inpres (Instruksi Presiden=President Instruction) while local government activities are implemented in the form of regional projects. However, the two kinds of activities are coordinated by either provincial or district/municipal government of the particular area in which the activities take place. In general, sectoral projects are projects or activities on the big scale and which take place in more than one province.

Since Inpres projects were introduced in 1969/70, these projects have been developed into two groups (**ASMARA, 1986: pp 219**). First group is programs providing subsidy assistance to any hierachies of the government administration: province, districts/municipalities[27] and villages. This aim of subsidy is to finance projects in APBD Tkt I and APBD Tkt II. The second group is programs which are more specific assistance for regional development in order to improve social facilities such as Inpres SD (primary school), Inpres Sarana Kesehatan (Health Infrastructure), Inpres Penghijauan dan Reboisasi (Forestrazation), Inpres Pasar (Market) and Inpres Prasarana Jalan (Road Infrastructure).

Assistance to Village Development through the development subsidy has the following objectives:

1. to stimulate creativeness and to develop cooperative-self help activities of communities,
2. to build village infrastructure such a production facilities, communication, marketing and social facilities,
3. to provide building materials which are not available in a particular village or can not be provided through cooperative-self help of the village community.

The budget for this type of assistance has been increased from Rp 100,000 in 1969/70 to Rp 1.25 million in 1984/85 per village. In total, there was an increase from Rp 4,600,000 in 1969/70 to Rp 98,075,100 in 1985/86 or an increase of 24 times.

27. The detail description of this type of INPRES cn be seen in DE WIT (1973; pp 65-85).

Assistance to district/municipal development is by direct central government intervention in order to create more job oppurtunities in the region. The objectives which need to be achieved are[28]:

1. to create job opportunities,

2. to utilize as much as possible local labour and local materials and to reduce the use of import material,

3. to increase production and to improve the distribution of agricultural production, and to improve the environment of low income groups,

4. to stimulate participation of local people in the development,

5. to be technically sound,

6. the increase implementation of projects by reasonably waged labor, rather than by cooperative-selfhelp,

7. to design projects which can be planned, implemented, and controlled by local technicians,

8. to design projects in which the implementation does not depend on other projects,

9. to encourage projects which can be completed within a fiscal year,

10. to promote projects which are integrated with other projects at the districts/municipalities, province and national level.

This program started in 1970/71 and the provision of the budget is based on the population of the districts/municipalities. This assistance began at Rp 50.- per capita and then increased to Rp 1,150.- per capita in 1984/85. It took Rp 5,700,000,000 in total in 1970/71 and it was increased 40 times to Rp 214,922,922,000 in 1985/86.

Assistance to provincial government is attempting to stimulate the role of a region in the national development framework. This is achieved if the balance between

28. The detailed description of this programme can be found in PATTEN et al (1980; pp 155-182).

sectoral and regional development and inter-regional growth as well can be maintained. This program can be identified into 2 categories:

1. budgets where amounts are determined by central government, such as roads, bridges and irrigation improvements and rehabilitation,

2. budgets where use is guided by central government, such as to finance productive-economic projects, remote and poor area development, project development in urban settlements, improvement of the civil service, to strengthen weak economic groups, to promote youth improvement, and other projects improving social welfare. This program started since 1974/1975 and it spent Rp 43,950,000,000 and in general, the budget for this program has been increased every year. In 1985/1986 the budget spent Rp 280,000,000,000 or an increase of 7 times that of 1974/1975.

Specific programs, which is one type of the asssistant function, started from Pelita I (1969/70-1973/74) by introducing Inpres SD. The aim of this program is to achieve the distribution of education opportunities to all regions in the country. Comparing to the budget in 1970/1971 with that of 1985/1986, it shows an increase of 37 times, from Rp 15,815,000,000 to Rp 553,156,748,000. In Pelita II (1974/75-1978/79), 3 specific Inpres were introduced; Inpres Kesehatan, Inpres Penghijauan dan Reboisasi and Inpres Pasar. The aim of Inpres Kesehatan is to distribute health care facilities to all parts of the country. This programme spent Rp 4,545,370,000 in 1973/74 and Rp 48,524,363,000 in 1985/86. The increase is approximately 12 times. Inpres Pasar spent Rp 20,000,000,000 in 1976/77 and Rp 11,000,000,000 in 1984/85. Inpres Penunjangan Jalan was introduced in Pelita III (1979/80-1983/84). It spent 12,727,000,000 in 1979/80 and was increased to Rp 101,722,000,000 in 1985/86. Another Inpres which was introduced in 1979/80 was Inpres Pertokoan (Shops). The aim of this Inpres is to provide local government easier accessibility to bank loans in order to assist the weak economic groups[29].

Bottom-Up Planning

The formulation of regional development is basically an effort to stimulate 'bottom up' and 'top down planning' through any level of government hierarchies; village, kecamatan (subdistricts), district/municipalities, province and national level. The objective of this two way planning policy is to achieve the integration and comprehensiveness of the central planning and local planning in the region. The other objectice of that policy is not only to accomodate local people's needs in their local area but also to stimulate more participation of the local people in planning, implementation and the control process of the development.

This bottom-up planning policy, in the Indonesian regional development context, involves at least 6 stages of planning. The six stages are not only to integrate the regional programme and sectoral programme but also as a filter to proposed projects from the lower hierarchies in the government administration[30].

The first stage of the planning mechanism is development meetings at the village level in which the LKMD is chaired by the head of the village. This meeting creates an inventory of the potentiality of the village, identifies the problems which are faced and collect suggestions to solve them including proposals of programs or projects

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29. This information is collected from National Planning Board.

30. The description of the bottom-up planning policy canbe found in SIBERO (1986; pp 3-14). Description of the planning process in transport sector can be seen in BINA MARGA (1985).

which are expected to be financed by Inpres/APBD Tkt II/APBD Tkt I/National. This proposal, after approval by the meeting is sent to the subdistrict level for further discussion. The second stage is a Development Discussion at the subdistrict level which is chaired by the head of the subdistrict. This discussion reconsiders the proposals provided by villages and its aim is to integrate all projects in the kecamatan.

The third stage of planning process is Rakorbang (Rapat koordinasi pembangunan=the development coordinated meeting) which take place at the district/municipality. This meeting is chaired by the Chairman of Bappeda of District/Municipality and is guided by the head/mayor of the district/municipality. The meeting is attended not only by the head of the kecamatans but also by other representatives of sectors in the district/municipality. The aim of Rakorbang is to integrate proposals from subdistricts and sectoral proposals.

In this forum, the third stage of the planning process, it is expected that the results will be:

a. programs/projects which will be funded by APBD Tkt II as components of the Plan of APBD Tkt II and to be submitted for approval of the People's Representative of the District or Municipality,

b. programs/projects which will be financed by the province as proposed to the Governor of the province for approval, including projects under APBD Tkt I,

c. programs/project which are proposed by sectoral implementer from the district/municipality whichare submitted to APBN through sectoral executers in the province.

d. programs/projects which are proposed the inclusion in Inpres and are proposed to the governor for approval,

e. programs/projects which include those for Banpres (Bantuan Presiden=Presidential Assistance), Foreign Assistance and others.

Programs/projects proposals which go through the governor will be discussed in stage four of planning process.

Stage four, is the Rakorbang Tkt I which are attended by Bappeda Tkt II and sectoral executers at the provincial level. The outcomes which are expected from this consultation are similar to those in the previous stage. The next stage is the consultation inter-Bappedas which are located in the same WPU (Wilayah Pembangunan Utama=Main Development Region)[31]. This consultation is also to integrate all programs and projects in the WPU and to investigate if the projects/programs support their provincial master plan or provincial Pelita. The final stage is national consultation of Bappeda which is held every year which are attended by Bappenas (Badan Perencana Pembangunan National=National Development Planning Board), representative of ministry and other central institution. This outcome of this consultation is as a National Revenue and Expenditure Budget Plan and after it is approved by representative of people become fixed national Revenue and Expenditure Budget for a particular fiscal year.

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31. In Pelita II, Indonesia has been divided into 6 WPUs and 38 subWPUs. These division are only as economic planning unit. They do not have official government institutions. The further description can be seen in **SJAFRIZAL** (1984; pp 359-385). Since Pelita III, the division of WPUs is not followed any longer. See interview with Hariry Hady, Deputy Chairman of Bappenas (PRISMA No 12, 1985, Jakarta).

Financial Resources for Development

Almost all the government activities are funded by the central government through deconcentration in the form of programmes or sectoral projects. The contribution of central government is almost 80 per cent of the total budget allocated in the districts/municipalities. The role of local government through the decentralization principle is meaningless, is only about 7 per cent of total government budget come from this source in its area[32]. Although the Inpres budget is allocated in APBD, in fact, this budget also comes from central government.

Until 1980, as a result of the increase in oil revenue, the intervention of central government to local government development budget became larger and larger. This results in a negative attitude. The local governments were not stimulated to cultivate their original income to finace their expenditures. The local governments, no doubt, greatly depend on the subsidy of the central government. The drop of the oil prices reduced the subsidy of the central government in the local budget but the local governments themselves are not able to substitute local funds for this decrease. With the exception at central government, very few of the local governments have savings, in the term of surpluses minus their routine budget.

The ability of local governments to finance their routine budget or development is shown by the Index of Routine Capability (IRC) or Index of Development Capability (IDC). On average, IRC for district/municipalities is 0.35. It means that the local government can only finance 35 per cent of their routine expenditure through

32. Decentralization principle in Indonesia is much related to the regional authonomy as SHAW (1980; pp 279)'s definition is "to mean discretionery power own expenditures by the local authorities" with or without "discreationery power over tax revenues".

regional income. Local government in villages can finance 92 per cent of their routine budget while provincial government can only finance 29 per cent. Of course, this level of capability differs from one region to another. IDC of districts/municipalities is 0.60 higher than IRC. The index of regional capabilities to finance the total routine and development expenditure is 0.42. This figure is still relatively low[33].

As stated in Section III.6, although data on government expenditure are available, major problems are encountered when expenditure needs to be disaggregated into subregions. The same problems are encountered when national expenditure has to be disaggregated into provinces. Nevertheless, despite these problems the findings of the analysis raise some questions.

Table V.13 shows the budgets which are allocated in the province during the study period. The growth presents the significant increase. Although regencial/municipal budgets show a high rate of increase, the percentage of this budget is not significant within the total budget which is allocated by central government[34]. The index of provincial capability is 0.05 and if taxes which are collected by central government are taken into account, the index become 34.98 per cent in 1985.

The percentage of central budget was allocated in Medan and RDU 3 was 9.11 and 29.31 per cent of the total budget allocated in the province, respectively. Foreign loans show a larger amount than that, 29.74 and 42.15 per cent, respectively. The

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33. This information is taken from **ASMARA** (1986; pp 226)
34. 'The biggest portion of regional income to finance its expenditure come from central government' is the characteristic of fiscal relationship in developing countries. See **ALDERFER** (1964; pp 149).

Table V.13 Government Activities in North Sumatera During 1975-1985 (Rp millions)

Year	Central Budget								I Districts/Municipal	
	Routine		Development		Tax Collected		Subsidy		Tax Collected	
	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real
1975	21233.4	21233.4	24959.1	24959.1	na	na	na	na	na	na
1976	25968.9	23524.7	36687.7	33234.6	na	na	na	na	na	na
1977	34240.1	28850.8	38514.5	32452.4	19860	16734.1	39587.8	33356.8	1.2208	1.0286
1978	43717.6	32882.7	45637.8	34327.0	40822	30704.8	50518.5	37998.1	1.6735	1.2587
1979	64719.9	44045.1	71682.6	48783.6	54365	36998.1	55695.4	37903.5	2.0420	1.3897
1980	92416.0	58137.9	105600.0	66431.8	72067	45676.3	86938.1	54691.8	2.5788	1.6223
1981	95972.5	56801.9	115200.0	68181.8	81836	48435.1	115100.0	68122.6	3.0315	1.7942
1982	111500.0	64294.8	131400.0	75769.8	89704	51726.4	135000.0	77845.7	3.4841	2.0090
1983	134000.0	72841.9	176800.0	96123.5	97478	52988.7	167500.0	91052.4	3.8359	2.0852
1984	150200.0	75916.1	177700.0	89815.5	90468	45725.6	165800.0	83800.9	5.0917	2.5735
1985	135600.0	66100.2	164100.0	79993.0	177300	86427.5	222500.0	108460.9	4.3229	2.1073

Year	Provincial Budget						I Districts/Municipalities			
	Routine		Development		Tax Collected		Routine		Development	
	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real	Nominal	Real
1975	21443.2	21443.2	8117.8	8117.8	na	na	na	na	na	na
1976	22777.0	20633.2	8958.7	8115.5	na	na	na	na	na	na
1977	33081.0	27874.1	8907.7	7505.6	4774.2	4022.8	na	na	na	na
1978	38119.1	28671.8	9224.2	6938.1	7225.0	5434.4	na	na	na	na
1979	45428.0	30916.0	21798.2	14834.8	9647.8	6565.8	17299.9	11773.4	10089.7	6866.5
1980	66208.7	41651.2	21600.6	13588.7	12001.0	7549.7	23958.8	15072.2	16901.8	10632.7
1981	83183.9	49232.9	20984.7	12419.9	13667.0	8088.9	29257.9	17316.5	28324.6	16764.1
1982	96779.0	55806.1	23171.6	13361.6	14626.8	8434.3	32815.5	18922.6	31161.3	17968.7
1983	113000.0	61426.4	21210.0	11529.7	17088.8	9289.4	38653.3	21011.8	38669.0	21020.3
1984	109600.0	55395.5	20008.2	10112.8	22131.3	11185.9	43229.9	21849.8	33928.5	17148.6
1985	147000.0	71657.3	26219.8	12781.2	24597.7	11990.5	47280.8	23047.7	57022.1	27796.3

Source: National Planning Board and
North Sumatera Regional Planning Board

provincial budget is better distributed, 4.03 and 15.34 per cent, respectively. These figures were based on 1985. Compared to 1975, it was estimated that the 1985 distribution was still better[35], although the difference was not much change.

Tax collection in the province shows that central government collects the most, 87.81 per cent of the total tax in the province, compared to provincial government of 12.18 per cent and the remainder was collected by 11 regencies and 6 municipalities in 1985. Although the figure shows that central government collected the most, the province receives more that that from the central government, approximately 65 per cent of its total budget allocated in the province. The disribution of tax collected is also more wide spread during the time period, although the Medan and its hinterland is still the potential resources of tax collected. In 1985, in Medan and RDU 3, tax collected was 51.23 and 77.33 per cent of the total tax in the province under study. It is speculated that the improvement of the amount of either budget allocated or tax collected and the better distribution as well is induced by road improvement.

V.5 Conclusions

It is likely that the North Sumatera development during the study period can not stimulate the economic growth to catch up with the progress of the six other provinces: East Kalimantan, Riau, Aceh, DKI Jakarta, Irian Jaya, South Sumatera and Central Kalimantan. Except DKI Jakarta which has a comparative advantage in industry, the other comparative advantages belong to other provinces but North Sumatera is in the oil sector. North Sumatera has the great potential in the agricultural sector.

35. The information is collected from North Sumatera Planning Board.

Among subregions in North Sumatera, during the study period, it has been seen that only Tapanuli Tengah and Medan do not have a comparative advantage in the agriculture. There was no upward or downward mobility in the agriculture sector during the study period. There was upward mobility in Nias and Labuhan Batu in the mining sector. In the industrial sector, Tapanuli Tengah, Tapanuli Utara and Medan had downward mobility and on the other hand Asahan had upward mobility. In the construction sector, Asahan came down but Langkat went upward. A similar situation occurred in Transport/Communication, Tapanuli Tengah and Langkat came down and went up, respectively. Upward mobility in the Bank/Financial Institution occurred in Simalungun. Ownership of dwellings went up in Nias and came down in Langkat and Public Administration went up in both Tapanuli Selatan and Simalungun. The impact of road provision on this mobility will be investigated in Chapter VII.

The position of a subregion among other subregions shows that there were 4 subregions having upward mobility. They were Tapanuli Selatan, Tapanuli Utara, Labuhan Batu and Simalungun, during the study period. On the other hand, only one region went down in its total GDP and growth: Langkat. The analysis also shows that the inequality of GDP per capita between a growth centre and its hinterland is not high, except for the ratio of GDP between Medan and Deli Serdang which were 2.04 and 2.16, respectively, and the others were under 2.00. Chapter VII will investigate further the impact of road provision on the position of the subregions in the province under study.

In more detail, in the agricultural sector, it was shown that the potential commodities of the province under study are rubber, palm oil, sugar cane and paddy. This illustrates that small holder rubber planted areas decreased in most subregions except in Labuhan Batu. Big plantation of rubber shows that they are expanded in almost subregions although if it is calculated in the province as a whole the expansion was a slight increase over the study period. It has also been shown that palm oil planted area increase considerably during the study period except in Deli Serdang which shifted to cocoa planted area. Paddy planted areas were considerably increased in some subregions but simultanously they were decreased in other subregions. As a whole in the province, the growth of paddy planted areas was only 2.52 per cent. No data on sugar cane is available.

Foreign and domestic investment, big/medium industry investment, small scale loans, and activities in transport sector appear to be more concentrated in the primate city, Medan, and its hinterland. On the other hand, government activities, budget allocation and tax collection distribution were better in 1985 during the study period. This shows that government activities were very essential as a means of promoting distribution of the welfare in the province under study.

North Sumatera's economy might be classified in the stage of development as 'at the end of traditional society' or 'in the beginning of the precondition for take off', following Rostow's term.[36] Private economy or government are willing to mobilize savings. It shows by the appearance of banks and other financial institutions for mobilizing capital. But all this activity proceeds at a limited pace within an economy and a society still mainly characteristics by traditional low productivity methods. Some characteristics of traditional society which ROSTOW (1974, pp 4-34) describes still exist in the North Sumatera's economy.

36. It might be more appropriate to say that the stage of development in 'the beginning of precondition of take off'.

The basic reasons why these characteristics still exist are modern science and technology are either not available or not regularly and systematically applied. The existence of the old social structure and values and the regional based political institution that developed on conjunction with them still predominate. It is speculated that different stages of development will lead to different impacts of roads on development.

It also shows that in the stage of development, North Sumatera is still relatively low level of inequality. The ratio of centre and their peripheries is also relatively low. Inequality in the province in overtime is discussed in more depth in Chapter VII of this study. The impact of roads on this inequality will be studied further.

VI. ROADS AND REGIONAL DEVELOPMENT

VI.1 Introduction

Previous chapters have discussed the indicators which can be considered as 'development'; land use, investment, government activities, inter-regional trade, education and health services. Based on the inter-regional trade, the trend of other transport modal users are considered as an indicator of development as well. The previous discussion has attempted to investigate the developments in North Sumatera during the study period.

Chapter IV investigates the development of three indicators; education and health services, inter-regional trade and transport mode. During the study period, it indicates that the number of health services increased as a result of government expenditure to provide such services. The indication also shows that the distribution was improved. A similar situation occurred in education. The distribution, the number of schools and teachers improved during the study period.

Chapter IV also indicates that the loading and unloading of inter-regional trade through potential ports in North Sumatera shows that Belawan, a port close to Medan, has become more important than before. The role of Sibolga as a potential port in the western part of the province in the past shifts to Tanjung Balai, an eastern port of the province. In general, the role of railways and river transport declined and air transport for short distance travel has declined as well.

Chapter V discussed economic growth factors: land use, investment and government activities. In the agricultural sector, it shows that the potential commodities of the province under study are rubber, palm oil, sugar cane and paddy. It appears that considerable number of land uses are shifted from other commodities to palm oil. Paddy planted areas considerably increased in some subregions but simultaneously they decreased in other subregions. Rubber planted areas declined during the study period. Almost all investment indicators show the distribution was more concentrated in Medan and its hinterland. On the other hand, the distribution of government activities was better among subregions during the period of study.

This chapter investigates the relationship between road and development indicators. The description of road networks is discussed in the beginning at this chapter before the analysis proceeds.

VI.2 Description of Road Networks

In the context of transport and development at the regional level, transport indices include generated traffic as a result of the effects of road improvements; levels of accessibility and transport networks (see Section III.3). However, studies of generated traffic need a certain period of time to monitor the trend of the volume of the traffic on improved and alternative roads systems. To measure levels of accessibility, transport costs or travel time model at the regional level are needed as a basic input for further analysis.

Unfortunately, neither of these approaches can be employed in the case of North Sumatera because of the lack of available data to support such research. This study attempts to pursue an analyses which takes account of the available data. As a result of this limitation, as stated at the outset of this study, the findings may be more indicative rather than conclusive.

The description of road networks can be categorised into two modes of analysis, the morphological and functional. The morphological analysis focusses upon the characteristics of road networks which are considered intuitively important, eg. uniform transport surface, network density, route factor and access points. The functional analysis is based upon the dominant patterns of road network use such as traffic magnitudes, geographical characteristics and traffic types.[1]

A uniform Transport Surface is defined in terms of levels of accessibility to all points of given directions over given distances in terms of time and costs. The accessibility approach is originally rooted in the locational theory.[2] Uniform Transport Surface is however an ideal situation and it does not exist in real life situation.

Among morphological considerations, network density, and total length of roads per area, are always adopted in many cases because of their simplicity, for example as investment criteria in many countries.[3] The weakness of this approach is that human activities such as development of settlements and geographical condition are flagrantly ignored and result in under supply of necessary services due to the non-uniformity of space. This situation result in different levels of accessibility existing in two regions of the same network density.

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1 Almost all definitions which are presented here are taken from **(HAY, 1973, pp 35).**
2 For example, **(LOSCH, 1954)** assumes that space in which all economic activities take place is as a broad homogenous plain with an uniform rates in all directions.

3 In Philipines and India, formulas for regional road requirement considers tha land area. See **HOWE and RICHARDS (84: pp 32 and 102).**

The Morphological approach as it has been explained above classifies whole networks, nodes and individual links into some categories, eg uniform transport surface, network density, route factor and access points. Many studies are interested in classifying road performance according to functions which are based on the volume of the traffic and types of traffic. Other alternative approaches have been devoted to the identification of topological properties defining either the language of graph theory or the language of matrix algebra.[4] Examples of road network analyses can be found in (HAGGETT and CHORLEY, 1969), (TAAFFE and GAUTHIER, 1973), (LOWE and MORYADDS, 1975) and (WERNER, 1968).

Simple analysis of a network which is represented by its structural indices was first fully described by KANSKY (1963), although most of the indices were introduced earlier by GARRISON and MARBLE (1962). GARRISON (1960) states that network graph indices can conveniently be adopted as simplified transport regional networks to represent the level of accessibility and connectivity of the transport as a whole or places in the network. Garrison introduced the graph theoretical methods to compute various accessibility and connectivity indexes in his study of regional road networks.

Kansky has adopted these measures in his analysis by using cross sectional data. These approaches have been calculated for the study area and it seems that the result is meaningless to support the objective of the study. These measures can not be adopted in dynamic analysis since there is lack of data and dynamic measurement is also not significant change during short-term period (YEATES, 1968). Another argument is that some of transport network measures are not always valid to represent

4. A simple introduction of the theory of graphs is written by DEO (1980). For more advanced theory can be found in HARVEY et al (1974), GONDRAN and MINOUX (1984), TOMESCU (1985) and FLAMENT (1963).

transport network (WERNER, 1968). Road density is still a better measure to describe transport network. SHARIF (1986) used this measure to investigate the spatial distribution of 143 development indicators in Bangladesh. Road density over time is similar to road length since the area of study remains unchanged during the period of study.

In this regard, the total length of roads, based on the data compiled by the Ministry of Public Work of Indonesia is used in this study. The Ministry of Public Works keeps road data in three categories. There are status condition, surface condition and structural condition.

Status condition is divided into three categories which are; state, province and regency/municipality. The status condition shows links which are under the responsibility of one of government levels in new construction, improvement and maintenance. Most roads linking provincial cities are a state responsibility, roads linking regency/ municipality cities are a provincial responsibility and the rest are under regency/ municipality responsibility.

Since there are more funds available in the higher level of government it is not surprising that state roads are better than provincial roads which in turn are better than regency roads. Since road lengths in any category do not significantly change, it is not justifible to use them as transport measures in this study.

Road surface are divided into, asphalt, gravel and earth. The available data is divided into road construction or maintenance periods. The surface condition data of a link is still listed by previous condition even when the links structural condition has declined owing to deterioration.[5] These procedures are not justified for adoption as a measures of transport networks.

The third classification based on the structural conditions is more fruitful to use as a measure of transport networks. Roads can be divided into four classes: good condition, sufficient condition, bad condition and very bad condition. The classifications are based very much on 'comfortability'. Although the term 'comfortable' is difficult to define, in general, the average running speed is taken by Ministry of Public Work of Indonesia as a criteria in the definition.[6]

The roads on which an average running speed of over 50 kms per hour can be maintained are classified as good condition roads and those which have an average running speed between 30 to 50 kms are classified as sufficient condition. The roads in bad or very bad condition are those with an average running speed under 30 kms per hour. The difference between the two is that the roads in bad condition are usable through out the year whereas those in very bad condition are usable only in dry seasons. The road inventory is shown in Table VI.1.

In the context of the objectives of this study, length of roads and/or road density can be used as a strong proxy for other transport measures for a number of reasons.

5. **PATERSON (1987)** have conducted a study which contains an extensive analysis of the physical process, causes of deterioration, and performance prediction relationship, as well as the effectiveness of maintenance practices on unpaved and paved roads.

6. World Bank distributes a country's road among the three classes of condition: good, fair and poor. A road in good condition requires only routine maintenance to remain that way. A road in fair condition needs resurfacing. A road in poor condition has deteriorated to the part that it requires either partial or full construction (**THE WORLD BANK, 1988**). The Public Works may still classify poor condition to bad and very bad conditions.

Table VI.1 Road Inventory in North Sumatera Classified into Road Condition, 1975-1985

Year	Good	Suff	Bad	V.Bad	TotA	TotB	TotC
1971	377	969	1068	2281	1346	2414	4695
1972	8	524	1181	2339	532	1713	4052
1973	392	80	1294	2397	472	1766	4163
1974	776	364	1407	2455	1140	2547	5002
1975	1299	1589	1445	2514	2888	4334	6840
1976	2145	1771	3001	2343	3916	6917	9260
1977	412	373	8	3221	785	793	4014
1978	2489	2632	1785	3221	5121	6906	10127
1979	1457	1105	1995	3221	2562	4557	7778
1980	4368	3331	2330	1913	7700	10030	11943
1981	4344	3335	2340	2343	7679	10019	12882
1982	3650	4737	2581	2047	8387	10967	13015
1983	5395	4001	1956	2575	9396	11352	13927
1984	4091	5381	2811	3088	9472	12283	15370
1985	4649	5370	3532	2440	10019	13551	15991
1986	4984	5397	1931	4560	10381	12312	16872

Source: Public Work Services, the Province of North Sumatera

Firstly, they also represent the product of transport investment since the correlation between transport investment and any measure of road length is relatively high. Secondly, they also represent the different level of travel time which reflects the level of accessibility.

However, a closer inspection of the road inventory shows problems which are created by the shortfall in the 1977 and 1979 data. There is no explanation from official data sources why this shortfall has occured. As a result two approaches have been used in the analysis. In the first, three years data are excluded from the analysis. In the second, only 1977 and 1979 are excluded since the 1978 data appear to be consistent with other years. It was found that there is no significant difference between the two results. However, the more data we have the more credible the analysis would be. This analysis therefore adopts the latter approach, leaving out only the 1977 and 1979 data.

The structural condition of roads also shows the level of settlements with which they are linked. Almost all roads linking the primate city, that is Medan. to kabupaten roads are in good condition. On the other hand, kabupaten roads to kecamatan towns are in sufficient condition, and those linking kecamatan towns to villages are in bad or very bad condition. This provides a basis to explain the impact of roads on provincial development.

The distribution of road network in North Sumatera can be explained as follows. Road density on total area (km/km^2) varies from 0.11 in Tapanuli Selatan to 0.53 km/km^2 in Karo. The subregions which have highest road density are Karo, Nias, Deli Serdang and Simalungun. Their densities are 0.53, 0.42, 0.31 and 0.27 km/km^2, respectively. Tapanuli Utara, Dairi, Tapanuli Tengah and Asahan can be classified into a group of medium road density. The densities are 0.21, 0.21, 0.17 and 0.17 km/km^2, respectively. Langkat and Tapanuli Selatan which road densities are 0.13 and 0.11 km/km^2, respectively, can be categorized into the lowest road density subregions. It appears that there is no correlation between distance from the primate city and the road density in the subregion. It shows that road network in North Sumatera is spatially distributed.

It was stated in Chapter III that the technique of analysis used to investigate the relationship between road and development indicators is simple regression analysis. However, there seems to be no reason to believe that for all indicators there should be a simple linear relationship. Simple XY graphical plots also help identify patterns before coefficients of correlation are calculated. Some of the plots are shown in Appendix III.

The computation of coefficients of correlation will cover three stages. Firstly, direct computations are applied if simple relationships exist between indicators. The pattern of relationship is shown by the XY linear graphical plots. Secondly, if the first stage of the graphical plots fails to show the relationships, lagged variables of road indicators are also plotted to see whether they have good indications of linear relationships. Thirdly, if the graphical plots do not show simple relationships but non linear ones may exist, transformations of the values into logarithmic forms are carried out before coefficients of correlation are computed. The coefficients of correlation of these relationships are presented in Table VI.2, VI.3, VI.4, VI.5, VI.6 and VI.7 and the figures will be discussed in the following sections.

VI.3 Roads and Economic Factors

Land Use

Chapter V has discussed land use development in the area of study. It reveals that there is a decrease in land use planted by cassava, sweet potato, small holder rubber and small holder coffee. This situation occurred as a result of a shift of land use from crop planted area to other commodities such as palm oil and big plantation rubber. This section is an attempt to identify if there are correlations between land use development indicators and road provision. The adopted technique is simple regression analysis.

It was stated in the previous paragraph that the computation of coefficients of correlation based on the XY graphical plots. This covers 3 stages of analyses. To explain the stages of analyses, the cases of paddy, maize and coconut small holder and their relationshipsv with road indicators are selected as examples. XY graphical plots for the 3 stages are shown in Appendix III.

At the first stage, simple linear relationship plots for 3 commodities and road indicators indicate that none of the plots seems to be straight line approximation. Therefore the analyses for relationships continue to the second stage. At the second stage, the graphical plots between 3 commodities and lagged variables of road indicators are produced. Similar to the first stage, none of the relationship between planted areas and roads appears significant.

Now, the basic concern for the remainder of the non significant relationship is to examine the adequacy of the straight line approximation after logaritmic transformation. This is at the third stage of computation. The plots in Appendix III indicate that the relationship between good/sufficient condition roads and coconut small holder is only significant. Coefficients of correlation computed at any stage for agricultural indicators are presented in Table VI.2.

Table VI.2 shows that correlations with values of $r < 0.6117$ at the 5 per cent level of significance[7] exist between all transport measures and all food crops, except for some commodities. Sweet potatoes appear to have a good correlation with total length of roads and the length of good, sufficient and conditioned road. Unlike sweet potatoes, expanded peanut plantation areas are only influenced by roads in sufficient and bad condition. The expansion of this plantation is also increased when the total length of roads increases. Both are potential export commodities from North Sumatera.

Sweet potatoes appear to have good correlation with the number of roads in good, sufficient and bad condition. Sweet potatoes generally appear to be planted along roads linking Medan to Kabupaten towns and Kecamatan towns. Except Simalungun and Labuhan Batu, the other subregions show that the sweet potato planted areas decreased, including in Nias which were the most potential producer in the past.

In the past sweet potatoes appeared to be consumed as the staple food instead of rice, especially in the rural areas surrounding Sibolga. Efficient distribution of rice and the control of rice prices by government at a certain price which can be afforded by larger groups of people led to a decline in sweet potato consumption. Simalungun has a

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7. This figure is used as the criteria to determine if the correlations are good or not. This criteria is based on CHILD (1970: pp 95).

Table VI.2 **Coefficient of Correlation Between Length of Roads and Land Use Indicators in Time Series 1975-1985 (without 1977 and 1979)**

Indicators	Level of Road Condition				
	Good	Suff	Bad	VBad	Total
(1)	(2)	(3)	(4)	(5)	(6)
1. Paddy	-0.0843	+0.4962	+0.3941	+0.1420	+0.4052
2. Maize	+0.3224	+0.4174	-0.0154	+0.2080	+0.4647
3. Cassava	-0.1273	-0.7685[a]	-0.6126[a]	-0.1909	-0.4940
4. Sweet Potatoes	-0.8225	-0.9667	-0.8161[a]	+0.0156	-0.9567
5. Peanuts	+0.3528	+0.7198	+0.7086[a]	+0.3640	+0.7158
6. Soyabeans	-0.4426	-0.2909	+0.2404	+0.1219	-0.3037
7. Small Green Pea	+0.0987	-0.1673	-0.1999	-0.0644	-0.0644
8. Rubber Big Plantation	+0.2784	+0.0142	-0.3862	-0.0063	+0.1563
9. Cocoa Big Plantation	+0.7261	+0.9345	+0.0635	+0.0332	+0.9249
10. Tea Big Plantation	+0.1191	+0.2072	+0.7744	-0.4225	+0.1532
11. Rubber Small Holder	-0.2973	-0.0788	-0.3138	-0.4458	-0.1278
12. Coffee Small Holder	-0.0077	-0.1731	-0.5223	+0.3278	-0.0995
13. Coconut Small Holder	+0.8777[b]	+0.7750[b]	-0.1545	-0.4964	+0.7392[b]
14. Palm Oil Holder	+0.7442	+0.8847	+0.1077	+0.1693	+0.9694

These figures are calculated from Table V.11c and Table VI.1

[a] significant relationships with lagged variables
[b] significant relationship with log transformation

comparative advantage over kabupatens because of its closeness to Medan as a large marketing place and as a distribution centre for export. Unlike sweet potatoes, it seems that most peanut planted areas are found along roads which link kabupaten and kecamatan towns. It also appears that although roads in sufficient and bad condition have an positive influence on the expansion of peanut plantation areas.

In contrast, sweet potatoes, which have good export marketability, are delivered to Medan which is the market centre. Peanuts are mainly delivered at P. Siantar as raw material supplied to food industries. It appears the peanut plantation areas which were concentrated in the kabupatens, Asahan, Tapanuli Selatan, Karo, Dairi, Langkat and Deli Serdang shifted to Tapanuli Utara, Tapanuli Tengah, Labuhan Batu, and Nias. Big plantation take the land in the first group of subregions (except in Dairi and Karo which shifted to food crops) to plant palm oil, cocoa and rubber, since roads improved to sufficient condition. Simalungun is still a potential area for planting peanuts.

Although the peanut planted areas are small, 63 ha, in the early 1980s, the increase in peanut plantation areas is significant in Labuhan Batu. The growth in planted areas has been 80 per cent since 1980 and land use has shifted from food crops, such as wet paddy, maize, cassava and soyabeans. The alternative prospective commodities in the district are rubber and palm oil. A similar experience has been witnessed in Simalungun, the kabupaten which had the largest peanut plantation area of 4325 ha in 1985 used to be popular for its growth of dry paddy, cassava and small holder rubber.

Other commodities appear not to be influenced by the provision of roads owing to the fact that;

1. farmers who grow food crops are clustered around the urban settlements to which they sell their products. This shows that food crops are still a local market trade.
2. 40 per cent of the GDP comes from the agricultural sector in the provinces and about 8 per cent of it comes from food crop farming. About 18 to 20 per cent of the provincial population still live below the poverty line. The homogeneity of commodities produced in the province combined with their low demand does not strongly promote inter-regional trade within the province. Food crop marketing still satisfies local needs.

Paddy is a different case. The National Cooperative Agency (BULOG) has a policy to buy paddy products at a given price. BULOG has built a storage unit in every kecamatan in the country including in the province of North Sumatera. When the farmers cannot sell their product in the market they sell it to the BULOG at a determined price.

The BULOG buys the paddy regardless of where it is collected. This marketing strategy ensures that roads have no influence over new paddy planted areas. This expansion has developed because of the government effort to promote paddy production. Paddy growing has been encouraged in order to achieve self sufficiency in particular provinces and for the nation as a whole.

The pattern of rice commercialization depends on the size of the annual harvest and changing household consumption requirements. This pattern fluctuates over time. In general, it appears that commercialization of rice which was increasing at the beginning of the project period has been going down in current years. Data on increasing importation of rice into the study area support this conclusion. This is attributed to declining soil fertility and the price is relatively low to earn sufficient income from selling the production to meet family needs. It also seems that the application of new technology which has been introduced by agricultural extension service to increase the production has not been very succesful.

There are only two indicators of big/state plantations which have enough data for time series analysis. These are rubber and cocoa. The correlation shows that there is no impact of roads on rubber plantations. Rubber big/state plantations are only found in some kabupatens such as Deli Serdang and Simalungun. The rubber state plantation area decreased in the last 10 years but on the other hand private entreprises have expanded the rubber planted area. The marketing city for rubber is Medan. The two kabupatens of Deli Serdang and Simalungun are well connected to Medan by rail. Rubber is one of the main export commodities from the province.

Cocoa plantation by small holders has increased considerably within the last 5 to 10 years except in Langkat owing to a good price in the world markets. However, Langkat land is not suitable for cocoa plantations. The cocoa plantations are mainly concentrated in Asahan. Other kabupatens which plant cocoa are Langkat, Simalungun and Tapanuli Selatan. In the 1970's when cocoa had a good price the large areas close to Medan suitable for cocoa was in Asahan. In 1980, the road which links Asahan to Medan was greatly improved. This has stimulated the cultivation of the area in Asahan for cocoa. In general, the areas where cocoa are planted have no access to the railroads. Although the total road network strongly influences expansion, the correlation shows that expansion is also correlated with good and sufficient conditioned roads. Roads in bad and very bad conditions appear to have no correlation with the expansion of cocoa planted area.

Tea plantations in North Sumatera have a long history. The plantations which were established before the Indonesia independence year, 1945, have not expanded much. Tea plantations are only run by state companies. Tea production in North Sumatera does not have a good world market as compared to tea products from west Java. They are supplied particularly for the regional needs, North Sumatera and the provinces in its surrounding area.

The expansion of tea planted areas takes place in the vacant land close to the existing plantation areas. Such a financial situation in the tea plantation enterprises combined with the high price of land prevents them from expanding the area to the roads which are in good and sufficient conditions. This is illustrated in Table VI.2 which shows that the provision of roads in bad condition has a good correlation with the tea planted area.

The correlations between road condition and areas of coconut plantation are significant at 5 per cent level. Suitable land for coconuts is found only in the area along the coast either in the western or eastern part of North Sumatera. There has been an increase of coconut planting by small holders in recent years. Like the coconut, palm oil is an export commodity, and its plantation areas have been substantially influenced by the increase in the number of good and sufficient condition roads. The areas planted with palm oil are mainly located along the roads which link Medan to kabupaten towns. This kind of enterprise seems to shift the site of its operations to make it more accessible to markets.

A 'step father system' has been adopted for small palm oil holders. Big companies protect and promote the growth of the small holders surrounding them. The dependency of small palm oil holders on their 'step father' is very strong since they need big plantation factories to process their raw materials. The dependency of small holders on the big enterprises appears to be linked to the location of the big plantation along good condition roads as well.

Rubber cultivation has been developed since the 1970s through government efforts to stimulate small scale enterprises involved in agriculture. The government provided a wide range of opportunities to the private enterprises to cultivate vacant land where accessibility had been provided along the roads in good condition. Therefore, rubber plantations have expanded and most of the growth is attributed to planting of high-yielding varieties. Local rubber is the most stable of crops. Much of the mature rubber has been tapped for several years owing to an unfavourable price structure. The increasing use of high yielding varieties may be partly attributable to extension efforts and subsidy schemes, but the actual production change from year to year appears to be a responsive to price changes.

Unlike big rubber plantation, traditionally planted rubber, called 'village rubber', does not use high-yielding varieties and they are found only on scattered sites closed to kabupaten towns. The majority of the mature rubber trees in this type of plantation are not presently tapped because of the relatively low price now prevailing. However, almost all villages produce some rubber for minimum cash income needs. The 'step father system' which was promoted by government works in the palm oil enterprises does not seem to work in the rubber plantations.

In North Sumatera, it appears that agricultural land is not stimulated to increase for expansion but the areas along good and sufficient condition roads which are planted by food crops tend to shift to palm oil and cocoa. Almost all the areas belong to big plantations. There was a similar experience with Malaysian's but the shifting of the area is from rainfed cultivated rice and maize into irrigated rice.

Unlike palm oil, coffee plantations do not show a good correlation with road lengths regardless of road condition. In general, coffee is planted by small holders who live in kecamatan towns or villages. This situation is different from those of rubber or palm oil small holders who live in Medan or kabupaten towns.

Cassava, sago, ginger are not shown in Table VI.2 because these types of commodities were planted during the current years so it has not been possible to calculate the correlation relationships with the road indicators. It is possible that those types of new commodities are a result of the road improvements. If it is true the role of roads is an a priori condition for introduction of the new commodities into the study's areas.

Calculated from table VI.2, it shows that only 30 per cent of the coefficients have good correlation between good condition roads and selected agricultural indicators. This indicates that the role of good condition roads to stimulate land use expansion is relatively small. The similar situation also occured within total length of roads and land use indicators. The total road network is not significant with land use expansion. Another indication shows that type of roads have a different responce to land use development. This also indicates that bad condition roads take more time than better condition ones to stimulate land use expansion.

Investment and Employment

The previous section discusses the impact of roads on land use development and this section is to attempt to discuss the impact on investments. Chapter V has discussed the trend of those investment indicators. In general, it appears that the investment was more concentrated in the primate city of the province under study and its surroundings. This section will investigate whether this concentration has been influenced by road provision. The coefficients of correlation betwen roads and the investment are presented in Table VI.3.[8]

Twenty-six indicators which have been selected to represent investment and employment in the study of the province. The selection was limited by the availability of data. The data sources are local government and sectoral agencies which operate each sector.

Table VI.3 illustrates that capital formation in North Sumatera is positively correlated with an increase in roads in either good and sufficient condition. Although there are good correlation with bad conditioned roads in lagged time, this may show that almost all potential resources in which capital is invested are only in the primate city of the region, kabupaten towns and kecamatan towns. The increase in investment along improved roads, in general, indicates that capital formation stimulates the economic activities only up to kecamatan's towns.

Identifing the impact of this capital formation on regional development can be looked at by splitting it into small categories. Capital investment in North Sumatera, can be

8. The computation of the coefficients of correlation follows the stages which has been described in the section VI.3.

Table VI.3 Coefficient of Correlation Between Length of Roads and Investment/Employee Indicators in Time Series 1975-1985 (without 1977 and 1979)

Indicators	Level of Road Condition				
	Good	Suff	Bad	VBad	Total
(1)	(2)	(3)	(4)	(5)	(6)
1. Capital Formation	+0.7739	+0.9329	+0.7642[a]	-0.3108	+0.9573
2. No of Domestic Cap. Estab.	+0.2988	+0.4929	+0.6778	-0.1049	+0.5561
3. No of Domestic Employees	+0.3833	+0.5106	+0.6860	-0.2326	+0.5992
4. Domestic Investment	+0.6516	+0.8335	+0.6587	-0.1520	+0.8493
5. No of Foreign Cap. Estab.	+0.8289	+0.8517	+0.6764	-0.4812	+0.8472
6. Foreign Estab. Employees	+0.8502	+0.8718	+0.8825	-0.5314	+0.8638
7. Foreign Investment	+0.8175	+0.7586	+0.7462	-0.6301	+0.6811
8. No of Industry Estab.	+0.3184	+0.4729	+0.6993	-0.2804	+0.4826
9. Input Costs Big/Med. Ind.	+0.7009[a]	+0.7350	+0.8654	-0.4340	+0.8330
10. Output Costs Big/Med.Ind.	+0.6285	+0.7710	+0.6954	-0.3778	+0.8239
11. Indirect Taxes Big/Med In.	+0.8859	+0.7970	+0.6088	-0.7317	+0.9312
12. Employees Big/Med. Ind.	-0.4661	+0.2503	+0.1035	-0.3531	-0.2927
13. Agri. Small Scale Loan	+0.7224	+0.9312	+0.6551[a]	-0.3233	+0.8962
14. Ind. Small Scale Loan	+0.7476	+0.9121	+0.6993[a]	-0.3127	+0.8907
15. Trade Small Scale Loan	+0.7149	+0.9419	+0.7183[a]	-0.3021	+0.9440
16. T'port Small Scale Loan	+0.8400	+0.9369	+0.7194[a]	-0.3079	+0.9635
17. Other Small Scale Loan	+0.6866	+0.9303	+0.7234[a]	-0.2789	+0.9416
18. Total Bank Loan	+0.7179	+0.9442	+0.7184[a]	-0.2966	+0.9433

Table VI.3 (Continued)

Indicators	Good	Suff.	Bad	V.Bad	Total
19. Electricity Sold	+0.8429	+0.9368	+0.3972	-0.3865	+0.9766
20. No of Village Cooperative	+0.6213	+0.9359	+0.6983	-0.5070	+0.9177
21. No of Coop. of Any Kinds	+0.6197	+0.9391	+0.7066	-0.4905	+0.9281
22. Cooperative Investment	+0.6576[b]	+0.8005	+0.5903	-0.1902	+0.8261
23. No of Gen. Truck Wagons	+0.8385	+0.9274	+0.6614[a]	-0.3482	+0.9692
24. No of General Buses	+0.7343	+0.9241	+0.3970	-0.2186	+0.9625
25. No of Bus Enterprises	+0.8868	+0.8717	+0.6347[a]	-0.3494	+0.9172
26. Priv. Consump. Exp'ture	+0.7726	+0.9535	+0.7443[a]	-0.3139	+0.9703

These figures are calculated from Table V.12 and Table VI.1.

[a] significant relationships with lagged variables
[b] significant relationships with lagged variables

divided into two categories, which are, foreign and domestic investment. Domestic investment has two types, which are registered in North Sumatera Regional Investment Coordination and which follow the normal procedures. The domestic investment is used here as a term for the first one, which is registered as North Sumatera Regional Investment.

The number of domestic investment show a good correlation with all type of roads except with very bad conditioned road. A similar situation, foreign investment show a positive correlation with the roads of good,sufficient and bad conditions as well. There is no relationship between the number of domestic investment employees and establishment and road indicators except with roads of bad condition but a positive relationship is found between the number of foreign investment employees and road measures in good, sufficient and bad conditions.

The number of industries in North Sumatera has a positive correlation only with roads of bad condition. This finding may illustrate that the small scale industries which are the largest in terms of establishment are located along roads which link between kecamatan towns. There is no data on the number of types of big/medium industries available over time. Input and output costs in this type of industries also show positive correlation with roads in good, sufficient and bad conditions respectively. Indirect taxes collected by government from these big and medium industries show a positive correlation with all types of roads except with very bad condition. However, employees and road conditions do not correlate with each other. There is no data available on small scale industry establishments.

There is also no available data on small scale enterprises except a small amount of loans allocated to that sector by banks in North Sumatera. Total bank loans in small scale enterprises can be classified into such categories as agriculture, industry, trade, transport and services. A correlation of all subsectors of small scale loans with road measures shows similar results with the correlation of total bank loans to road measures. Total bank loans have a positive correlation with the roads in good and sufficient, respectively and bad condition in lagged time relationship.

New enterprises came to the agricultural sector to get benefit from credit facilities and established businesses particularly in planting sweet potato, palm oil, coffee, rubber and peanuts. The open market to the kecamatan town shows that this stimulates other jobs than agriculture, such as industry, transport and trade. This expands the market structure from second class traders to third class traders who are residents of kecamatan towns. It may indicate that villages have not got much benefit from road provision during the study's period.

Road improvement seems to have had the effect of encouraging traders to establish their shops to kecamatan towns and they commute to villages to collect the commodities. In general, both traders and farmers have long relationship. The evidence seems to conform with the view that road improvement, so far, has benefited mostly traders as far as crop marketing patterns are concerned.

Another measure of industrialization which is often used is the amount of electricity sold. The correlation in Table VI.3 shows the same result as that which has been illustrated by the small scale enterprise bank loans, except with bad conditioned roads. Electricity sold has a positive correlation with roads in good and sufficient condition, respectively, and it also has a good correlation with total road lengths.

Based on the Indonesia national ideology, cooperatives have the dominant role in the national economy. In reality, cooperatives can not compete with private enterprises although goverment has attempted to promote their role in the national economy.

The role of roads in promoting the government's aims is very important. The number of cooperatives of any kind and the number of village unit cooperatives are highly correlated with roads of all types and total road length except very bad condition. Although the coefficient of correlation shows that the number of cooperative investments has a good correlation with roads in good and sufficient respectively it, however, does not have correlation with bad and very bad conditioned roads.

What is the impact of roads on transport enterprises? Three indicators are selected which are: the number of general truck wagons, the number of general buses, and the number of bus enterprises. The number of general truck wagons has a good correlation with types of roads except to those of very bad condition and the number of general buses has a good correlation only with roads in good and sufficient condition. The number of bus enterprises have a good correlation with any type of road condition except with very bad condition. Private consumption expenditure in the province of North Sumatera shows good correlation with roads in good, sufficient and bad condition, respectively.

Table VI.3 shows that 77 per cent of the coefficients of correlation between good structural condition roads and the selected indicators reflect strong relationships. This shows that good condition roads have an important role to induce the investment/employee development in North Sumatera. This also suggests that road network as a whole is very important in stimulating investment development in North

Sumatera. Similarly with agricultural land use, in terms of time, it appears that the type of roads has a different kind of response with respect to stimulating investment developments.

Inter-Regional Trade

i. Sea Ports

This section's aim is to investigate the influence of roads on the roles of those ports which promote inter-regional trade in terms of loading and unloading. As explained in Chapter IV, North Sumatera has many ports although three ports are the most important. These are Belawan, Sibolga and Tanjung Balai. The importance of these ports as inter-regional trading ports is promoted by subregional growth centres. Sibolga in the western part of Sumatera is expected to be as a counter pole to Medan and its port, Belawan, in the future.

Another port which plays an important role is that of Pangkalan Susu. This port handles exported oil and gas and it is linked to the oil and gas stations by pipes. Besides oil, only a small volume of the surounding areas, needs are loaded and unloaded in this port. Polonia, as a main airport in the province, has the role of promoting inter-regional trade but until 1985 it had only a small volume of goods/commodities loading/unloading compared to other sea ports.

Table VI.4 shows that roads do not have good correlations with either the total volume of exports or imports from/to North Sumatera.[9] The total export value from

9. The coefficients of correlation in Table VI.4 are computed follows the stages which are described in Section VI.3.

Table VI.4 Coefficients of Correlation Between Length of Roads and Interregional Trade Indicators in Time Series 1975-1985 (without 1977 and 1979)

Indicators	Level of Road Condition				
	Good	Suff	Bad	VBad	Total
(1)	(2)	(3)	(4)	(5)	(6)
1. Export Volume from N.S.	-0.0844	-0.2854	-0.2033	+0.2860	-0.1027
2. Import Volume from N.S.	+0.2651	+0.1357	-0.0404	-0.5241	-0.0206
3. Export Value from N.S.	+0.8559	+0.7132	+0.0141	-0.1146	+0.8368
4. Import Value from N.S.	+0.2900	+0.0998	-0.0994	-0.5892	-0.0181
5. Export Vol. from Belawan	+0.5632	+0.5078	+0.0963	+0.5647	+0.7654
6. Import Vol. from Belawan	+0.3547	+0.6103	+0.7789[a]	+0.4437	+0.7555
7. Export Value from Bel.	+0.3525	+0.0039	+0.0736	+0.1365	+0.3130
8. Import Value from Bel.	-0.3846	-0.6745	-0.2812	-0.6561	-0.9070
9. Export Vol. from P.Susu	+0.0208	-0.6863	-0.8671	-0.0690	-0.6161
10. Import Vol. from P.Susu	-0.5734	-0.7201[a]	-0.1886	-0.6460	-0.8574
11. Export Value from P.Susu	-0.3095	-0.8327	-0.4783	-0.5737	-0.9373
12. Import Value from P.Susu	+0.7515[a]	+0.7631	+0.3878	+0.3073	+0.4400
13. Export Vol. from Sibolga	-0.7963[a]	-0.6717	-0.1584	-0.8913[a]	-0.7612[a]
14. Import Vol. from Sibolga	-0.2523	-0.1228	-0.2092	-0.4229	-0.5075
15. Export Value from Sibolga	-0.7891[a]	-0.6554	-0.1425	-0.8957[a]	-0.7395[a]
16. Import Value from Sibolga	-0.7373[a]	-0.7225[a]	-0.6307[a]	-0.8923[a]	-0.7901[a]
17. Export Vol. from T.Balai	+0.4218	+0.8203	+0.6191[a]	+0.5764	+0.9345
18. Import Vol. from T.Balai	+0.3738	+0.6753	+0.7870[a]	+0.5800	+0.8575
19. Export Value from T.Balai	+0.3950	+0.8340	+0.4341	+0.5698	+0.9190
20. Import Value from T.Balai	-0.2089	+0.5349	+0.2296	+0.3310	+0.4084

Table VI.4 (Continued)

Indicators	Good	Suff.	Bad	V.Bad	Total
21. Export Vol. from Polonia	+0.3971	+0.7065[a]	+0.0512	-0.7555[a]	+0.4823
22. Import Vol. from Polonia	+0.2377	+0.6777[a]	+0.6751	+0.1573	+0.6263
23. Export Value from Polonia	+0.6019	+0.6367	+0.6630[a]	+0.6480	+0.6941
24. Import Value from Polonia	-0.6285	-0.7411	-0.8292[a]	-0.8015	-0.9332
25. Expenditure on Export	+0.8397	+0.8465	+0.2460	-0.1939	+0.9617
26. Expenditure on Import	+0.7552	+0.8427	+0.3526	-0.1531	+0.9461

These figures are calculated from Table IV.10 and Table VI.1

a significant relationships with lagged variables all ports in North Sumatera has a good correlation with roads of good and sufficient condition respectively and with the total length of roads. The total import value from North Sumatera's ports does not have a good correlation with any road measures. This may show that the demand for imported goods is centred mainly in big towns, Medan in particular. The different results between export volume and export value to road lengths show that the export volume of North Sumatera varies but it is dominated by commodities with low weight/high value per volume such as palm oil and natural oil.

Pangkalan Susu is the main oil port and therefore, commodities loaded are not varied. Both the value and volume of export commodities show a negative correlation with the total length of roads. The role of this port, however, has decreased since another port in the province of Aceh, Lhok Seumawe, 300 kms from Pangkalan Susu, has been improved. Ninety-five per cent of oil production in northern Sumatera (Aceh and North Sumatera) is produced at Aceh. The provision of roads in North Sumatera induces the decline in the role of Pangkalan Susu as an inter-regional port.

Belawan, 22 kms from Medan, is a main port in northern Sumatera and it is the fourth biggest port in Indonesia in terms of value and volume of imported and exported commodities/goods. Export volume from Belawan provides a good correlation with the total length of roads but it has a low correlation with any types of road condition. This shows that the total road network despite the types of road condition can stimulate the inter-regional export commodities. The export value does not show a good correlation with any total roads length.

The above findings indicate an opposite result for North Sumatera export volume and value. The different results between export volume and value to road lengths illustrates that the exported commodities are varied. North Sumatera's exports are dominated by commodities which have high weight but low value per unit volume. Exports from Belawan also show that the exported commodities are varied but they are dominated by high weight and low value per unit volume commodities/goods such as cement and agricultural produce.

Import volume from Belawan shows a good correlation between roads in sufficient condition and the total length of roads. A similar condition exists for import value from Belawan. This illustrates that the value per unit volume of imported goods is not as widely varied as the exported commodities are.

Sibolga, a 66,000 population port town, which is located in the western part of North Sumatera, is a centre of growth in the area and a counter-pole of Medan in the future. The provision of roads here shows a different outcome. The exported volume of commodities shows a good but negative correlation with the roads in sufficient condition including total road length and with good condition in lagged relationship. This illustrates that the decline of export volume from Sibolga is influenced by the improvement or provision of roads particularly the availability of linkages from Medan to almost all kecamatan towns. A similar situation exists for exported value. It has been shown that Sibolga handles commodities whose value to unit volume or type of commodity is not widely varied. Oil and palm oil are not loaded in this port.

The import volume of Sibolga does not show a good correlation with the road lengths but import value have a good correlation with any type of roads in the lagged relationship. This also indicates the view that imported goods do not vary widely in terms of value per unit volume. The import might be dominated by cement from Padang, West Sumatera. This negative finding of correlations also illustrates that road network improvements encourage the distribution of cement from Medan.

Tanjung Balai is another important sea port in North Sumatera. Different findings from Sibolga are recorded here. Export volume and value from this port provide a positive correlation with total road lengths and particularly with the roads of sufficient condition. This finding demonstrates that the provision of roads can stimulate this port as a prospective centre of growth in its subregion in the future.

The Tanjung Balai import volume shows a positive correlation with total road lengths and particularly with roads in the sufficient condition. On the other hand, the relationship between import value and roads provision does not show a similar outcome. This illustrates that the types of goods unloaded in this port are widely varied in terms of low value per unit volume, eg. agricultural commodities.

ii. Airports

Polonia, as the main airport in North Sumatera located in Medan, does not play an important role in inter-regional trade. Loading and unloading in this airport was only 0.3 per cent of the total loading and unloading in the province in 1985. Export value shows that they have a good correlation with any type of roads. Export volume is not influenced by provision of roads except with sufficient conditioned roads in lagged relationship. Import value are negatively correlated with any type of roads. There are no available data to identify the types of goods which are sent through Polonia.

Calculated from Table VI.4, it shows that 70 per cent of the their coefficients of correlation are significant correlated. It seems that roads in sufficient condition induce most activity in inter-regional trade. It also appears that the influence on good condition roads have a less significant influence on inter-regional trade. Medan and kabupaten towns as marketing and collector centres are likely to maintain a good trade relationship with the rural areas whether or not the linkage roads are in good condition. Similarly with roads and investment indicators, it also appears from Table VI.4 that the total network of roads is very significant in stimulating the interregional trade. Seventy per cent of the coefficients of correlation are significant at the 5 per cent level of confidence.

Government Activities

Table VI.5 shows the coefficient of correlation between road lengths of any condition and government activities.[10] Government activities are defined here as activities which are involved with budget allocation including subsidies, transport budgets and tax collection. There are 14 indicators showing these government activities.

Routine government budget allocated by the central government in North Sumatera are significantly correlated by roads in good, sufficient and bad condition. Very bad condition roads show no significant correlation with routine government budgets. Development central budget is not significantly correlated by the provision of roads of any condition level. The development budget which is defined as the ministry sectoral budget in a region is expected to play a very important role in promoting regional development. This budget is one of central government's instruments for

10. The computation of coefficients of correlation in Table VI.5 follows the stages which are dicussed in Section VI.3.

Table VI.5 Coefficients of Correlation Between Length of Roads and Government Activity Indicators Series 1975-1985 (without 1977 and 1979)

Indicators	Level of Road Condition				
	Good	Suff	Bad	VBad	Total
(1)	(2)	(3)	(4)	(5)	(6)
1. Routine Central Budget	+0.9450	+0.9647	+0.6631	-0.4970	+0.9535
2. Development Central Budget	+0.1962	+0.3764	+0.2944	-0.1034	+0.3235
3. Routine Provincial Budget	+0.8550	+0.9399	+0.7904[a]	-0.4342	+0.9605
4. Development Prov. Budget	+0.8899	+0.8638	+0.7262[a]	-0.6562	+0.9026
5. Routine Regency Budget	+0.6478	+0.8663	+0.6455	-0.7225	+0.9414
6. Development Regency Budget	+0.6435	+0.6997	+0.6828	-0.4088	+0.8155
7. Central Transport Budget	+0.8438	+0.7714	+0.7259[a]	-0.1167	+0.8266
8. Prov. Transport Budget	+0.6559	+0.8794	+0.7260[a]	-0.0509	+0.8815
9. Total Transport Budget	+0.7712	+0.8954	+0.7840[a]	-0.6307[a]	+0.9181
10.Taxes Collected by Central	+0.7631[a]	+0.7495	+0.8677	-0.4771	+0.8484
11. Taxes Collected by Prov.	+0.8592[a]	+0.9205	+0.8371	-0.7188[a]	+0.9909
12. Taxes Collected by Reg.	+0.8832[a]	+0.9258	+0.7804	-0.4539	+0.9326
13. Total Taxes Collected	+0.5877	+0.7915	+0.8785	-0.4839	+0.8868
14. Subsidize From Central	+0.6740	+0.8757	+0.7743	-0.4911	+0.9420

These figures are calculated from Table V.15 and Table VI.1.

a significant variables with lagged variables stimulating growth and alleviating inequality. The low correlation shows that the road provision does not support the expectation.

Both routine and development budgets which are allocated by provincial governments show that they are significantly correlated with roads in good and sufficient and bad condition. Since only roads at a certain level of condition influence the provincial budget within subregions in the province, it shows that the 'provincial development coordinating meeting' every fiscal year proposes projects in a certain area which have already been linked by road improvements. Most of the projects such as water supply and irrigation projects followed provision of accessibility. This situation lead to disbenefits in very remote areas.

Regencial routines and development budgets which are allocated by the third hierachy of government levels, kabupatens and kotamadyas, show that they are also significantly influenced by road provisions of good, sufficient and bad condition. This illustrates that the condition of roads has more influence on the relative amount of routine budgets when the hierarchy of government level which allocates the budgets is lower.

Transport budgets allocated by central government or by the provincial government are significantly correlated with roads in good, sufficient and bad condition. Since 1970 transport budgets have been dominated by road betterment projects of good and sufficient condition rather than new construction. The betterment projects are financed by The World Bank. The Ministry of Public Work's program to increase the length of roads by introducing gravel roads has been succesfully implemented in Kenya did not take place in North Sumatera[11].

It has already been explained that approximately 90 per cent of taxes which are collected by local government go to central government. Table VI.5 shows that taxes collected by central government are influenced by roads in bad condition, sufficient and good condition. Provincial and local taxes show that they have a positive correlation with roads in good, sufficient and bad condition. The amount of subsidies provided by central government shows that subsidies have a significantly positive correlation with roads in good, sufficient and bad condition. This is similar to what happens with respect to provincial and local taxes.

The picture of subsidy scheme shows that farm enterpreneurs in the villages (except there is no accessibility for the whole year) and the kecamatan town as well seems to be closely associated with subsidy schemes, both through direct participation and through diffusion. Villages also get benefit from road linkages as far as subsidy is concerned. Their response, to this scheme still depends on commodity prices and other factors. Therefore the effect of road improvement or linkages to remote areas on subsidy schemes, no doubt, has a short-term impact by making it feasible to commercialize local products. For a long term, the linkages of resources to supply, market price, the amount of labour required and farming input should be considered if the scheme is expected to be succesfully implemented.

11. In 1980's, Ministry of Public Work of Indonesia intensively implemented gravelly rural road. It might be a reason, they visited on going similar proyects in Kenya which is organized by ILO. The description of the Kenya rural road program is explained in DE VEEN (1980).

The length of good and sufficient condition roads influence most on the government activities which account to more than 90 per cent of all correlation as shown Table VI.5. Ninety-two per cent of the total length of roads provide significant influence on the government activity indicators. It shows that this result is similar with what occur between roads and investment and interegional trade. Total network is very significant to stimulate the distribution of government activities despite the relationships between very bad conditioned roads and government activities are weak. The findings also indicate that in term of time, bad condition roads are associated with a slower responce to the developments than better condition roads.

VI.4 Non Economic Factors

Education and Health

As stated above only formal education has been developed in the province of North Sumatera. Formal education can be classified into comprehensive schools and vocational schools as basic education before entering university. The comprehensive schools can be further classified into three levels which are for children of 6-12 years, 12-15 years, and 15-18 years respectively.

Vocational schools are schools which educate pupils in a more practical way so that after they complete their education they can go to a job straight away. One cannot go straight to university from vocational school although some universities do accept students from these types of schools if they have years of experience.

These vocational schools can further be divided into two levels which are; junior vocational schools and senior vocational schools which are at the same level as senior and junior ordinary high schools. Vocational schools can also be subdivided into study areas, such as; mechanics, building and agriculture. There are no available data on vocational schools.

Although there are private universities established in some cities outside Medan, most of them are located in Medan. The role of state universities is still very dominant. Private universities are a new development in North Sumatera. It started in the 1980s and there are no available data to show the university development trend. This is a limitation preventing this study to investigate the development and influence of higher education in North Sumatera.

Table VI.6 shows that provision of elementary schools, junior high schools and senior high schools seem to be stimulated by road length of good, sufficient and bad condition.[12] The provision of roads at the beginning of the period of study did not much affect the government policy to distribute education facilities into the remote areas. In recent years, central government realized this weakness and then they attempted to distribute educational facilities over all regions in Indonesia, including in the province of North Sumatera.

This finding seems to support the role of road provision on the literate improvement distribution. As revealed in Chapter IV of this study, the percentage of illiterate males in 1985 decreased to a half that of the 1975 estimates in urban settlement but there was no considerable change in rural illiterates. Also, the number of female illiterates in towns differ to less than half within study period but in the rural areas

12. The coefficients in Table VI.6 are computed follows the stages which has been described in Section VI.3.

Table VI.6 Coefficient of Correlation Between Length of Roads and Social Indicators in Time Series 1975-1985 (without 1977 and 1979)

Indicators	Level of Road Condition				
	Good	Suff	Bad	VBad	Total
(1)	(2)	(3)	(4)	(5)	(6)
1. No of Elementary Schools	+0.7065	+0.9090	+0.6791	-0.5468	+0.9505
2. No of Elementary Students	+0.7453	+0.8848	+0.6755	-0.6885	+0.9215
3. No of Elementary Teacher	+0.7287	+0.8700	+0.6891	-0.6020	+0.9395
4. No of Junior High School	+0.9514[a]	+0.8577	+0.7804	-0.6661[a]	+0.9411
5. No of Jun.H.Sch. Students	+0.6894	+0.8822	+0.7952	-0.7508[a]	+0.9783
6. No of Jun.H.Sch. Teachers	+0.6131	+0.8490	+0.7871	-0.6506[a]	+0.9624
7. No of Senior High Schools	+0.9570[a]	+0.9168	+0.9067	-0.8093[a]	+0.9641
8. No of Sen.H.Sch. Students	+0.9574[a]	+0.9269	+0.8059	-0.8546[a]	+0.9695
9. No of Sen.H.Sch. Teachers	-0.1491	-0.2338	-0.0243	-0.2175	-0.0690
10. No of Health Centres	+0.7079	+0.6571	+0.4837	-0.6363[a]	+0.8017

These figures are calculated from Table IV.4 and VI.1

a significant relationship with lagged variables there was no considerable change. The total percentage of illiterates was 57 per cent in 1975 in the province.

The correlation figures reveal that the role of roads which are of good and sufficient condition is very important in achieving government objectives to distribute education and health facilities. Roads in very bad conditions do not promote the distribution of educational facilities. Table VI.6 also reveals that the number of students has a good correlation with road lengths in good, sufficient and bad conditions. This situation is similar to that of the relationship between the number of schools and the provision of roads as described above.

During the period of study, it shows that 29.20 per cent of primary school male pupils and 25.68 per cent of females continue their school to junior schools. Fifty-six and fifty-three per cent of the group, respectively, continued their study to senior high schools. It shows that there is general improvement in education but females are still relatively less educated.[13] As stated above the number of schools allocated by the government seems to be influenced by road improvement. A similar situation shows that the number of teachers increased simultanously with the increase in the road length of good, sufficient and bad conditions.

The number of elementary school teachers and junior high school teachers appears to be affected by the provision of roads in good condition, sufficient and bad condition. The level of road improvment plays an important role in promoting the mobility of teachers. The roads in very bad condition within an area make the areas unattractive for teachers to settle in. There is, however, no evidence that these types of roads

13. Source of education information is 'North Sumatera in Figures' (1975 and 1985). The discussion on the educational and health facilities is presented in Chapter IV.

reduce the numbers of teachers interested in working in the rural areas. The number of senior high school teachers, unlike those in elementary and junior high schools, do not have a good correlation with the provision of roads in good and sufficient condition.

The number of health clinics also has a good correlation with the provision of roads in good and sufficient conditions. The distribution of health clinics in recent years appears to have been promoted by the increase in road lengths in good and sufficient condition.

As with to educational institutions, it appears to confirm the government's decision to provide health clinics in settlements where the accessibility is already available. It also shows that this decision to allocate health clinics is limited to kecamatan towns. This supported all the facts that within the period of study almost all kecamatan towns have clinics while the rural settlements are still without them.

Some indication from Table VI.6 shows that the length of good and sufficient condition roads have the most influence on social indicators. This accounts for 80 per cent of the total calculated coefficients of correlation are significant at 5 per cent level, respectively. Total network of roads still show very significant to stimulate the distribution of the social development indicators.

Mode of Transports[14]

As stated previously other competitive modes to the road network in the province are trains and waterways. It has been explained that rail networks and waterways do not

14. It is not fully true that mode of transport is an indicator of development. It is not a complete analysis without considering the impact of roads to other modes.

cover the whole province. It is therefore seems impossible to draw conclusions between transport mode competition at the regional level. A specific study at a specific area should be pursued in the future. However, this study attempts to draw carefully some indication which may occur between transport modes.

Railroads only carry goods and commodities in the short haul in the same way as waterways. Therefore neither mode can compete with roads for the whole region. No doubt in recent years there has been a decline in the role of railroads and waterways in passenger and goods services in the province. Airlines and sea ships are the other transport modes which connect the province to other regions, particularly to Jakarta. Polonia and Medan airports are also open to international flights which are connected to Amsterdam, Tokyo, Sydney, Kuala Lumpur and Singapore. Sealink frequencies have been discussed in the beginning of this report.

Plantation crops which are carried by rail have declined during the last ten years. There is no indication that the decline was caused by the provision of roads of any types, since the tonnage of plantation crops has no correlation with road networks. In general, plantation crops are carried by buses with passengers as their personal marketing produce. This is similar to **HAY (1973)**'s experience in Nigeria. The role of both truck and trains in the transport of crops is very low.

Quarrying products carried by train increased during the last 10 years. This increase was influenced by the increase in road lengths in sufficient and bad conditions. The improvement of roads to good condition, however, does not have significant correlation with the products carried by trains. The increase in road length stimulates cultivating of quarrying extensively.

Table VI.7 Coefficients of Correlation Between Length of Roads and Volume of Commodities/Goods Transported By A Transport Mode in Time Series 1975-1985

Indicators	Level of Road Condition				
	Good	Suff	Bad	VBad	Total
(1)	(2)	(3)	(4)	(5)	(6)
1. Crops by Train	+0.2415	-0.0543	+0.4854	+0.8360[a]	+0.4236
2. Quarrying Product by Train	+0.2945	+0.6250	+0.7235	+0.7625[a]	+0.7304
3. Fertilizer by Train	-0.1218	-0.6700	-0.1311	+0.9926[a]	+0.9017[a]
4. Cement by Train	-0.1254	-0.7678	-0.2850	-0.2778	-0.5791
5. Forestry Product by Train	-0.7605[a]	-0.6616	-0.2171	-0.2332	-0.5615
6. Total Comm/Goods by Train	-0.1902	+0.8102[a]	+0.6799	+0.9034[a]	+0.9844[a]
7. No of Ship Using Waterways	+0.3796	-0.8451	-0.9895	-0.9698[a]	-0.6321
8. Passenger by Waterways	+0.2857	-0.6961	-0.9372	-0.9192[a]	-0.8102[a]
9. Goods by Waterways	+0.3870	-0.7592	-0.9537	-0.9258[a]	-0.7897[a]
10. Passenger from Sibolga*	-0.7507[a]	-0.8275	-0.4514	-0.7228	-0.7070
11. Passenger from Meulaboh*	-0.3392	-0.6903	-0.6503	-0.6639	-0.9583
12. Passenger from B.Aceh*	-0.1369	-0.7490[a]	-0.6730	-0.9148[a]	-0.9939[a]
13. Passenger from P.Baru*	-0.1654	-0.6022	-0.8719	-0.9334[a]	-0.8344
14. Passenger from Abroad*	-0.6449	-0.8865[a]	-0.1419	-0.2156	-0.4877
15. Passenger to Sibolga*	-0.6805[a]	-0.8100	-0.4345	-0.7316	-0.7047
16. Passenger to Meulaboh*	-0.3288	-0.6940	-0.6277	-0.6712	-0.9500
17. Passenger to B.Aceh*	-0.2989	-0.8373[a]	-0.3659	-0.2573	-0.6358
18. Passenger to P.Baru*	-0.2027	-0.7815[a]	-0.8506	-0.9156[a]	-0.8389
19. Passenger to Spore/M'sia*	-0.6366	-0.8988[a]	-0.2787	-0.3186	-0.6182
20. Passenger to Padang*	+0.0521	+0.5341	-0.0516	+0.2683	+0.2144
21. Passenger to Jakarta*	+0.3569	+0.5958	+0.0404	-0 9049[a]	+0.4859

* Using Medan Airport 'Polonia'
These figures are calculated from Table IV.6, IV.7, IV.8 and VI.1.

a significant relationship with lagged variables

There was an increase in the use of fertilizers on agricultural crops other than paddy. The use of fertilizers has declined since the land use planted by paddy and food crops in some subregions has decreased. Thus it is speculated that the increase in fertilizers is due to vegetables and fruit production.

Fertilizers carried by trains declined and the evidence shows that the decline was influenced by the provision of roads in sufficient condition. This happened because crops which need fertilizers are planted in the area along roads which link kabupaten towns and kecamatan towns and other settlements in the kabupatens. These findings show that low level of road conditions may reduce farmer interest in using fertilizer.

As explained above, cement comes to the province from two ports, those of Belawan and Sibolga. The.cement which comes from Belawan is from the Banda Aceh in the province of Aceh and that which comes from Sibolga originates from Padang in the province of Western Sumatera. Trains carry mainly cement from Belawan which is distributed to the regencies in which the railroad pass. There are no railroads which connect Sibolga to its surrounding areas.

Table VI.7 shows that the cement which is carried by rail is decreasing and that this is influenced by an increase in roads in sufficient condition. This is also the case with fertilizers.[15] A reason for this might be an increase in roads of sufficient condition to attract trucks or other modes of transport to carry cement. This investigation reveals that cement is used for buildings mainly in kecamatan towns. Housing in the other settlements of a lower hierarchy than kecamatan towns use timber or bamboo

15. The stages of the computation of the coefficients in Table VI.7 follows the description in the Section VI.3.

rather than cement for building. Roads of sufficient condition have a negative correlation with forestry products carried by rail.

The number of ships, passengers and goods using waterways are greatly influenced by roads in sufficient, bad and very bad condition. The provision of roads of the types as explained above reduces the use of waterways. It has been revealed that the provision of roads at certain improvement levels has a negative impact on the use of waterways. The total length of roads decreases the use of this mode of transport. This situation also reveals that the role of trucks has improved when roads are improved into better condition. However, this understates the importance of trucks in commodity transport because most trucking is in the hands of the merchants. The farmer will deliver his product to the merchant, who is the point of sale; the farmer does not actually travel in the truck to a larger market place.

The provision of roads in North Sumatera has a negative correlation with the number of passengers using air flights to the four towns, of Sibolga, Meulaboh, Banda Aceh and Pakan Baru. The number of passengers departing to Banda Aceh shows that there is a negative correlation with road lengths. People who want to visit Banda Aceh tend to go there through Medan. The results show that the trips to Medan are reduced if the roads linking Medan to other places are in bad condition. The number of passengers departing to Pakan Baru shows that there is a negative correlation with roads in sufficient, bad and very bad condition.

It appears that road improvement in the province stimulates an increase of road transport mode user for short distance travel and consequently the number of air users declined. A different result occurred for long distance travel as shown by correlation between the number of air mode users and the length of roads. It implies that for long-distance travel, road improvement has benefited primarily those who were already travelling prior to the project and, that it has not induced significant change in travel pattern among the previously non-mobile population. It also shows that there was not a great deal of more personal travel now than before the period of study.

The indication from Table VI.7 shows that the length of sufficient condition roads has the most influence on transport modes. This accounts for more than 80 per cent (10 per cent positively and 70 per cent negatively correlated) of the total calculated coefficients. The good condition of roads only account for 10 per cent negatively correlated of the total calculated coefficients. Less than 75 per cent of correlation coefficient between the total length of roads and transport mode indicators are significant. The findings also indicate that the responce of very bad conditioned roads to influence the user of other mode is slower than the other type of roads.

VI.5 Conclusions

Previous sections of this chapter have discussed the input side of the regional economy and investigated whether they have correlations with the road development over time. This chapter has been concerned with studying the exrent to which the shifts of land use and the distribution of economic factors, as discussed in Chapters IV and V, have correlations with the provision of roads.

Only some commodities show that they have good correlations with road provision, thus, reflecting their special background. Sweet potatoes and peanuts are the most profitable crops during the period of study. However, the provision of roads also attracts big enterprises including state enterprises to the subregion which have a locational advantage at the area closed to Medan and this has results in shifting the peanut planted area to palm oil. The decrease in the planted areas in the subregions close to Medan has given the opportunity to other subregions which are relative longer distance from Medan to grow this commodity to fulfil the present demand.

The demand for peanuts is still relatively stable but the demand for sweet potatoes has decreased during the study period. The decrease in sweet potato planted areas has not been followed by an increase of this area in other subregions. It appears that sweet potato planted areas have shifted their priorities to growing palm oil and cocoa as well. In general, the provision of roads, has only played a small role in promoting the expansion of agricultural land use, during the period of study.

There are only four investment indicators which do not have a good correlation with the total length of roads. They are, number of domestic capital establishments, the number of domestic employees, the number of industry establishments and the number of employees in big/medium industries. The distribution of investments during the period of study can be classified into three categories: (1) more concentration on Medan and its hinterland such as foreign and big/medium investment, (2) no significantly change of distribution and (3) more wider spread distribution such as small scale loans and cooperatives. Road network shows a significant influence on the attraction of investment into the area of study but it seems that they do not have an effect on the type of the concentration.

As stated previously at the beginning of this study, planning area units have been established in the province to distribute development in the study area. The growth centres of three of the four planning area units are ports. It is expected that the ports can stimulate the development of their influence area by promoting interregional trade. However, the aim of the establishment of planning area units has not been completely achieved. The interregional trade of the province is more concentrated in Medan although there is some evidence that Tanjung Balai also has a considerable increase in interregional trade. Sibolga's interregional trade has declined. It appears that provision of roads during the study period had a considerable impact on this outcome.

Government activities either through budget allocation or tax collection show that they have been distributed well among subregions. This may indicate that the provision of roads had a considerable impact on this distribution. During the study period, it is seen that education and health facilities were well distributed. The role of road provision to stimulate this kind of distribution appears to be very significant.

It is impossible to compare between roads and other transport mode at a regional level since other transport modes do not cover the whole region. However, it would appear that other transport modes in the province than roads have been influenced negatively by the provision of roads except long-distance air transport such as Medan to Jakarta. It shows that for short-distance travel roads play the most important role.

Comparing the positive and negative impacts of roads on development, it appears that the positive impact of roads on investment, government and social activities is more significant than the negative impacts. On the other hand, the negative impact of road provision and improvement on other transport modes is more significant than positive impact. The role of road length and improvement is positively significant with loading/unloading in the ports on the eastern coast of North Sumatera particularly with Belawan (Medan port) which has better facilities and has been well established. The role of roads is negatively significant in the smaller ports and those which locate on the western coast of North Sumatera.

VII. ROADS AND THE REGIONAL ECONOMY

VII.1 Introduction

Chapter VI discussed the correlation between the provision of roads and regional development; land use, investment, government activities, interregional trade, education and health, and transport modes. The outcome suggests that except for land use, the increase of road length is significant on the trends of the other development indicators during the period of the study. In the agricultural sector, in North Sumatera's experience, it appears that provision of roads does not significantly influence land use expansion, particularly in food crops.

The previous chapter also shows that roads of good and sufficient condition are more significant on promoting regional development than roads of poor condition. The next section concentrates more on the regional economy in the sense of GDP and identifies the level of contribution of roads the economy. The technique of the analysis which is adopted is multiple regression analysis, as explained in the Chapter III of this study.

The second stage of the analysis in this chapter looks at the size of distribution of income and investigates whether roads play a role on the distribution process. The technique which is used is simple regression analysis. The last stage of the analysis is an attempt to investigate the role of roads on subregional economic position. At this stage, other factors of accessibility, road density and village accessibility, are taken into account. The technique used for this purpose is discriminant analysis.

VII.2 Roads Condition and Regional Economy

As described previously, economic factors can be disaggregated into land use, capital, employment and technology. In developing countries includes Indonesia, it is difficult to see the accurate data about employment and measurement of technology. Both indicators are always aggregated into capital investment. The macro economic approach considers that export and import from/to a region influence the growth of the region, either to increase or decrease.

In general, in Indonesia, land uses are classified into three categories, crop land use, small holder land use and big plantation including those run by state enterprises. Big plantation land use data are given in two classifications which are, 'only productive area' and 'productive area plus not yet productive area'. Although the types of commodities produced are similar between small holders and big plantations, the way data is collected is slightly different. Data is not available on the 'not productive area' in small holders.

Capital formation in North Sumatera from 1975 to 1986 have been calculated and can be found in (BPS SU, 1984) and (BPS SU, 1986). Government expenditure is not included in the private capital formation after substracted from total capital formation. There are no detail data to show disaggregation of the capital formation. The only data can be collected from the local authorities related to the capital formation are in the big/medium industry sector, domestic and foreign investment. There are no data of small scale industries are found. As it has been explained at the begiining of this study, the realiability data is still questionable. But since there is no other sources to confirm or to reject these data, these data are still used at least to give some indication which may occur in the province of study as the impact of transport.

Export/import value and tonnage can be colected from Belawan port authority from 1975 to 1986. The value and the tonnages of export and import commodities/goods from airport will not be taken into account. The difficulties are to collect data on export/import from/to North Sumatera through land transport. Therefore the export/import volume which are presented here avoid the value of import/export using land transport.

Table VII.1 shows the coefficients of correlation between development indicators. Although crop land use has a good correlation with export value but it has no correlation to the total land use development in North Sumatera. Small holders have a good correlation to big plantation land use but not to total land use. It shows that the role of big plantation as 'step father' to small holders become very important. The strong correlation between big plantation land use and total land use which illustrates that the expansion of land use since 1975 is much dominated by big plantations. There are strong correlations between GDP per capita and small holders, big plantation and total land use expansion respectively.

Capital formation shows a strong correlation with either medium/big industry input or medium/big plantation output and domestic investment. The table shows the weak correlation between foreign investment to either capital formation or its disaggregation. The weak relationship also exists between foreign investment and GDP per capita. This proves that the foreign investment do not play an important role in promoting regional growth in North Sumatera.

Table VII.1 also shows that government expenditure has a strong correlation to most indicators except to crop land use and foreign investment. It also has a good

Table VII.1 Coefficient of Correlation Between Development Indicators

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
A. Crop Land Use	-																
B. Small Holder Land Use	0.2564	-															
C. Big Plantation Land Use A	0.3445	0.9617	-														
D. Big Plantation Land Use B	0.3521	0.9390	0.9598	-													
E. Total Land Use A	0.2811	0.2811	0.9817	0.9347	-												
F. Total Land Use B	0.2887	0.2887	0.9805	0.9593	0.9958	-											
G. Medium/Big Industry Input	0.3207	0.9489	0.8905	0.8663	0.9241	0.9260	-										
H. Medium/Big Industry Output	0.3163	0.9379	0.8928	0.8783	0.9123	0.9175	0.9946	-									
I. Domestic Investment	0.2729	0.8833	0.8363	0.8517	0.8590	0.8732	0.9307	0.9442	-								
J. Foreign Investment	-0.2556	-0.1893	-0.2291	-0.3570	-0.1855	-0.2304	-0.1586	-0.1997	-0.4498	-							
K. Capital Formation	0.1211	0.9864	0.9399	0.9200	0.9684	0.9723	0.9193	0.9106	0.8474	-0.1278	-						
L. Government Expenditure	0.1209	0.9475	0.9563	0.9497	0.9452	0.9543	0.8615	0.8717	0.8152	-0.1622	0.9691	-					
M. Export Value	0.6244	0.2892	0.3480	0.2943	0.3409	0.3277	0.3292	0.3240	0.4093	-0.1744	0.1879	0.2037	-				
N. Import Value	-0.3197	-0.9382	-0.9670	-0.9322	-0.9622	-0.9621	-0.8774	-0.8787	-0.8764	0.2613	-0.9121	-0.9321	-0.5017	-			
O. Export-Import Value	0.4270	0.8750	0.9140	0.8716	0.9080	0.9049	0.8328	0.8326	0.8508	-0.2679	0.8279	0.8486	0.6693	-0.9785	-		
P. North Sumatera GDP Total	0.1059	0.9686	0.9543	0.9262	0.9659	0.9677	0.8802	0.8760	0.8022	-0.0877	0.9888	0.9887	0.1951	-0.9265	0.8418	-	
Q. North Sumatera GDP Percapita	0.1304	0.9692	0.9665	0.9519	0.9678	0.9742	0.8957	0.9010	0.8568	-0.1990	0.9812	0.9933	0.2164	-0.9468	0.8645	0.9902	-

The figures are calculated from Table V.11, Table V.12 and Table VI.1.

correlation with GDP per capita. This proves that government decisions to allocate the budget in the subregions within the province may not consider the interest of the small scale farmers.

Import values have more influence on development indicators than export values. Export value only has a strong correlation with crop land use. It also has a weak correlation with GDP per capita of the province. The import value influences most indicators negatively. Although import value and export value have good correlation with the difference between their value, the import value has a stronger correlation.

A possible approach to the theory of regional growth is to adopt models originally developed for the national economy to a regional context. These models can be categorized into three groups which are: macro-economic, input-output and regression. The first two models have been developed by many authors based on demand and supply approaches, as has been discussed in the Chapter III of this study. The third one is more simple to construct and shows a relationship between independent and dependent variables.

As Adelman described economic factors, **RICHARDSON (1979:pp 331)** constructed a model based on the neoclassical approach which concentrates on the supply side. The rate of growth in income is determined by three elements: capital accumulation, an increase in labour supply, and what may be broadly called technical progress. It is assumed that the rate of technical progress is, within each region, a constant function of time. Given a production function for the i-th region of the following model:

$$Y_i = f_i(K, L, t) \quad \ldots\ldots\ldots\ldots \text{(VII.1)}$$

where Y= real regional income, K is the capital stock, L is the supply of labor, and t represents time which brings technical progress with it.

GLASSON (1978: pp 106) extended the above model which is similar to Adelman's explanation but Glasson considers transport as one of the explanatory variables. Therefore, this model is supply oriented and explains regional output in terms of certain regional factors, each of which can be analysed. The proposed model is

$$O_n = f_n(K,L,Q,T_r,T,S_o) \quad \text{............} \quad \text{(VII.2)}$$

where,

O= potential output of region n,

K= capital formation,

L= labour,

Q= Land (natural resources),

T_r= transport,

T= technology,

S_o= socio-political system.

GDP by sectors will be adopted to describe the potential output of the region. There are 11 sectors of GDP available for Indonesia. Government expenditure, private investment and interregional trade to and from the region are proposed as explanatory variables in the equations instead a single variable, capital formation. There are no data on total employment except in the foreign and domestic investment sectors which are a small percentage of the total. Employment as one of the explanatory variables is therefore omitted from the equations and a land use expansion is adopted to describe natural resources. It appears that data on land use expansion may be more reliable than data on agricultural production. This study adopts road density and the length of roads to describe transport. It is expected that these measures can describe transport investment and networks as well. It is also assumed that the subregions are homogenous from standpoint of this analysis.

The basic purpose of the multiple regression analysis is to measure the relationship between the length of roads and regional economic indicators which simultanouesly account for the probable influence of other development indicators, length of roads. Multiple regression analysis is establised to see if the GDP by sector is influenced by development indicators as explained above.

The significance of the findings of such an analysis can be evaluated in two ways which are regression analysis and analysis of variance. Both analyses show that the total variation in Y is split into additive components, the 'regressor (s)' and the 'residual' in regression analysis 'between' and 'within' in analysis of variance. **KUOTSOYIANNIS (1981, pp 140-172)** proves that 'regressor(s)' correspond to 'between' and 'residual' correspond to 'within'.

Regression analysis is a more powerful method than the analysis of variance particularly when the input data are market data such as economic indicators. This method not only provides all information which can be obtained from analysis of variance but also gives numerical estimates for the influence of each explanatory variables (see **KOUSOYIANNIS, 1977**).

Regression analysis is adopted here to obtain estimates of the parameters of a population from a random sample based on ordinary least square methods (see **EZEKIEL and FOX, 1959** ; **VAN DE BEER, 1970**; **FINK, 1985**; and **FOX, 1968**). Another method for obtaining estimates of the parameters of a population from a random sample is the maximum likelihood method. This method assumes that the sample is fixed but this sample can be generated by various different parent populations, each having its own parameters which are assumed variables.

Maximum likelihood makes use of the normal distribution of the variables. The assumption of normal distribution in a small sample has strong bias therefore this method needs the observed sample to be as large as possible (**KLEIN, 1953**). This is the reason why ordinary least squares is preferable to maximum likelihood methods in this study.

This analysis begins by establishing the equations showing the relationship between GDP by sectors as endogenous variables and land use, capital, government expenditure, differences between imports and exports, length of roads as exogenous variables which is assumed they work simultaneously. The result of the exploratory regression analysis can be seen in the Table VII.2.

The coefficient of determination (R^2) enables the reliability of the regression models to be estimated. The scores of R^2 are added progresively along the rows such that the first value of R^2 reveals the proportion of variance in Y that is accounted for by the first independent variable land use expansion (TOTLUB). The second value of R^2 is interpreted as the proportion of variance Y that are accounted for by private capital formation (CAPFOR) and land use expansion together. The last score reveals the

Table VII.2 Multiple Regresion Analysis Between
GDP by Sectors and Economic Indicators

GDP by Sectors		Totlub	Capfor	Exp	Dxm	Good	Suff	Bad	Vbad	Constant	The Highest Simple Cor. With
1. Agriculture	Pm	1.3393	0.0030	-1.6258	-0.0599	111.0500	215.6100	-26.7590	-39.2390	- 1.6x10[illegible]	Exp
	R adjust	0.9024	0.9272	0.9277	0.9141	0.8926	0.9422	0.9204	0.8604		R=0.9737
	SE	3.1672	1.4477	2.8175	0.0037	157.9200	169.7300	192.9300	104.4900	3.5x10[illegible]	
2. Quarrying	Pm	2.6217	-0.5458	-0.3937	-0.1855	141.5750	261.5800	-209.3800	-120.9100	-2.7x10[illegible]	Good
	R adjust	0.1907	0.0758	0.0880	-0.0674	-0.1695	0.0995	- 0.3178	0.2658		R=0.7111
	SE	2.2771	1.0411	2.0262	0.2683	113.5700	122.0600	138.7500	75.1370	2.5x10[illegible]	
3. Industry	Pm	-1.0134	-0.1326	3.7721	0.2150	-171.5700	-169.6200	145.0900	68.2120	1.1x10[illegible]	Totlub
	R adjust	0.8844	0.8700	0.8509	0.8211	0.8899	0.9207	0.9071	0.9719		R=0.9508
	SE	0.8737	0.3993	0.7772	0.1029	43.5640	46.8210	53.2220	28.8220	9.7x10[illegible]	
4. Construction	Pm	0.0094	0.0107	0.0897	0.0061	- 4.5566	-1.9005	4.4272	1.2222	6711.9	Totlub
	R adjust	0.9456	0.9453	0.9430	0.9318	0.9745	0.9661	0.9861	0.9899		R=0.9745
	SE	0.0285	0.0128	0.0249	0.0033	1.3976	1.5020	1.7074	0.9246	3.1x10^{4}	
5. Elec/Gas/Water	Pm	0.2229	-0.1256	-0.3092	-0.0100	3.5790	3.4641	- 9.8830	0.9894	- 2.7x10[illegible]	Exp
	R adjust	0.9070	0.8984	0.9804	0.9766	0.9734	0.9645	0.9850	0.9707		R=0.9652
	SE	0.2109	0.0964	0.1875**	0.0248	10.5140	11.3007	12.8450	6.9562	2.3x10[illegible]	
6. Trade	Pm	0.4846	-0.0453	0.5406	-0.0363	-06.0693	39.4290	-10.7150	-8.3533	- 5.5x10[illegible]	Exp
	R adjust	0.9400	0.9491	0.9880	0.9862	0.9890	0.9964	0.9988	0.9935		R=0.9937
	SE	0.3250	0.1486	0.2891**	0.0383	16.2060	17.4170	19.7990	10.7220	3.6x10[illegible]	
7. Trans/Com.	Pm	-0.0108	0.1162	-0.8629	-0.0012	-38.8610	11.1840	12.2830	- 0.1782	- 3995.1	Exp
	R adjust	0.9160	0.9503	0.9691	0.9637	0.9926	0.9936	0.9966	0.9933		R=0.9832
	SE	0.2738	0.1251	0.2436*	0.0322	13.6520**	14.6720***	16.6780	9.0320	3.04x10[illegible]	
8. Bank/Finance	Pm	0.0158	-0.0474	0.5377	-0.0088	-23.7400	- 6.4086	0.9773	2.5097	- 2.5x10^{4}	Exp
	R adjust	0.8684	0.8985	0.9200	0.9125	0.9637	0.9570	0.9392	0.8840		R=0.9712
	SE	0.3400	0.1554	0.3025	0.0400	16.9540	18.2220	20.7130	11.2170	3.8x10[illegible]	
9. Housing	Pm	0.1055	-0.0493	-0.2368	-0.0055	- 7.6872	2.3999	- 3.1143	- 1.2251	- 1.0x10[illegible]	Exp
	R adjust	0.9298	0.9373	0.9845	0.9824	0.9946	0.9932	0.9909	0.9840		R=0.9929
	SE	0.0995	0.0455	0.0885*	0.0117	4.9608***	5.3317	6.0607	3.2821	1.1x10[illegible]	
10.Public Adm.	Pm	0.1152	0.0656	0.2618	-0.0353	- 8.2198	26.0710	-5.2184	- 1.1960	- 1.9x10[illegible]	Exp
	R adjust	0.9003	0.9410	0.9893	0.9893	0.9876	0.9986	0.9987	0.9997		R=0.9940
	SE	0.1121	0.0513	0.0990**	0.0132	5.5922	6.0102	6.8320	3.6998	1.2x10[illegible]	
11.Services	Pm	0.1739	-0.0850	0.2158	-0.0119	-10.5830	6.1680	- 4.9848	- 2.3598	- 1.8x10[illegible]	Exp
	R adjust	0.9229	0.9246	0.9582	0.9542	0.99907	0.9925	0.9903	0.9900		R=0.9832
	SE	0.0695**	0.0318***	0.0618*	0.0082	3.4649**	3.7329**	4.2331	2.2924	7.7x10^{4}*	

* 1 per cent level of significance
** 5 per cent level of significance
*** 10 per cent level of significance

Pm=parameter of multiple regresion equation
R =coefficient of multiple correlation
SE=standard error of parameters

These figures are calculated from Table V.4, Table V.11, Table V.12 and Table VI.1.

total proportion of variance in Y that is accounted for all eight variables working simultaneously.

R^2 is computed along the row and the R^2 of the eight variables working simultanously and the standard error (SE) of parameter estimates are calculated in the last computation. The results are disappointing because most of the parameter estimates are statistically significance from zero even at the 10 per cent level of significance. The smaller the standard errors, the stronger is the evidence that the estimates are not statistically significant.

The coefficient of determination shows that GDP by sector indicators have good correlations with all economic and road indicators. The results also show that the standard error of parameter estimates are very high. The two different outcomes between the coefficient of determination and the standard error denote the presence of a linear relationship among explanatory variables. This condition is called multicollinearity.

Multicollinearity is a a phenonmena inherent in most relationships due to the nature of economic magnitudes. This case always exists among explanatory variables at a certain degree of intercorrelation, due to the interdependence of many economic magnitudes over time. High coefficient of determination and high standard error of parameter show that the explanatory variables change by the same proportion over a period of time. The growth factor in time series is the most serious cause of multicollinearity. Another cause of multicollinearity might be concerned with the use of lagged values of same explanatory variables as seperate independent factors in the relationship.

KLEIN (1977) seems to accept that multicollinearity is not necessarily a problem if the product simple correlations between explanatory variables are high relative to the overall degree of multiple correlation among all variables simultanously. He argues that the collinearity has severity if

$$r^2_{xixj} \geq R^2_{y.x1,x2,......xk} \quad .... \text{(VII.3)}$$

where r^2_{xixj} is the simple correlation between any two explanatory variables (x_i and x_j) and R^2 is the overall multiple correlation of relationship. Based on Klein's argument the previous equations in Table VII.2, show multicollinearity problems because the square of all simple correlations among explanatory variables is higher than the multiple coefficient of determination.

FARRAR and GLAUBER (1967) reject Klein's argument. They state that the statistical test for multicollinearity is not as simple as Klein's approach. Farrar and Glauber proposed a set of three tests for multicollinearity. The first test is a chi-square test for detection of the presence of the multicollinearity in a function with several explanatory variables.

The basic hypothesis in this case is Ho: the X's are orthogonal, and it is tested against the alternative hypothesis H_1: the X's are not orthogonal. Farrar and Glauber have found that quantity,

$$^{*}X^2 = -[n-1-1/6(2k+5)] \log_e[Z] \quad .... \text{(VII.4)}$$

where Z = value of the standardized determinant

$^*X^2$ = observed value of X^2

n = size of the sample

k = number of explanatory variables

v = 1/2(k(k-1)) degrees of freedom of X^2

If the observed $^*X^2$ is greater that the theoretical value of X^2 with 1/2(k(k-1)) degrees of freedom, the assumption of orthogonality is rejected. It means that there is multicollinearity in the function. The higher the observed $^*X^2$ the more severe the multicollinearity. If the observed $^*X^2 < X^2$ the assumption of orthogonality is accepted, which mean there is no multicollinearity in the function.

To test for the overall degree of multicollinearity the $^*X^2$ was computed and found equal to 82. The theoretical $X^2_{0.05}$ with 28 degrees of freedom is equal to 41.3. Since $^*X^2$ is much higher than $X^2_{0.05}$, it can be concluded that there is a substantial degree of multicollinearity in the function.

After identifying that the whole set of explanatory variables are orthogonal , the next step is to find out the pattern of multicollinearity to determine which variables are responsible for the presence of multicollinearity variables. This is the second test which uses the F test.

Farrar and Glauber calculate the multiple correlation coefficient among the explanatory variables ($R^2_{xi.x1x2...xk}$) and observed F^* can be computed,

$$F^*=((R^2_{xi.x1x2..xk})/(k-1))/((1-R^2_{xi.x1x2..xk})/(n-k)) \quad .... \text{(VII.5)}$$

where n=size of the sample

k=number of explanatory variables.

The hypothesis being tested at this stage is

$H_0: R^2_{xi.x1x2....xk}=0$

and the alternative hypothesis is

$H1: R^2_{xi.x1x2....xk} \# 0$

The theoretical value F is computed to the observed F^* with $v_1=(k-1)$ and $v_2=(n-k)$ degrees of freedom at a certain level of significance. If $F<F^*$, the variable X_i is multicollinear and therefore the null hypothesis is rejected, on the other hand, if $F>F^*$ the variable X_i is not multicollinear and the null hypothesis is accepted.

To find the source of multicollinearity, the multiple correlations are computed and their associated F-statistics with the set of explanatory variables. To test for the overall degree of multicollinearity the $^*X^2$ was computed and found equal to 19.4 for v1=7 and v2=2.

$R^2_{totlub,capfor\cdots vbad}$ =0.9856. F^*=19.55

$R^2_{capfor,exp .....,totlub}$ =0.9932. F^*=20.87

$R^2_{exp,dxm ....,capfor}$ =0.9896. F^*=27.19

$R^2_{dxm,good ....,exp}$ =0.9891. F^*=25.93

$R^2_{good,suff ......,dxm}$ =0.9872. F^*=22.04

$R^2_{suff,bad ....,good}$ =0.9879. F^*=22.33

$R^2_{bad,vbad ....,suff}$ =0.7521. F^*= 0.87

$R^2_{vbad,totlub ....,bad}$ =0.8211. F^*= 1.31

The above results show that all factors are affected by multicollinearity except roads in bad and very bad condition.

The result of computation above shows that except for bad and very bad condition roads, the other variables are subject to multicollinearity. The third test is to detect the variables which cause multicollinearity. In order to achieve this objective, the partial correlation coefficients are computed and subjected to a t-test to determine their statistical significance.

The basic hypothesis here is

$H_0: r_{xixj \cdot x1x2....xk}=0$

and is tested against the alternative hypothesis

$H1: r_{xixj.x1x2....xk}\#0$

Having estimated the partial correlation coefficients, the observed value t^* can be computed as,

$t^*=((r_{xixj.x1x2..xk})V(n\text{-}k))/V(1\text{-}r^2{}_{xixj.x1x2..xk})$

where $r_{xixj.x1x2..xk}$ denotes the partial correlation coefficient between x_i and x_j.

The theoretical t value with v=(n-k) degrees of freedom is compared with the observed value. If $t<t^*$, the partial correlation coefficient between the variables X_i and X_j are responsible for the multicollinearity in the function. On the other hand, if $t<t^*$, the partial correlation between variables is not statistically significant. The analysis is not necessary to continue to this stage since the previous stage shows that all the variables which are severe multicollinearity have been identified.

The disadvantages of Farrar and Glauber's approach is detecting the multicollinearity based on the relationship between explanatory variables without dependent variables also being taken into account. Confluence analysis tries to overcome this disadvantage by constructing all possible regressions between the variables which are present in relationships.

Each variable successively is taken as dependent variable and all possible regressions of each variable on all others are considered. However, in this case, the results of this approach show similar results with the previous analysis, all of the variables are subject to severe multicollinearity. The existence of multicollinearity imposes some limitations on the interpretation of the findings. The small number of observations also precludes an analysis of the effect of lagged variables. However, Table VII.2 gives some indication in the relationship between transport and development.

Table VII.2 shows that estimates of government expenditure are significancly related to only GDP by electricity/gas/water supply, trade/hotel/restaurant, public administration at the 5 per cent level, to GDP by services, transport and housing at the 1 per cent level. The other economic factor, estimates of total land use and private capital formation are statistically significant with GDP by services at the 5 per cent level and the 10 per cent level, respectively.

The length of roads in good condition is statistically significant with GDP by transport/communication and services at the 5 per cent and housing rent at the 10 per cent level, respectively. The length of sufficient condition roads is statistically significant with GDP by transport/communication and GDP by services at the 10 and 5 per cent, respectively.

Despite the problems of multicollinearity, then, these results suggest that government expenditure among the economic factors and good and sufficient conditioned roads among the road indicators play an important role in promoting the regional economic development.

VII.3 Road and Regional Inequality

The next discussion looks at the size distribution of income within the region under study over time. This study adopt a general methodology, consisting basically of looking over time of the region and,

1. measuring the degree of inequality at each year,
2. relating the level of inequality to the economy's characteristics as measured by GDP by sectors, using correlation and regression analysis. The questions can be raised that how relative inequality differs at different stages of development and whether any particular relationship between inequality and level of development arises if such a relationship is unavailable.

Some of the measures to represent inequality are Kuznets ratios, coefficients of variation, variance of the logarithms of income, the standard ordinal shares. Kuznets ratio is the ratio of percentage of income share of 60 per cent poorest and of 20 per cent richest in a population (KUZNETS, 1955:pp 20-21). The coefficient of variation as a measure for inequality has been adopted by WILLIAMSON (1965) in his study to study the correlation between the stage of development and the level of inequality among subregions. The logarithm of per capita income has been used to test the significance with the percentage of income share of the top 20 per cent, middle 40 per cent and the lowest 40 per cent by AHLUWALIA (1976a). The strength and the weakness of the measures as has been listed have been reviewed by **WEISSKOFF (1970)**.

This study take a Gini ratio and coefficient of variation as measures of inequality. The Gini coefficient is taken because this coefficient is the most popular measure of relative income inequality owing to the ease of interpreting it. The Gini coefficient bears the closest relationship to the Lorentz curve, showing the ratio of the area between the Lorentz curve and the forty-five-degree line to the total area of triangle.[1] The result of gini ratio and coefficient of variation are shown in Table VII.3.

Table VII.3 shows that inequality indicators do not present high inequality in the province under study. This result supports the cross-sectional analysis in Chapter V. It shows that inequality between GDP per capita in the centre and GDP per capita in the periphery is still relatively low.[2] Table VII.3 also shows that the inequality was higher at the beginning of the study period and declined then increased toward the end of the period.

To identify the relationship between Gini ratio and GDP both indicators are plotted in Fig VII.1. It illustrates more clearly the relationship which shows a U pattern. It states that the relative income difference between regions decreases during the early stages of increases in income per capita, reaches a plateau, and then rises when income per capita continues to increase.[3]

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1. Many literatures review Gini ratio such as **COATES (1979: pp 19-21)** and **METWALLY and JENSEN (1973)**.
2. See Table V.7
3. Actually, term 'stages of development' used by Rostow and Kuznets is slightly different. Kuznets defined it by single variable 'income'. Rostow defined it by

Table VII.3 Overtime Inquality in North Sumatera

Year	Gini*	Vw	Vuw
1975	0.1168	108	97
1976	0.1009	107	98
1977	0.0644	98	92
1978	0.0688	99	94
1979	0.0615	92	92
1980	0.0756	109	107
1981	0.0819	120	119
1982	0.1069	142	136
1983	0.1411	206	192
1984	0.1333	219	202
1985	0.1207	202	191
1986	0.1192	196	179

* This Gini Ratio is calculated based on the subregional income and population

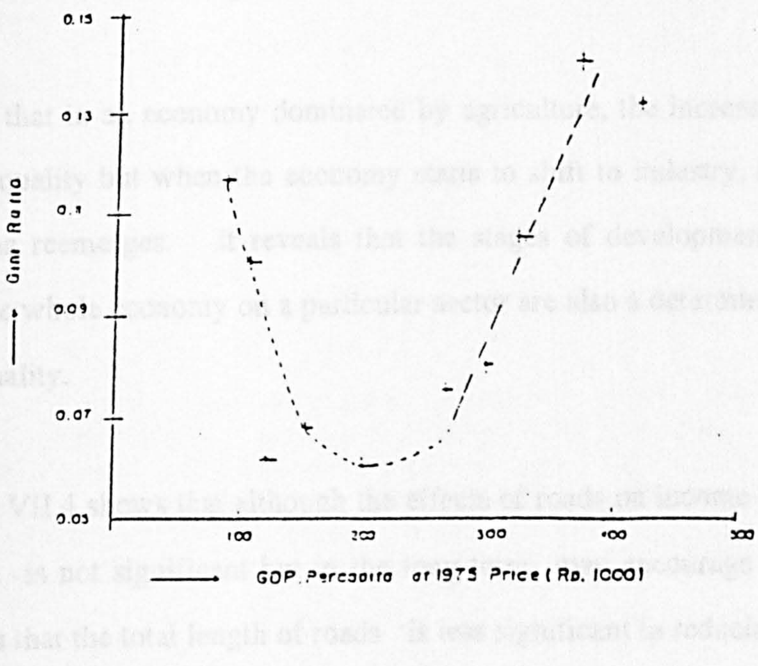

Fig. VII.1 Relationship Between GDP per Capita at 1975 Price and Gini Ratio

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'income' plus 'other characteristics'. This study adopts Rostow's definition for 'stages of development' and it uses 'income per capita' when it refers Kuznets' definition.

This illustration, the low Gini ratio and U pattern, may result in a development process in developing regions in which economy depends on agriculture, such as in the case of North Sumatera. This supports Kuznets' view that the level of economic development is a major determinant of the extent of income inequality in the region although the two measures move in different direction. Kuznets' experience shows that the relationship between Gini ratio and GDP is an inverted U.

A different finding could be as a result of the different stages of development. Kuznets' studies were based on countries which were analyzed in cross-sectional time. The findings for North Sumatera come from an economic environment based on an economy dominated by agriculture at the beginning of the study period and one which started to shift to industry and trade at the end of this period.

The trend shows that in an economy dominated by agriculture, the increase in GDP alleviates the inequality but when the economy starts to shift to industry, inequality among subregions reemerges. It reveals that the stages of development and the dependency of the whole economy on a particular sector are also a determinant of the variation of inequality.

In general, Table VII.4 shows that although the effects of roads on income inequality in the short term is not significant but in the long term may encourage it. Table VII.4 also reveals that the total length of roads is less significant in reducing income inequality than the length of good and sufficient condition roads. It may indicate that provision of roads to link the main settlements in the province may assist in reducing the subregional income gap.

Table VII.4 Coefficient of Correlation Between Length of Roads and Gini Ratio

Based Year of Road Indicators	Good+Suff. vs Gini Ratio	Total vs Gini Ratio
1971	0.6925 (0.013)	0.6217 (0.028)
1972	0.5089 (0.475)	0.4064 (0.037)
1973	0.5187 (0.062)	0.4788 (0.081)
1974	0.4441 (0.099)	0.3804 (0.139)
1975	0.4132 (0.118)	0.4083 (0.121)

(   ) Level of Significance

Note:
In addition to the correlation between road indicators (1975-1986) and Gini Ratio (1975-1986), the lagged variables of road indicators (based year 1971-1974) are also computed to see whether they have good indications of linear relationship with Gini Ratio (1975-1986). Gini Ratio (1975-1986) are presented in Table VII.3.

The previous discussions reveal that roads play an important role in promoting regional development. Road improvement induces regional income but in the same time it encourages inequality. On the other hand, the increase in road length to serve most parts of the province may reduce the regional inequality. Regional inequalities could increase in North Sumatera if the level of capital investment favours the better developed subregions. Industrialization and the provision of roads, based on the 1975 to 1985 experience, make this situation possible. The role of government expenditure in the less favoured areas may reduce this inequality.

VII.4 Roads and Subregional Economic Position

The first section of this chapter discusses what role road conditions play on the regional economy. It shows that roads of sufficient and good condition contribute the most to regional economy. This section is an attempt to identify in more depth the role of roads on the regional economy. It focuses on the impact of roads on the position of subregional economy within the province.

The position of the subregional economy, in the sense of subregional income, was discussed in the Chapter V.1 of this study. It showed that subregions can be divided into 2 groups: high GDP and low GDP. The group of high GDP includes Tapanuli Selatan, Tapanuli Utara, Labuhan Batu, Asahan, Simalungun, Karo and Medan. The other subregions are classified in the low GDP group. The present analysis investigates whether the classification of these subregions have a correlation with road indicators.

Road indicators which are adopted here can be classified into 3 categories. Firstly, roads as have been described previously and the total area of region under study are considered. Secondly, the effective area is taken into account instead of the total area. Both categories represent density of roads which is commonly used in developing countries to measure the comparative advantage on roads among subregions. The last one is the accessibility of villages to the 'rest of the world'. Five indices of accessibility which have been introduced in Seatac's study have been discussed in Chapter II of this study. Except for village accessibility, there are no data available on other accessibility indices. Percentages of villages in a particular category of accessibility is the measure which is used in this analysis. Three variables are found suitable to this analysis. They are the villages which are accessible over the whole year, accessibility which is dependent on the weather and the villages which can not be accessed at all by vehicles.

Discriminant analysis was used to test if the provision of roads or accessibility lead to any significant difference between the two groups **(OGUNJUMO, 1988)**. The stepwise selection method was then used to ensure that only the predictor variables that added statistical significance to the group centroids above the seperation already achieved by previously selected variables were retained in the analysis. The discriminant function is shown in Table VII.5.

There were two discriminant functions. Wilks' lambda in road density (total area) is 0.77648 before any function is derived. This indicates the much lower discriminating power remaining in the variables used for the analysis. The chi-square statistic for the first discriminant function was 2.30286 with 8 degrees of freedom at the 0.1676 level of significance. Wilks' lambda is 0.55944, chi-square is 2.75621 with 7 degrees of

Table VII.5 Discriminant Function Value

	Road Density (Total Area)	Road Density (Eff. Area)	Accessibility of Villages
Action Entered	Good/Suff	Eff. Area	Depend on Weather
Wilks' Lambda	0.5594	0.7102	0.7966
Significance	0.1310	0.1084	0.1908

Fisher's Linear Discriminant Function

	Entered Actions	Group 0	Group 1
a. Road Density (Total Area)	Good	0.8690×10^{2}	0.1706×10^{-1}
	Suff	0.1366×10^{-1}	0.2329×10^{-1}
	Constant	-2.6806	-7.1277
	Group Centroid	-0.9721	0.6481
b. Road Density (Eff.Area)	Eff.Area	0.3344×10^{-1}	0.7473×10^{-1}
	Constant	-1.1392	-2.9208
	Group Centroid	-0.6997	0.4665
c. Village Accessibility	Depend	0.2590	0.1714
	Constant	-4.4215	-2.3278
	Group Centroid	0.5535	-0.3690

freedom at the 0.1310 level of significance after the first function is removed. It indicates the much lower discriminating power still remaining in the variables.

The eigenvalue of 0.78749 and its relative percentage of variance of 100 per cent indicate that the dominant position is in the first discriminat function. All variables are indicated but their contribution are only to the first discriminant function, as shown in Table VII.5.

Roads of good and sufficient condition contributed the most to the descriminant function. This road dimension seperated the subregional areas in group 0 from those in group 1 at the 13 per cent level of significance. The dominance of this dimension indicates that the subregional areas with low road infrastructure (group 0) are significantly different from the ones in group 1. Those in group 0 are disadvantaged areas and only special consideration in the road provision could assist their development.

A similar analysis has been followed for the road density based on subregional effective area and villages accessibility. The result can be seen in the Table VII.5. In road density on effective area, it shows that effective area contributed the most to discriminate the two groups at the 11 per cent level of significance. Village linkages dependent on the weather contributed the most significance in discriminating the two groups.

It can be concluded that roads of good and sufficient condition and effective area is very significant in promoting regional income. The total area which is always considered when road density needs to be calculated is not a significant measure when correlated with regional income. It appears that villages which have full accesibility or those without accessibility at all in the whole year do not provide contributions regional income.

VII.5 Conclusions

The analysis in chapter VI leads to certain findings. One of them is that the positive impact of roads on investment, agriculture and government activities, and social indicators are more significant than the negative impact. Negative impact is more significant on transport mode user trends. It also appears that the impact of roads on loading/unloading in the ports is very dependent on the location of the ports in the province. The first section of this chapter discusses the contribution of the level of road conditions on the development in greater depth.

The findings of the at the beginning of this chapter suggests that good and sufficient conditioned roads are significant to regional GDP. Because of the degree of multicollinearity that is involved it is not possible to identify with any certainty, the contribution of the level of good and sufficient road conditon to the regional GDP, respectively. However, bad and very bad condition roads, in general, are not significant with regional GDP.

The impact of roads on development can be classified into positive, neutral and negative. In general, the indications from this analysis are that positive impacts may emerge after a certain period of time. The speculation that the impact of improved condition of roads leads to a 'backwash effect' from the less developed subregions may appear to be true in North Sumatera's experience. In the short term, it indicates that good and sufficient conditoned roads may alleviate the income inequality but in the long term those type of roads may strengthen it. The linkages to whole settlements in the province may reduce this negative impact.

The role of roads of good and sufficient quality play important role in stimulating regional development. At the same time, it affects regional inequality. Regional inequality can be reduced when all villages in the region can be accessed by vehicles in all weather. Road density in the sense of effective area rather than total area is an appropriate measure to identify the lack of roads in a particular region since this measure is significant in promoting regional income. It appears that the conventional concept of road density which is based on total area does seem appropriate in the province under study.

The finding also shows that the North Sumatera analysis indicates a different pattern of relationships between GDP and inquality from Kuznets' finding. This might occur because the countries in Kuznets' study and in this study are at different stages of development. North Sumatera is at the stage of development which might be called traditional society. One of the characteristics is that the economy is dominated by agriculture. In this stage of development, there is a relatively high inequality while when development increases the regional income, the inequality decreases until at a minimum point and then increases at the same time as income increases.[4] Provision of roads provides a quick responce to the GDP by agriculture but on the other hand, provision of roads is not significant with the GDP by industry. It may indicate that the stage of development has an influence in determining the direction of inequality change and the response of roads to the development.

4. In this stage, it might be that industry take the role of agriculture in the economy of the country.

VIII. Road and Transport Demand

VIII.1 Introduction

The objective of this study is to explore the relationships between road network and transport demand. Transport demand is illustrated by a marketing area which is induced by transport costs. Therefore, a hypothesis can be proposed to be tested is that volume of traffic between two nodes has significant correlation with the regional development of marketing area of the two nodes. The first stage of this analysis is to identify the market area in the province which is limited into the second hierarchy of the settlements in North Sumatera.

Regional development requires extensive interaction between rural communities and the urban settlement which serve the communities, either as a market or a location of the facilities they need. The interaction and spatial integration among settlements within a region are needed to promote the development of the region. The impact of absent linkages or weakness bring the isolated region to perpetuate localized dependence and subsistence agriculture. This circumstances come into difficulty with marketing the agricultural product and, consequently, slows down the regional development.

Commercialization of agriculture can be achieved only when a network of mutually dependent communities emerge in a region. The integration of subsistence communities into a larger economy can increase the incentives for farmers to attain greater productivity. Linkages or interaction among dispersed groups or organizations are the primary means of expanding the system of exchange and eventually transforming underdeveloped societies. Thus, a number of linkages among settlements in a region and between a region and external places must be strengthened.

Within the last 10 years, transport facilities in Indonesia have been greatly improved in order to promote economic growth. In the case of highways, for examples, such a concept as a framework to provide guidance in budget allocation, in the long term, has been introduced. This concept attempts to identify how a region economy process works in relation to the transport level of accessibility. This theory is based on the regional self balance theory, which stated that the improvement of the level of accessibiliy will result in the regional equilibrium. The disparity between regions is recognized by the differences of the levels of accessibility between them. It introduced what is called a unit development region, or UDR, as a key to understanding levels of accessibility.

Urban settlements, as nodes in a transport network, can be divided into hierarchy, say, first order, second order etc. The second order cities are under the influence of the first one and the first order is not subordinate to the others. They can do exchange in the same level although the cities do not have to be the same size. The areas which are influenced by the first order (called UDR), that is the areas which are under the second order and the third order cities are called partial development regions (PDR). The boundaries of the areas determined by the market structure of the cities, are based on the transport cost. This means thatif transport costs are higher, the boundaries are smaller than those of the lower transport costs. This theory supports a hypothesis which stated that if there is road improvement, the transport costs will decrease and the areas which are served bay the market centre tend to be larger.

The Ministry of Public Work conducted a survey of traffic flow as a measurement to determine a regional boundary, and their findings showed that 70 UDRs were found in the whole nation. The sizes of the UDRs were not in the same level. This means that their oppurtunities for growth were also not in the same level. The presence of the UDRs would be a precondition to increase the disparity between regional growth if improvement were not provided. The improvement should bring the groeth of UDRs to equilibrium, at least in the long run. But,up to now, there has been no intensive study to identify the boundaries of PDRs within UDRs themselves. The UDRs in Northern Sumatera, as the result of Ministry of Public Work's survey, are presented in Fig. VIII.1.

In this study, which was conducted in North Sumatera, it was easily found that the first hierarchy urban settlement in the province was Medan, and Belawan is its port. Fig. VIII.1 which is based on a 1978 survey, shows that the province under study is formed by one UDR, on the other hand, the province of Aceh is formed by 3 UDRs.

VIII.2 Definition of Partial Development Regions

As in the UDR, described previously, the similar approach was adopted to identify a regional boundary which was influenced by the second order urban settlements. These regions are called Partial Development Region (PDRs). The first step in analyzing PDR's is to identify the second hierarchy of the urban settlements. This was done by providing a list of urban functions among selected urban settlements in North Sumatera. That is approximately 192 and their distribution, based on their settlement size, as can be seen in Table VIII.1.

The selection of urban settlements was based on the population ranks and came to 34 settlements, as has been shown in Table IV.11. As described previously in this study, the province under study has 17 secondary hierarchy governments which consist of 11 districts and 6 municipalities. The six municipalities and 11 towns which are capitals of the districts were also included in the 27 settlements.

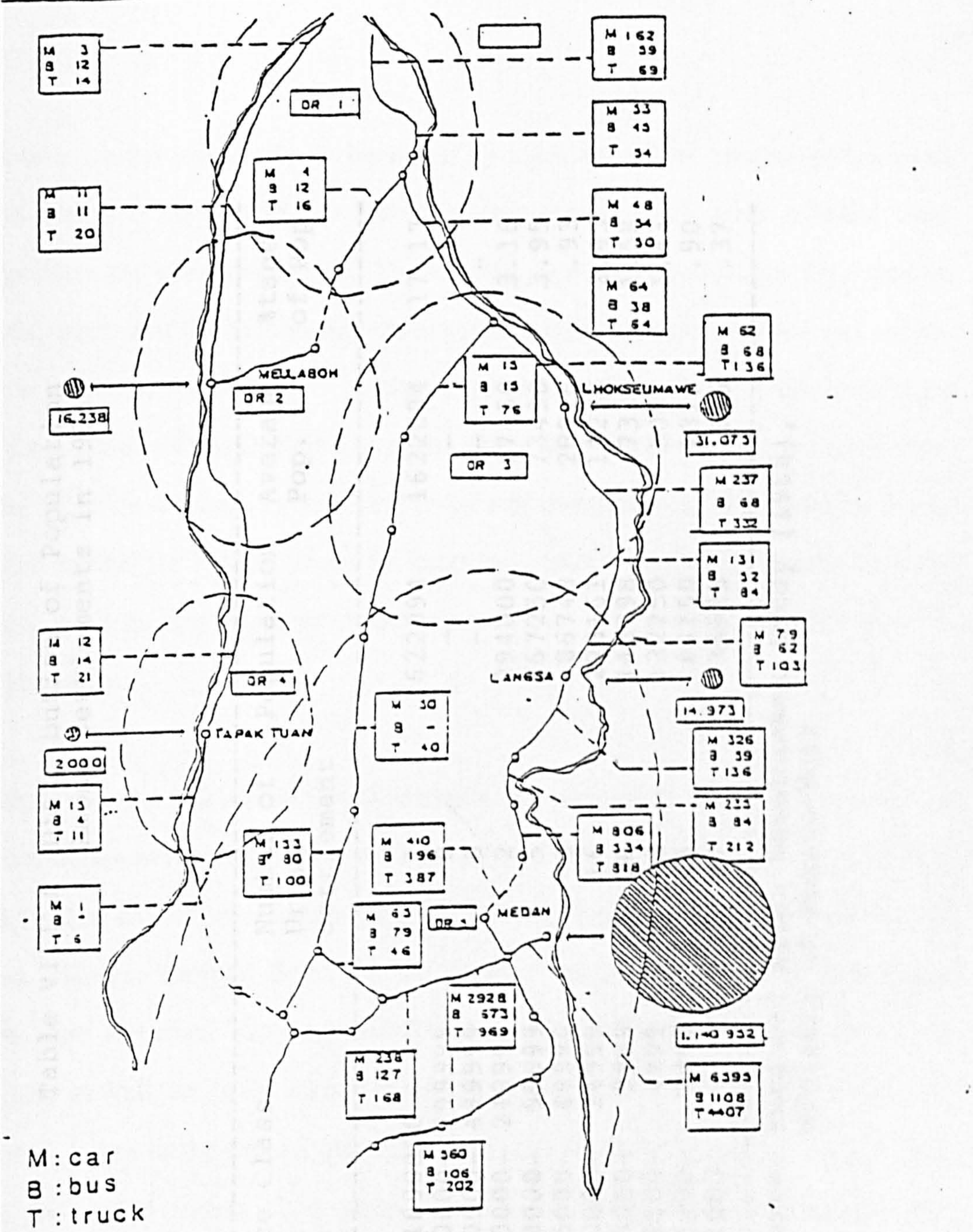

Fig. VIII. 1 Northern Sumatera Unit of Development Region
(Source : PURNOMOSIDHI, 1978)

Table VIII.1 Distribution of Population Among Settlements in 1985

Size Class	Number of Urban Settlement	Population	Average Pop.	%tage of Pop.
> 1000000	1	1622094	1622094	17.17
500000- 999999	0	-	-	-
250000- 499999	0	-	-	-
100000- 249999	2	294000	147450	3.16
50000- 99999	5	367250	73450	3.95
25000- 49999	3	86748	28916	.93
10000- 24999	16	228161	14260	2.45
5000- 9999	20	146798	7339	1.58
2500- 4999	43	132750	3087	1.43
1000- 2499	45	84150	1870	.90
< 1000	57	35625	625	.37

Source: National Urban Development Study (1986), Ministry of Public Work

The PDR of a market centre can be identified by using the travel patterns of imported goods and exported commodities. The imported goods which were selected were cement, fertilizer and kelontong goods. The selected exported commodities depended on the potential product of the kecamatan but, in general, they were rice, rubber and coffee. Most of the products, that came to Medan were either sold on the Medan market or exported from Medan through Belawan port. The role of Belawan, as port of Medan, was crucial factor in influencing the travel pattern of commodities. The same approach was adopted to analyse PDRs formed by imported goods. The result showed that the PDRs which were formed by either export commodities or import commodities were in the same boundary.

Geographic marketing orientation from kecamatan is presented in Fig VIII.2. From this figure, it can be found that in the second hierarchy of urban settlement in North Sumatera are 14 units. The centres are Pematang Siantar, Tebing Tinggi, Binjei, Kisaran, Padang Sidempuan, Sibolga, Tanjung Balai, Rantau Parapat, Pangkalan Berandan, Kabanjahe, Sidikalang, Aek Kanopan, Tarutung and Balige. All of the capitals of districts and municipalities as well, are in the second hierarchy of settlements. There are 3 kecamatan (sub-districts) towns in the second hierarchy in the province under study. Table VIII.2 shows that the market centres of the second hierarchy and their population belong to the market centres.

The result of the study showed that there are three districts whose boundaries overlap with PDR boundaries. These are Dairi, Karo and Tapanuli Tengah. Siantar influences not only its regency, Simalungun,but some areas of tapanuli Utara and Asahan. Labuhan Batu is divided into two PDRs; one extends to its capital, Rantau Parapat and the other to Aek Kanopan. Like Labuhan Batu, Asahan is also divided into 2 PDRs; one towards Kisaran, the capital, and the other to Tanjung Balai, a municipality.

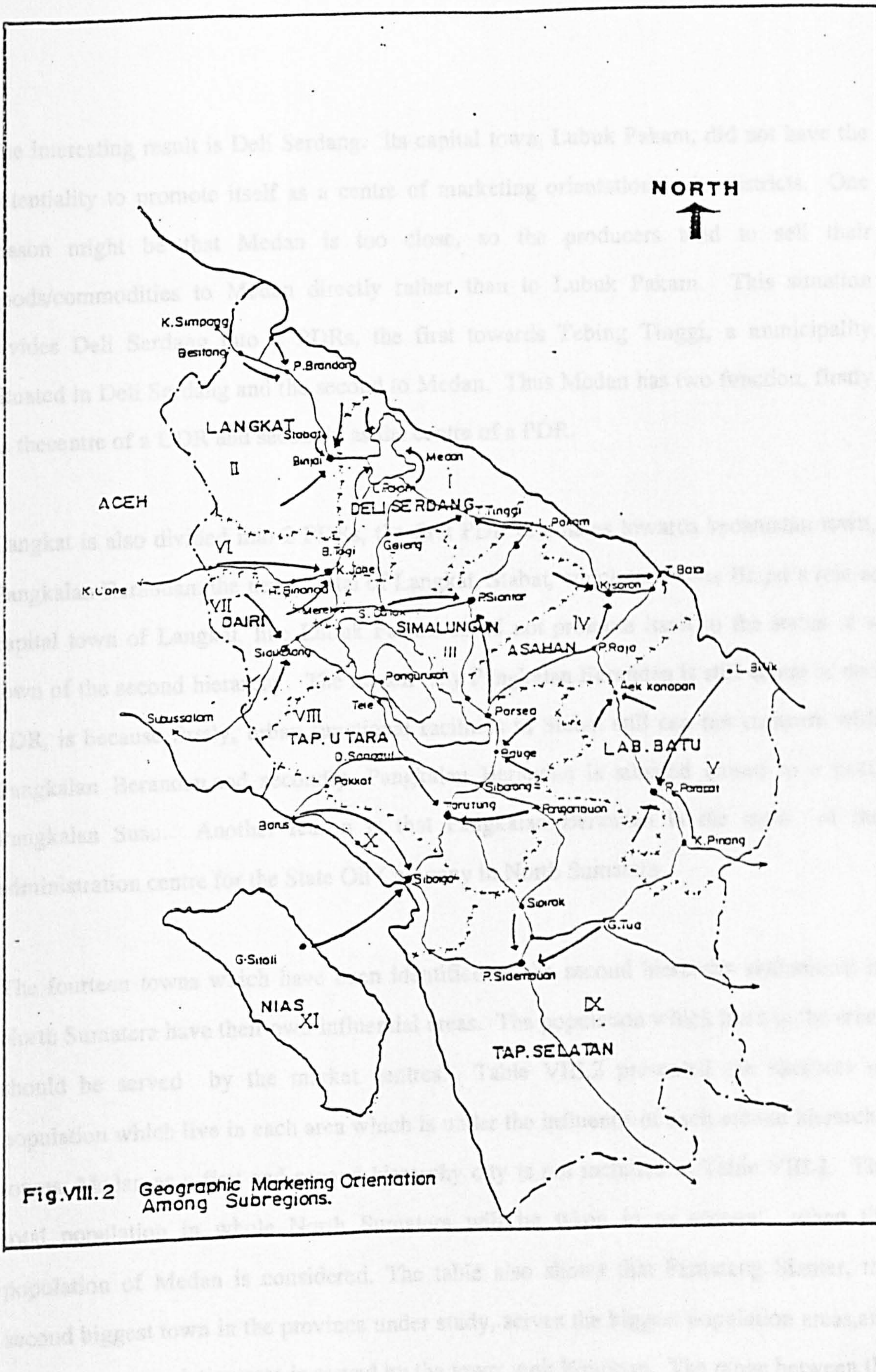

Fig.VIII.2 Geographic Marketing Orientation Among Subregions.

The interesting result is Deli Serdang. Its capital town, Lubuk Pakam, did not have the potentiality to promote itself as a centre of marketing orientation in its districts. One reason might be that Medan is too close, so the producers tend to sell their goods/commodities to Medan directly rather than to Lubuk Pakam. This situation divides Deli Serdang into 2 PDRs, the first towards Tebing Tinggi, a municipality situated in Deli Serdang and the second to Medan. Thus Medan has two function, firstly as thecentre of a UDR and secondly as the centre of a PDR.

Langkat is also divided into 2 PDRs, the first PDR orientates towards kecamatan town, Pangkalan Berandan. the new capital of Langkat, Stabat, which took over Binjei's role as capital town of Langkat, like Lubuk Pakam could not promote itself to the status of a town of the second hierarchy. The reason why Pangkalan Berandan is still centre of one PDR, is because firstly, urban functional facilities in Stabat still can not compete with Pangkalan Berandan,and secondly, Pangkalan Berandan is situated closed to a port, Pangkalan Susu. Another reason is that Pangkalan Berandan is the town of the administration centre for the State Oil Company in North Sumatera.

The fourteen towns which have been identified as the second hierarchy settlements in North Sumatera have their own influential areas. The population which lives in the areas should be served by the market centres. Table VIII.2 presented the numbers of population which live in each area which is under the influence of each second hierarchy towns. Medan as a first and second hierarchy city is not included in Table VIII.2. The total population in whole North Sumatera will be taken in to account when the population of Medan is considered. The table also shows that Pematang Siantar, the second biggest town in the province under study, serves the biggest population areas,and the smallest population area is served by the town, Aek Kanopan. The range between the

Table VIII.2 Number of Population Which Are Served by 2nd Hierarchy Towns in 1985.

Disricts	2nd Hierarchy Towns	No of Pop. are Served	Land Use (km^2)	Dom. Inv. (Rp 10^6)	Gov. Inv. (Rp 10^6)
Tap. Selatan	P. Sidempuan	941350	8430	13742	20847
Tap. Tengah	Sibolga	803013	1463	5706	6247
Tap. Utara	Tarutung	473031	3788	5116	6508
	Balige	302519	2331	1705	2789
Labuhan Batu	Rantau Parapat	480624	7749	35432	3508
	Aek Kanopan	192588	2528	19079	2445
Asahan	Kisaran	762626	2131	58641	7322
	Tanjung Balai	265237	1065	19628	2197
Simalungun	P. Siantar	1151979	5261	13490	28403
Dairi	Sidikalang	299024	733	-	7191
Karo	Kabanjahe	273528	1376	807	8934
Langkat	Binjei	659701	1593	52525	6254
	P. Berandan	223837	1195	35016	2680
Deli Serdang	Tebing Tinggi	459052	2303	28370	16416
Medan	Medan	9444097	2242	122654	68574

It is calculated from North Sumatera in Figures (1985)

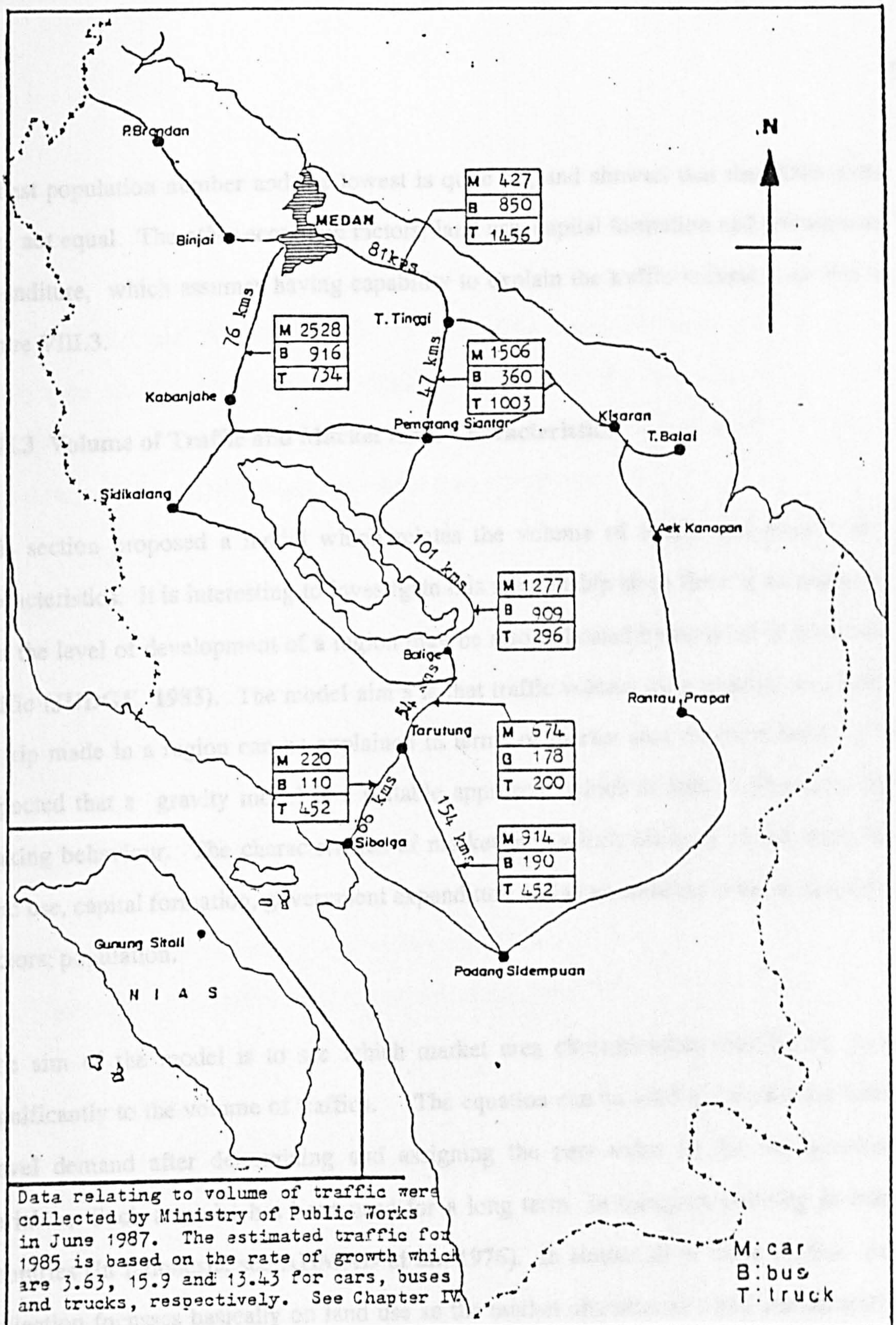

Fig. VIII.3 Volume of Traffic per Day Between Secondary Towns in North Sumatera (1985) highest population number and the lowest is quite big and showed that the PDRs sizes were not equal. The other economic factors, land use, capital formation and government expenditure, which assumes having capability to explain the traffic volume is shown in Figure VIII.3.

VIII.3 Volume of Traffic and Market Area Characteristics

This section proposed a model which relates the volume of traffic and market area characteristics. It is interesting to investigate this relationship since there is an argument that the level of development of a region may be also indicated by its level of generated traffic (**JUDGE, 1983**). The model aim's is that traffic volume on a network as a result of trip made in a region can be explained in terms of market area characteristics. It is expected that a gravity model is a suitable approach which is able to illustrate trip making behaviour. The characteristics of market area which are used in the study are land use, capital formation, government expenditure and as an addition to those economic factors; population.

The aim of the model is to see which market area characteristics contributes most significantly to the volume of traffics. The equation can be used to forecast the future travel demand after determining and assigning the new value to the trip generator variables. Such a model has been used for a long term in transport planning in many countries (In Indonesia, see **AHMAD et al., 1976**). In almost all of these studies, data collection focusses basically on land use as the market characteristic and administrative boundary as the planning unit.

Experiences from these countries show that they concentrated too much effort on data collection which in turn, led to a complex static analysis. Given the speed at which circumstances change in most developing countries, forecasts from these models often fails to project into the future **(CASE, 1966)**. In common with in United Kingdom's experience, the result of this model were overestimated during 1962-1971 **(MACKINDER and EVANS, 1981)**. In developing countries, where data collection and storage are still far behind the developed countries such as United Kingdom, a simplified model is necessary. The simplified model includes cross-sectional rather than over-time analysis and secondary data rather than primary data.

The typical formulation of the model is similar to the one reported by **(LOW, 1972)** but it is modified to the regional situation instead of urban situation. The model assumes that most of the trip making pattern in an urban areas can be explained by a simple gravity model of the form:

$$T_{ij} = k\,(P_i A_j / A_j) d_{ij}^{-B} \quad \text{.........} \quad \text{(VIII.1)}$$

where T_{ij} is the trip interchanges between i and j;

P_i and A_j are parameters representing trip production attraction at zones i and j respectively;

t_{ij} is the spatial seperation between i and j

B is the exponent for t_{ij}

K is the constant for calibration, which is selected = 1 in this study.

A model showing the relationship between market area characteristics, say agricultural land use, and volume of traffic is constructed based on the gravity model. In a similar way, other submodels based on the other characteristics can be developed.

Table VIII.3 Friction Factors of Gravity Models For K=1

Economic Indicators	Car	Bus	Truck
Capital	3.08***	3.26	3.26***
Population	4.85	5.00***	4.99
Gov. Exp.	3.03	3.21	3.21
Landuse	2.15	2.33	2.32***

* 1 per cent level of significance
** 5 per cent level of significance
*** 10 per cent level of significance

Note:
Calibration of a Gravity model involves finding the numerical value of the parameter. The simplest procedure is to run the model for a range of parameter values, thereby calibrating the model by 'trial and error' (**BLACK: 1981, p 76**). An iteration process is adopted until there is a close agreement between the result of the last and the previous iteration or the frequency curves are 'close' when compared visually (**BRUTON: 1974, p 111**). The difference between the observation and estimation should be within $\pm$ 3 per cent. An example of the procedure is shown in **BLUNDEN and BLACK (1984)**. The another simpler approach is by using regression technique (**BROOK: 1974, p 42**). This is the criterion used in this study.

The validity of the equations in Table VIII.3 depends on the reliability of the input data which is still questionable. However, Table VIII.3 shows that there is different level of the contribution to the volume of cars, bus and trucks among development indicators. Nevertheless, some comparisons can be made. Agricultural land use and population have a significant contribution to the generation of the volume of trucks and buses, respectively. Capital investment influences significantly on the generation of the volume of cars and trucks. Government expenditure does not show a significant contribution on the generation of any type of traffic. Despite the level of significance, the figures in the table show that land use contributes the biggest share to the volume of traffic and it is followed by investment irrespective of the type of investment. Population is the least important contributor.

VIII.4 Conclusions

The finding shows that the province of North Sumatera which are divided into 10 official administrative districts, has 14 market areas. Except for Lubuk Pakam and Stabat, the tendency of the market areas are toward their administrative capital. Market areas as basic planning units shows their significance to estimate traffic volume in the province under study. The results of a simple gravity model show that government expenditure does not have a significant role in generating traffic. The other economic indicators only have a significant influence on particular types of traffic. Despite the level of significance, population is the smallest contributor to the volume of traffic.

IX. CONCLUSIONS and RECOMENDATIONS

IX.1 Summary

These has been no clear policy on roads in Indonesia except for those introduced at the national level by the Ministry of Public Work in 1970[1]. As a result of these policies and the lack of a local government budget as well, road improvements during 1975 and 1985, were dominated by the Central Government budget followed by the provincial budget which mainly linked Medan to kabupaten towns and kecamatan towns, respectively. The lack of links between villages within districts is still not seriously considered while the road condition of links between urban settlements have been significantly improved.

The provincial government established four Regional Development Units in 1980. The main aim of these establishments is to coordinate inter-subregional planning among the districts and municipalities in the province. The other aim is to attempt to redistribute economic activities throughout the whole of the province and to stimulate market centres which can promote inter-regional trade. In order to achieve this aim, three of the four selected centres are ports. The success of this strategy can be evaluated by monitoring the volume of loading and unloading in the ports. The results show that the role of Belawan has become continously more important than those of the other ports. The policies on road provision proposed by the Ministry of Public Works have conflicting objectives with the regional development policies. Road provision during the period of the study tended to support the market orientation towards Medan rather than to srengthen the proposed centres.

1. An example of national transport policy, the policy of transportation of USA can be taken as a comparison. This policy is discussed by **HAZARD** (1988).

North Sumatera is one of the provinces with the most potential outside Java. It is also one of the provinces which has benefited from government expenditure on the road sector. This is the main reason why North Sumatera was taken as the case study. The study has the following aims:

(1) to predict the impact of roads on development and income distribution,

(2) to provide an inputs to the policy makers by suggesting the most effective ways by which road investment can help to broaden social and economic benefits at the provincial level. These aims, can be broken down into 3 objectives relating to roads and regional development, roads and regional income and roads and transport demand respectively. The main findings of the study in relation to these three objectives can be summarized as follows.

Roads and Regional Development

The first objective was to identify the impact of road networks on regional development. Regional development is defined as the expansion of land use, the accumulation of investment, government activities, and inter-regional trade, the provision of social facilities and the growth of the user of other transport modes rather than roads. Six hypotheses were tested in terms of this objective.

The findings of the analysis show that the potential agricultural commodities of the province under study are rubber, palm oil, and paddy. The small holder rubber planted areas decreased in almost all subregions except in Labuhan Batu while big plantations of rubber expanded in almost all subregions. The palm oil planted area increases during the study period with the exception of Deli Serdang which has shifted to cocoa planting. The paddy planted areas considerably increased in some subregions while simultanously decreasing in other subregions. In total in the province, the growth of paddy planted areas slightly changed during the period of study. The total agricultural landuse only increased slightly in the study period. This happened because the planted area by small holder significantly dropped.

Although the findings must be treated with some caution because of the problems presented by the data that was available, only five commodities showed good correlations with road provision, thus, reflecting their special background in North Sumatera. These were sweet potatoes, peanuts, cocoa big plantations, tea and palm oil small holders. Sweet potatoes and peanuts were the most profitable crops during the period of study. However, the provison of roads appear to have attracted big enterprises including state enterprises to invest in those areas which have an advantageous location with respect to Medan. This resulted in a shift from peanut planted area to palm oil. This decrease in the peanut planted areas close to Medan gave an opportunity to other less favourably located areas to grow the commodities to fulfill the present demand.

The demand for peanuts is still relatively stable whereas the demand for sweet potatoes has decreased during the study period. The decrease of sweet potatoes planted areas is not followed by an increase in the planted area in other subregions. It appears that sweet potatoes farmers have shifted their priorities to growing palm oil and cocoa.

In general, the findings of the analysis suggest that the provision of roads whether, in terms of an increase in road length or an improvement in road conditions has only played a small role in promoting the expansion of agricultural land use, during the period of study. This finding is similar to those in Seatac's study of Malaysia and the Philippines (SEATAC, 1979)[2].

Land consolidation, as found in Edward's and Matin's study in Bangladesh (EDWARD, 1978: MATIN, 1986), has also occurred in Indonesia. Like Boney's study in Sabah (BONEY, 1964), this study also finds that distance from the larger market centres and road improvement are influential factors in attracting big plantation investments to such areas. This results in changes in land use from other commodities to palm oil, cocoa and rubber. The shift of land use also occurs in El Salvador as found by Hirsch (HIRSCH, 1966).

During the period of study, it is likely that the total population growth and the degree of primacy changed only slightly. On the other hand, the change in the urban population growth is very significant. This finding supports Blair's study in Sierra Leone (BLAIRE, 1978) which suggests that the tendency of the people to migrate has accelerated. There is some indication from the North Sumatera case study that the provision of roads stimulates people migrating more to intermediate towns than to the primate ones in the region.

Even when allowance is made for the inadequacies of the data base in this case, the 26 investment indicators show that they have good correlations with total length of roads apart from of the 4 of the indicators. This suggests that the provision of roads may stimulate investment in the province to some extent. The distribution of this investment during the period of study can be classified into three categories of concentration characteristics: (1). more concentration on Medan and its hinterland

2. All previous experiences as comparisons to the findings of this study has been reviewed in the Chapter 2 of this study.

such as foreign and big/medium investment, (2). continuation of existing condition such as cooperatives and (3). wider spread of distribution such as small scale loan.

In contrast to Seatac's findings in Malaysia and Thailand (**SEATAC, 1979**), North Sumatera's experience suggests that the provision of roads has a good correlation with small scale loans. Both the increase in road length and the improvement of road condition have a good correlation with investment over time in the province. Nevertheless it seems that factors other than roads are more influential in producing concentration. The relatively good correlation between road indicators and investment is also indicated by the findings of Klein's study of Guatemala (**KLEIN, 1966**) and Hughes' study in Malaysia (**HUGHES, 1969**).

Investment, either foreign or domestic, big/medium industry, and activities in the transport sector appears to be concentrated in the primate city, Medan, and its hinterland. In addition, government activities, budget allocation and tax collection distribution were better by the end of the period of study. This indicates the importance of government activities in promoting the distribution of welfare in the province. In contrast to Blaikie's experience in Nepal (**BLAIKIE et al, 1977**) where road development stimulated the concentration of the government activities at Kathmandu valley, the provision of roads provided appear to have had a considerable impact on the distribution of activities in North Sumatera.

The trend of inter-regional trade through North Sumatera's ports show that the volume of exports increased, except in Pangkalan Susu and Sibolga. On the other hand, the value of exports decreased, except in Tanjung Balai and Gunung Sitoli. This shows that the relative market price of commodities from North Sumatera generally declined except for those with comparative advantages such as coconut oil from Tanjung Balai and Gunung Sitoli. Apart from Tanjung Balai and Gunung Sitoli, all the ports showed a decrease on import volumes. Except for Pangkalan Susu and Tanjung Balai, import values also decreased.

As stated previously, planning area units have been established in the province to help distribute development in the study area. It is expected that the ports can stimulate local development by promoting interregional trade. So far this objective has not been achieved. The interregional trade of the province under study has become more concentrated on Medan although there is some evidence that Tanjung Balai has had considerable increase in interregional trade. Sibolga's interregional trade has declined. The provision of roads during the study period may have had some impact on this outcome.

The findings of the study suggest that roads can promote inter-regional trade but at the same time they have stimulated concentration on the port of the primate city. North Sumatera's experience shows that traffic patterns are influenced by road improvements. This is different from Quarmby's and Bricknell's findings in the U.K. (**QUARMBY, 1986: BRICKNELL, 1986**) which show that marketing orientation has an influence on traffic flow patterns.[3]

The increase in educational and health facilities was very significant during the period of study. Despite the lack of educational facilities in Medan and its hinterland (RDU 3), the provision of these facilities, especially for senior high school teachers, were widely distributed in 1985 than in 1975. The condition of links between villages to bigger towns was probably an important factor inducing migration from villages.

3. Some experiences from developed countries such as U.K. are also reviewed in Chapter II.

Even when allowance is made for the inadequacies of the data, the role of road provision in stimulating this kind of distribution is very significant.

The findings regarding education are similar to those from the Philippines but different from those for Thailand in Seatac's study **(SEATAC, 1979)**. Seatac's study in the Philippines suggests that transport improvement induced educational development although on the other hand it shows that health development was not stimulated. In contrast, Thailand's experience suggests that road improvement did not promote educational service delivery.

Sea and air transport are complementary to road networks in the national transport network. The other mode competitors to road in the province are rail and river transport. It is likely that both modes have declined in the recent years. The use of air transport modes for short distance transport is negatively influenced by the provision of roads. This shows that roads play the most important role in the short distance travel. The study finds that the use of railways declined as roads improved. This finding supports those of Hoyle's study in Sierra Leone and the Ivory Coast **(HOYLE, 1973)** and Klein's study in Guatemala **(KLEIN, 1966)**. This study finds that there is no significant difference in the number of users of transport mode whether it is the quality or the quantity of road that is improved.

In overall terms it seems likely that the positive impacts of roads are more significant on investment and government activities than the negative impacts. On the other hand, the negative impacts of road provision and improvement are more significant on other transport modes. The provision of roads is also positively related to loading/unloading in the ports on the eastern coast of North Sumatera particularly with Belawan (Medan port) which has better facilities and has been established for a long time.

Roads and Regional Income

The second objective of this study was to investigate the impact of road development on regional growth. Three hypotheses were proposed to explore this relationship. Firstly, economic factors and types of road improvement make different contributions to regional growth. Secondly, the improvement of the road network in a region has an influence on the subregional economy within that region. Thirdly, the road network has a significant influence on GDP inequalities between subregions.

The North Sumatera development during the study period did not enable the province to catch up on the progress of the six other provinces: East Kalimantan, Riau, Aceh, DKI Jakarta, Irian Jaya, South Sumatera and Central Kalimantan. Except for DKI Jakarta and North Sumatera which have comparative advantages in industry and agriculture respectively, the main comparative advantage found in the other provinces is in the oil sector.

Nevertheless, despite the inadequacies of the data, the findings of the study suggest that roads of good and sufficient condition can play an important role in generating regional economic development, but in the long term they may result in increasing inequalities. However, improved accessibility may keep to reduce these inequalities. It also seems that roads of good condition and those of sufficient condition may have a similar effect in promoting regional economic. This suggests that a sufficient condition roads strategy could be particularly cost effective in achieving these objectives.

The fact that land use contributes more than investment to regional income supports the argument that North Sumatera is still 'at the beginning of the precondition stage to take off' or at least 'at the end of traditional society stage', if one uses Rostow's terms. The private sector or the government are willing to mobilize savings. This can be seen in the appearance of bank and other financial institution for mobilizing capital although this activity still proceeds at a limited pace within the regional economy and the society is still mainly characterised by traditional low productivity methods.

Some characteristics of traditional society still exist in North Sumatera's economy. These include a limited production function and the very high proportion of the resources that one devoted to agriculture. The basic reasons why such characteristics still exist is that modern science and technology are either not available or not regularly and systematically applied. The old social structure and values still persist and the regional based political institution that developed in conjunction with them.

The findings of the study also shows that at this stage of development, North Sumatera does not suffer from severe subregional inequalities. Difference in income between subregions are relatively small. Roads of good and sufficient condition may play important roles in stimulating regional development, but in the long term, they may also increase regional disparities. These regional inequalities may be reduced in some measure when all villages in the region can be accessed by vehicles in all weathers. Road density in the sense of effective area rather than total area is an appropriate measure in situations of this kind to identify the lack of roads in a particular region. It appears that the conventional concept of road density which is based on total area does not seem appropriate in the province under study.

The findings of the study also show that the relationship betwen income and GDP in North Sumatera is different from that found by Kuznets. This may be because this study and Kuznets' study were carried out in countries at different stages of development. As noted above North Sumatera is still a traditional society in many respects.

Roads and Transport Demand

The third objective of this study was to investigate the relationship between road networks and transport demand. Transport demand is defined as the marketing areas formed by commodity flows and the volume of traffic resulting from attraction and generation between two market centres. The hypothesis was that the volume of traffic between two nodes has a significant correlation with the development of respective market areas of the two nodes. Although the analysis was severely constrained by data problems, its findings suggest that land use contributes significantly on truck generation.

IX.2 Conclusions

The findings of the study suggest that roads may have a significant impact on the role of ports along the eastern coast in North Sumatera, particularly Belawan. In the case of air transport, road improvements have a negative impact on the number of short distance travellers. The decrease in river/lake and rail transport is also related very much to the improvement of roads. In the light of these findings it may be agreed that the role of roads seem to be important in stimulating developments in secondary towns.

Roads cannot induce the expansion of agricultural landuse although the contribution of agriculture to the total GDP is the highest among other GDP sectors. Nevertheless ten years experience in North Sumatera during the period of study shows that land consolidation is positively related to road improvement.

Road building may also have stimulated the concentration of private, foreign and transport investment in the primate city and its surroundings. Road improvements cannot assist the distribution of these types of investment. On the other hand, roads may help stimulate the distribution of government expenditure, tax collection, cooperatives and small scale loans.

Roads building may have influenced the increase in incomes but its effects on the rate of the growth probably small. Roads also give an impact on the mobility of GDP sectors. Accessibility to all villages in all weathers seems to be important to reduce regional inequalities. Accessibility to about 33 per cent of the villages in North Sumatera still depends on the weather conditions.

From the standpoint of the policy maker on the road sector, three issues which need further consideration emerge from the study. These are (1). the extent to which whole year accessibility is a key factor reducing the regional inequalities, (2) the importance of measuring road density in terms of effective areas rather than road density in total areas to identify the lack of road provision, and (3). the extent to which estimating traffic volume as a function of population (**MAKARACHI, 1989** and **ADAMS and LINDSAY, 1988**), landuse (**AHMED et al,1976; TENNANT, 1975**) and existing volume (**HOLLAND et al 1983**) without considering

investment may produce misleading results.

IX.3 Policy Implication

Despite the problems associated with the data used in the analysis the findings of from this study generally tend to support the view which states "roads are built in such a way as to serve not the needs of the indegenous population" but those of capitalist wanting "access to trade centres, ports" **(TODARO, 1985: pp 99)**[4]. This situation needs to be explicitly considered when the government formulates transport policies in the future.

No doubt, the provision of roads is necessary as a prerequisite of development. The Free market can attract private investment into one area but this tend to concentrate in the primate town. Government investment should be allocated to areas lacking private investment if a more even distribution of development is to be achieved. This reflects a dualism on the issue of 'regional development' or 'pure free market'. Despite the interpretation of the Indonesian constitution on economy, in reality, Indonesia has adopted 'mixed economy' strategy[5]. The findings of this study suggest if the economy is based only on the free market system, income disparities between subregions increase. The role of government investment in alleviating this gap is still very significant and the role of road building is very important in stimulating this investment.[6]

4. Todaro presents a big exposition of the Neo-Marxists' views on economic development according to **BERAN (1968)**, **SWEEZY (1972)** and **MAGDOFF (1969)**. It is also likely that road policy tend to follows collective consumption approach since "the intervention of the state become necessary in order to take charge of the sectors and services which are less profitable but necessary for the survival of capitalist system" **(CASTELLS, 1978: pp 18)**.
5. Indonesian 'mixed economy' gives more weight to 'free market concept'.
6. This is similar with World Bank evaluation of highways which have typically disappointing response of the productive structure of the opportunities opened by the

Recently the Indonesian government introduced IUIDP (Integrated Urban Infrastructure Development Programming) and Secondary Cities Development as part of its National Urban Development Strategy. The objective of IUIDP is to provide integrated planning and programming of infrastructure for urban development. This programme is expected to respond to critical problems of urban expansion as a result of the limitation of public sector resources. The Secondary Cities Development Program is an attempt to strengthen the role of networks of secondary cities in order to "redistribute urban population and reduce polarisation in the settlement patterns of countries with 'primate city' spatial systems (**RONDINELLI,1982; pp 537**).

The findings of this study suggest that investment in roads can be an important factors in achieving the objectives of the programme. The extent to which road networks can be used to manage urbanization depends on the level of government budget allocation to each region and its road systems. The provision of roads may not effect the total population in the region but it it may have an influence on the increase in the population of secondary cities.[7] In consequence the careful selection of road systems may be very important in achieving the objectives of Secondary Cities Development programme.

The government programme to improve the quality of roads linking some towns with very good condition roads needs to be reconsidered. The findings of this study suggest that an extensive policy of road construction may be more favourable than an intensive one in terms of reducing regional inequalities. Sufficient condition roads

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road investment because of the lack of complementary government action (**WORLD BANK, 1974**).

7. A review of the secondary cities in respect to intermediate city concept during 1961-1980 in Sumatera can be found in **WITHINGTON (1988)**.

seem to have a similar effect as good condition roads. This suggests that a lower quality of roads would be sufficient to support an extensive road policy[8].

The Inpres Jalan program which has been started since Pelita I provides a direct budget for the road sector from central government. The criteria used for this type of programme is the amount of rupiahs per head of population. The findings of this study suggest that this measure is not appropriate in the context of regional development. The proposed criteria based on the findings of this study is the length of roads per effective area.

Pelita IV and V recognize that the eastern part of Indonesia is much less developed than the western part. The eastern part of the country consists of many islands which need transport to support their development. The findings of this study show that the accessibility is a very important facts in alleviating inequalities.

The success of the planning process depends on two strategies: decentralization and community participation. Chapter V of this study showed how participation works at each stage of the development process. There are both advantages and disadvantages of this process. It can be seen that bottom-up planning starts from the village meeting which is called LKMD (Lembaga Kerukunan Masarakat Desa). The success or failure of this process depends on the democratization of LKMDs themselves in responding to their people's needs and demands. There is also no clear means of knowing how much subvention a region is likely to receive for one fiscal year before the bottom-up planning process takes place. Consequently, it is not

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8. Roads of sufficient condition are normally penetration macadam type. Many literatures have described types of road pavements. One of those is written by PROUDLOVE (1968).

unusual for a project proposal to be rejected after it has passed through all the planning stages. This can lead to disappointment and a waste of resources.

For bottom-up planning to suceed some steps should be taken. First, an environment that is sensitive to peoples' needs and demands should be created. Secondly, the amount of APBD Tkt I and APBD tkt II provided by the central government should be known before the bottom-up planning process starts. This can cut the lengthy process. Since the predominant actor regarding local development is the kabupatens/kotamadyas (dati II), it is suggested that the planning process upto this level be limited[9]. This limitation can reduce the unnecessary influence of the higher hierarchies of the government administration on local development. The other important condition is to accept that decentralization not only means discretionary power over expenditure by the local authorities' but also discretionary power over tax revenues' if such an environment to promote bottom-up planning succesfully want to be achieved.

IX.4 Further Research

Further research to develop a practical model for investment planning is proposed in the light of the findings of this study. This model should be flexible and simple enough to applied at the regional level. The outcomes of this model should identify links in the network which need to be built or those needing rehabilitation. The two basic inputs to this model are estimated traffic volumes and transport costs. The most important constraint to this model in the developing countries is the available financial resources.

9. This needs restructure of the stages of planning process from six stages to three stages: villages, kecamatans and kabupatens/kotamadyas.

To simplify the model, the actual transport costs might be taken as an input to the model rather than generated costs using transport demand and vehicle operating cost models[10]. Estimated traffic volume uses the approach which is adopted in this study but the model still needs further investigation. The four variables, as shown in Equation (VIII.1), are land use, government expenditure, private investment and population can be expanded to other variables. However, the reliability of the data for the variables to be included in the model must be investigated carefully in application to regions such as North Sumatera. The model is based on the region-wide optimization of road transport by means of mathematical programming rather than cost benefit analysis[11]. Mixed integer programming can satisfy the needs of such a model. The beauty of this model is that binary decisions (yes and no)[12] can be used in (See **TAHA, 1977** and **RAO, 1979**) for evaluation purposes.

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10. Vehicle operating costs models for developing countries have been developed by many authors such as **CHESHER** and **HARRISON** (1987) and **WATANATADA** et al (1987).
11. The introduction of cost benefit analysis on road projects can be found in **COLE** (1987), **WOHL** and **HENDRICKSON** (1984) and **WINFREY** (1975). Evaluation methodologies for transport investment in U.K. is found in **ROE** (1987).
12. It is a selection of 'to build new construction or to do nothing' or 'to rehabilitate or to do nothing'.

Appendix IA. Gross Regional Domestic Product (GRDP) of North Sumatera and Its District/Municipalitis 1975 - 1985 Current Price (Rp 000 000)

Year	North Sumatera	Nias	TapSel	TapTeng	TapUt	Labuhan Batu	Asahan	Simalungun	Dairi
1975	621289	24161	46148	11118	41307	46517	61881	66597	11475
76	764615	29658	58474	15085	52471	59963	73254	67701	13357
77	955034	38523	73486	21743	75579	70789	96913	101601	18075
78	1194037	41419	95861	23111	89368	89441	138423	105984	22457
79	1549395	56059	140241	29341	112872	110687	155715	150707	26546
80	2053949	65278	183702	36795	144502	154516	203058	172308	38082
81	2403949	74245	193217	41999	172020	178396	262302	201726	43550
82	2723534	81984	210292	47360	164888	209063	281572	224873	49680
83	3131126	85723	214664	48601	170215	213629	366553	248523	57738
84	3886811	105825	263341	57937	204278	268690	483002	313532	70006
85	4399096	122835	309061	68641	240961	304316	514150	358902	82130

Year	Karo	D.Serdang	Langkat	Sibolga	T.Balai	P.Siantar	T.Tinggi	Medan	Binjei
75	16950	67794	50626	6681	4588	13829	3723	143565	4330
76	21174	87258	69069	8658	5571	20797	4667	175818	5519
77	24487	97863	80889	12585	6434	24546	5981	202510	6788
78	29574	147592	89819	14255	8555	32109	7316	257264	9049
79	38621	186342	128160	19635	8948	43938	11790	328805	12817
80	56742	239587	182586	23609	12669	54938	17158	462767	16650
81	63306	290767	192687	23844	15803	66762	23356	548405	23387
82	74146	332789	217127	32741	21695	68050	30686	659469	27407
83	85921	350427	228337	32316	23713	85946	43661	870267	22788
84	111025	448726	286696	38204	28821	100294	54533	1038907	27341
85	133386	531466	337399	41915	31318	97194	62130	1128387	31804

Source: 1. Pendapatan Regional Kabupaten dan Kotamadya Propinsi Sumatera Utara, 1975-1983, North Sumatera Statistical Office

2. Sumatera Utara in Figures (1986), North Sumatera Statistical Office

Appendix IB. Gross Regional Domestic Product (GRDP) of North Sumatera and Its District/Municipalities 1975 - 1985 at 1975 Constant Price (Rp 000 000)

Year	North Sumatera	Nias	TapSel	TapTeng	TapUt	Labuhan Batu	Asahan	Simalungun	Dairi
1975	621289	24161	46148	11118	41307	46517	61881	66597	11475
76	677908	24409	49179	12823	43548	53039	66324	82629	11647
77	752638	29038	56185	16858	58490	55902	80576	85001	13955
78	834253	26597	63787	15129	61034	62165	99579	76945	15026
79	900796	31414	73364	15074	65222	65323	95444	97796	14548
80	978071	29553	84465	16432	71215	76397	101928	85960	18177
81	1055480	32764	84315	17638	76818	82991	121478	89571	19167
82	1101561	34151	85349	18391	66702	87462	121219	94003	19970
83	1185264	35329	89496	19419	69451	89999	153864	97071	21059
84	1283342	37607	95602	19964	75125	99009	169808	109061	22483
85	1335544	39515	99976	21479	76322	106940	167380	114858	23654

Year	Karo	D.Serdang	Langkat	Sibolga	T.Balai	P.Siantar	T.Tinggi	Medan	Binjei
1975	16950	67794	50626	6681	4588	13829	3723	143565	4330
76	18841	79506	62891	7728	5006	14689	4094	154199	4818
77	19780	73070	60645	10033	5241	16153	4795	161587	5328
78	20591	79811	60037	9671	6524	17642	5521	189608	6583
79	24459	101900	70786	11059	5768	18376	7019	196773	7470
80	28039	105356	83219	11326	6677	20861	8491	221939	8038
81	28393	117184	80643	10371	7964	24478	10731	241640	9332
82	30634	126571	85833	11320	8869	26831	12753	261281	10221
83	32590	131628	86638	11878	9075	28445	13450	285121	10751
84	37183	146432	97226	12580	9464	30689	14567	297205	11433
85	39381	156875	104099	12783	9740	33439	15578	303993	12095

Source: 1. Pendapatan Regional Kabupaten and Kotamadya Propinsi Sumatera Utara, 1975-1983, North Sumatera Statistical Office
2. Sumatera Utara in Figures (1986), North Sumatera Statistical Office

Appendix IC. Population of North Sumatera and Its District/Municipalitis 1975 - 1985

Year	North Sumatera	Nias	TapSel	TapTeng	TapUt	Labuhan Batu	Asahan	Simalungun	Dairi
1975	7365008	408180	685350	150051	649235	429015	672188	703728[illegible]	208124
76	7558357	418854	699912	153615	656645	448660	692265	714495	214368
77	7754627	430062	714604	157185	667300	469275	712512	725427	220779
78	1194037	441804	729425	160760	673881	490862	732930	736526	227357
79	8155928	454081	744376	164342	678761	513421	753519	747526	234103
80	8360894	468375	757159	167161	682437	547171	775656	759024	241785
81	8532430	481332	778381	170639	691251	560839	786121	769889	247505
82	8705968	494289	799604	174117	700064	574508	796586	780754	253225
83	8879508	507246	820826	177595	708878	588176	807052	791620	258946
84	9059353	520203	842049	187375	717692	601845	817517	802485	264666
85	9444097	540755	873380	196246	740076	622507	855883	828530	276524

Year	Karo	D.Serdang	Langkat	Sibolga	T.Balai	P.Siantar	T.Tinggi	Medan	Binjei
75	198268	1300638	596854	47879	36674	137839	33024	1041137	66824
76	202504	1321030	616766	49686	37582	140297	33804	1089213	68661
77	206822	1345864	636902	51646	38540	142863	34622	1129686	70538
78	211222	1339206	657262	53760	39547	145539	35480	1205802	72454
79	215706	1285021	677846	56026	40604	148323	89665	1278529	74410
80	219204	1241190	702059	59897	41894	150376	92087	1378955	74464
81	223128	1266739	711636	60968	42149	151037	92845	1422420	75551
82	227051	1292289	721214	62039	42403	151699	93602	1465885	76639
83	230975	1317838	730791	63110	42658	152360	94360	1509351	77726
84	234899	1343388	740369	64181	42913	153022	95118	1552817	78814
85	246028	1423253	774471	66012	44530	155750	97619	1622094	80439

Source: 1. Pendapatan Daerah Regional Kabupaten dan Kotamadya Propinsi Sumatera Utara, 1975-1983, North Sumatera Statistical Office
2. Sumatera Utara in Figures (1986), North Sumatera Statistical Office

APPENDIX ID. Gross Domestic Regional Product of Districts/Municipalities by Sectors at 1975 Constant Price (1975-1983)

The meaning of the terms in the Appendix ID

Kabupaten	=	District
Kotamadya	=	Municipalities
Lapangan Usaha	=	Sector
Pertanian	=	Agriculture
Penggalian	=	Quarrying
Industry	=	Industry
Listrik,Gas dan Air Minum	=	Elec./Gas/Water
Bangunan	=	Housing
Perdagangan, Hotel dan Restoran	=	Trade/Hotel/Restaurant
Pengangkutan dan Komunikasi	=	Transport /Communication
Bank dan Lembaga Keuangan Lainnya	=	Bank/Other Financial Institution
Sewa Rumah	=	House Rent
Pemerintahan	=	Government Administration
Jasa-Jasa	=	Services

Source: Pendapatan Regional Kabupaten dan Kotamadya Propinsi Sumatera Utara 1975-1983, North Sumatera Statistical Office

i. 1975

No.	Kabupaten/ Kotamadya	LAPANGAN USAHA: Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	Jumlah (Produk Domestik Regional Bruto)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	Nias	15948,10	4,75	263,85	7,73	293,04	2953,66	165,57	267,91	1073,25	2264,65	918,12	24160,63
2.	Tapanuli Selatan	28506,91	39,55	786,21	51,23	493,65	6251,63	1802,25	724,86	3535,35	2413,07	1542,90	46147,61
3.	Tapanuli Tengah	4537,20	2,66	1327,23	8,22	88,50	1350,36	887,10	129,10	328,75	2121,02	338,08	11118,22
4.	Tapanuli Utara	24740,22	10,76	142,05	36,85	505,45	5029,38	1593,82	1015,52	2042,51	4730,39	1460,04	41306,99
5.	Labuhan Batu	29813,97	23,26	4130,06	39,13	422,85	4137,22	2700,63	225,92	1660,95	2398,71	964,52	46517,22
6.	Asahan	42048,25	44,74	4372,02	55,85	2100,48	5035,95	1896,08	366,18	2106,82	2341,26	1513,07	61880,70
7.	Simalungun	42870,04	22,41	4851,96	58,65	1494,72	5414,44	4114,19	372,15	1488,05	4328,21	1582,67	66597,51
8.	Dairi	5626,40	7,99	11,18	6,29	92,44	1697,59	863,27	319,63	671,72	1709,26	469,00	11474,77
9.	Karo	8699,64	12,53	31,14	41,77	198,64	1795,07	1765,50	674,40	623,44	2662,04	445,80	16949,97
10.	Deli Serdang	36529,37	101,30	1808,08	95,34	5294,46	9413,94	2447,93	492,50	2379,21	6305,59	2926,71	67794,43
11.	Langkat	24726,78	45,92	6133,92	48,91	1158,41	4537,87	7072,57	207,52	2291,95	3059,43	1342,37	50625,62
12.	Sibolga	3035,16	-	202,75	58,45	163,24	1203,19	709,64	298,01	336,60	550,60	122,95	6680,59
13.	Tanjung Balai	1791,07	3,83	134,77	75,04	90,47	368,58	1093,63	195,28	228,25	512,30	94,69	4587,86
14.	Pematang Siantar	768,44	0,40	4835,29	195,27	623,45	2221,36	1553,34	650,95	1510,56	1125,14	354,54	13828,75
15.	Tebing Tinggi	205,65	10,72	428,00	70,36	358,05	565,05	1108,58	54,01	148,90	694,24	85,20	3722,76
16.	Medan	9584,72	2,15	13498,80	2139,84	5923,81	57652,12	31267,06	3848,91	7045,66	9931,00	2671,24	143565,31
17.	Binjai	345,00	8,50	324,82	35,51	371,71	859,46	847,86	130,16	502,44	732,54	172,22	4330,22
	SUMATERA UTARA	279776,84	341,53	43282,10	3024,44	19667,37	110486,87	61889,02	9973,01	27964,41	47879,45	17004,12	621289,16

ii. 1976

No.	Kabupaten/ Kotamadya	LAPANGAN USAHA											Jumlah (Produk Domestik Regional - Bruto)
		Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	N i a s	17512,13	5,11	284,78	8,59	302,60	3281,68	160,94	290,14	1101,34	2364,33	1097,31	26408,95
2.	Tapanuli Selatan	30506,17	42,54	845,47	49,59	493,72	6961,41	1961,25	800,45	3613,04	2611,35	1834,13	49719,12
3.	Tapanuli Tengah	5406,84	2,86	1710,96	8,04	95,56	1431,47	934,27	265,59	336,92	2228,21	402,08	12822,80
4.	Tapanuli Utara	26018,26	11,57	148,31	34,07	507,65	5243,95	1817,86	1164,88	2065,46	4814,36	1721,23	43547,60
5.	Labuhan Batu	34564,51	25,02	4298,89	44,46	439,97	4770,79	3179,24	284,52	1740,12	2424,82	1176,54	53038,88
6.	A s a h a n	44702,39	48,12	4918,65	58,48	2110,24	5389,97	2129,18	469,26	2173,09	2429,87	1814,32	66323,57
7.	Simalungun	37376,50	24,10	5265,17	62,27	1497,08	5753,82	4454,17	482,26	1511,17	4330,40	1871,77	62628,71
8.	D a i r i	5419,62	8,60	13,24	6,98	99,54	1834,40	971,93	313,76	692,57	1724,09	562,52	11647,25
9.	K a r o	9939,96	13,48	34,69	44,54	199,08	1922,93	1969,29	751,05	637,06	2797,87	530,83	18840,78
10.	Deli Serdang	46426,51	108,96	1845,07	108,11	5325,38	9936,46	2294,52	518,31	2422,83	7057,69	3462,27	79506,11
11.	Langkat	36545,06	49,45	5798,65	46,20	1196,47	4988,71	6823,19	328,33	2372,86	3125,55	1616,25	62890,72
12.	Sibolga	3299,41	—	507,35	53,88	163,25	1499,63	893,74	219,21	349,08	589,82	152,79	7728,16
13.	Tanjung Balai	1985,97	4,11	141,00	75,37	91,57	415,45	1291,01	137,47	233,88	514,20	115,95	5005,98
14.	Pematang Siantar	829,92	0,44	5215,10	187,67	631,08	2494,95	1585,86	592,67	1526,98	1194,77	429,96	14689,40
15.	Tebing Tinggi	192,25	11,54	504,90	61,51	360,33	628,97	1317,28	66,53	152,49	695,69	102,36	4093,85
16.	M e d a n	9787,42	2,31	14415,66	2606,15	6018,18	61703,48	34466,43	3808,04	7384,60	10672,24	3334,11	154198,62
17.	B i n j a i	381,58	9,15	345,24	129,99	376,26	934,44	963,90	113,17	516,70	836,84	211,03	4818,30
	SUMATERA UTARA	311064,50	367,36	46293,13	3585,90	19907,96	119192,51	67214,06	10605,64	28830,19	50412,10	20435,45	677908,80

iii. 1977

No.	Kabupaten/ Kotamadya	LAPANGAN USAHA											Jumlah (Produk Domestik Regional - Bruto)
		Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	Nias	17849,20	13,40	320,50	9,31	357,12	3481,46	212,76	258,77	1130,84	4217,43	1187,38	29038,17
2.	Tapanuli Selatan	32605,04	111,63	960,62	47,35	560,86	7569,27	2022,96	924,41	3691,26	5720,80	1970,41	56184,61
3.	Tapanuli Tengah	8877,60	7,52	1975,84	7,63	116,75	1601,72	948,64	234,79	345,10	2308,28	434,30	16858,17
4.	Tapanuli Utara	25110,85	30,37	158,51	37,62	14018,50	5505,00	1851,91	1036,21	2089,28	6811,74	1839,91	58489,90
5.	Labuhan Batu	35442,00	65,65	4953,10	52,79	521,94	5071,39	3391,04	285,63	1823,65	3000,09	1294,35	55901,63
6.	Asahan	44115,75	126,28	5628,74	61,32	14537,16	5809,30	2189,59	483,02	2240,08	3419,17	1966,13	80576,54
7.	Simalungun	56011,87	63,24	6019,56	61,98	1508,59	6132,59	4566,14	443,30	1534,65	6658,74	2000,36	85001,02
8.	Dairi	6551,16	22,56	14,71	10,04	121,33	2042,82	992,30	348,65	713,99	2527,79	609,74	13955,09
9.	Karo	10659,26	35,38	36,04	48,90	228,92	2025,29	2011,74	691,83	650,99	2820,49	571,23	19780,07
10.	Deli Serdang	34994,85	285,92	2111,57	103,42	6071,00	10622,94	2669,66	597,58	2461,47	9439,32	3711,90	73069,63
11.	Langkat	32357,03	129,75	6428,67	50,90	1620,76	5348,41	6378,10	377,31	2412,93	3785,04	1756,47	60645,57
12.	Sibolga	4858,83	-	584,45	63,06	183,14	1668,38	1189,18	325,85	362,75	631,95	165,44	10033,03
13.	Tanjung Balai	2153,85	10,80	142,87	78,97	96,15	449,52	1224,33	189,38	239,38	532,17	123,70	5241,53
14.	Pematang Siantar	725,21	1,16	6073,25	206,81	652,43	2798,20	1713,94	620,62	1554,64	1350,37	456,11	16152,77
15.	Tebing Tinggi	222,25	30,27	563,79	64,85	574,59	789,86	1351,37	158,82	156,31	771,64	111,30	4795,05
16.	Medan	9103,93	6,07	16543,10	3051,73	7055,36	62692,71	36187,30	3961,45	7742,28	11641,16	3601,81	161586,90
17.	Binjai	397,57	24,00	389,90	199,99	430,37	1028,89	986,65	229,67	531,31	884,73	225,19	5328,27
	SUMATERA UTARA	322036,25	964,00	52905,22	4156,70	48654,97	124637,75	69887,61	11167,29	29681,32	66520,91	22025,73	752637,75

iv. 1978

No.	Kabupaten/ Kotamadya	LAPANGAN USAHA											Jumlah (Produk Domestik Regional - Bruto)
		Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lalainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	Nias	13930,52	16,95	580,30	15,07	384,20	3685,99	245,69	386,05	1161,89	4916,03	1274,54	26597,23
2.	Tapanuli Selatan	37361,48	140,07	1192,59	73,62	582,34	8739,13	2284,73	1227,26	3770,48	6309,68	2105,87	63787,25
3.	Tapanuli Tengah	6566,24	9,44	2295,50	9,01	130,48	1610,87	958,75	319,76	353,30	2412,07	463,89	15129,31
4.	Tapanuli Utara	24372,85	38,38	203,27	56,94	14772,43	5562,63	2231,54	1495,70	2123,67	8231,68	1945,11	61034,20
5.	Labuhan Batu	39528,03	82,33	5549,82	82,62	565,42	5415,69	3365,91	418,12	1911,39	3828,69	1416,93	62164,95
6.	Asahan	59898,06	158,48	5980,82	102,76	15235,56	5941,54	2474,02	671,57	2307,45	4693,97	2115,05	99579,28
7.	Simalungun	45176,49	79,42	6390,80	74,13	1510,21	6400,64	5482,87	565,38	1558,48	7580,80	2126,54	76945,76
8.	Dairi	6364,67	28,33	25,25	15,14	135,31	2345,62	1062,81	539,42	736,00	3116,55	656,79	15025,89
9.	Karo	10780,43	44,43	78,27	68,72	239,22	2142,35	2056,67	957,04	665,16	2948,09	610,86	20591,24
10.	Deli Serdang	56525,11	358,96	2347,09	117,90	6340.45	10862,70	3140,36	1022,57	2508,63	10720,33	3867,26	97811,36
11.	Langkat	29365,62	162,96	7224,25	76,89	1862,99	5882,64	5987,63	495,79	2494,50	4586,77	1896,89	60036,93
12.	Sibolga	3389,18	-	540,81	99,17	188,47	1936,74	1619,46	620,41	377,61	719,79	179,50	9671,14
13.	Tanjung Balai	3079,19	13,56	160,47	108,77	96,65	464,68	1393,71	277,42	246,08	551,33	132,26	6524,12
14.	Pematang Siantar	690,48	1,45	6568,64	262,89	681,41	2924,50	1948,21	865,46	1583,59	1631,02	484,77	17642,42
15.	Tebing Tinggi	187,19	38,02	708,54	118,50	717,65	829,53	1547,21	260,55	160,28	834,65	118,98	5521,10
16.	Medan	10043,73	7,75	20146,08	3689,72	7456,80	75737,79	2188,03	5877,89	8040,61	12427,92	3991,67	189607,99
17.	Binjai	449,28	30,15	1012,92	293,34	451,85	1093,34	1073,09	327,21	546,21	1064,38	240,80	6582,57
	SUMATERA UTARA	347708,55	1210,67	61005,42	5265,19	5135,44	141576,38	79060,69	16327,60	30545,34	76573,75	23627,71	834252,74

v. 1979

No.	Kabupaten/ Kotamadya	LAPANGAN USAHA Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	Jumlah (Produk Domestik Regional Bruto)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	N i a s	18177,25	30,30	614,02	24,66	405,55	3901,12	261,73	345,80	1194,49	5122,84	1336,58	31414,34
2.	Tapanuli Selatan	44172,66	184,48	1241,25	88,39	590,80	9998,34	2555,29	1149,35	3850,15	6342,18	2190,84	72363,73
3.	Tapanuli Tengah	6229,23	25,35	2377,63	11,62	145,20	1642,80	1013,87	289,94	361,50	2494,12	482,32	15073,58
4.	Tapanuli Utara	26932,81	50,70	250,94	65,50	15288,97	5895,97	2477,21	1403,36	2144,92	8717,53	1994,07	65221,78
5.	Labuhan Batu	41092,94	108,42	5986,28	110,81	600,82	5857,60	3677,36	422,78	2003,56	3951,00	1511,75	65323,32
6.	A s a h a n	54831,79	208,71	5495,48	129,57	15721,32	6276,61	2707,80	634,06	2375,37	4845,71	2217,23	95443,65
7.	Simalungun	65359,10	91,84	6009,68	89,53	1514,56	6646,79	5549,19	466,43	1582,71	7688,21	2198,04	97796,08
8.	D a i r i	5640,49	37,15	29,91	17,58	150,20	2361,96	1073,55	425,28	758,59	3365,08	688,69	14548,48
9.	K a r o	14429,84	58,68	109,64	80,09	245,33	2217,73	2084,08	824,91	679,65	3095,87	633,49	24459,31
10.	Deli Serdang	59352,34	456,81	2424,60	116,24	6483,80	11343,59	3303,46	1072,11	2496,40	11069,12	3781,77	101900,24
11.	Langkat	37373,60	214,61	7033,88	100,13	1987,70	6180,97	7986,24	445,15	2376,93	4893,22	1994,07	70786,50
12.	Sibolga	3590,11	-	126,29	126,75	190,26	2117,82	2872,85	707,53	393,71	744,28	189,13	11058,74
13.	Tanjung Balai	2236,89	25,83	162,01	121,71	97,63	495,56	1450,98	233,14	252,69	534,25	137,35	5768,04
14.	Pematang Siantar	508,69	1,91	6682,88	399,63	683,43	3010,52	2042,54	1198,11	1613,78	1734,00	500,55	18376,04
15.	Tebing Tinggi	419,23	51,66	1095,52	152,24	876,19	994,79	1594,23	354,02	338,97	863,04	279,55	7019,44
16.	M e d a n	9525,14	9,89	21183,85	4786,39	7750,53	80299,48	41838,91	6069,20	8449,81	12573,51	4291,49	196773,20
17.	B i n j a i	478,66	38,11	1590,26	360,26	463,13	1186,36	1117,25	229,92	561,48	1124,33	250,16	7469,67
	SUMATERA UTARA	390350,78	1594,45	630013,87	6781,10	53195,22	150428,01	83606,54	16341,09	31629,71	79178,29	24677,08	900796,14

vi. 1980

No.	Kabupaten/ Kotamadya	LAPANGAN USAHA Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lalainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	Jumlah (Produk Domestik Regional - Bruto)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	N i a s	15759,05	48,11	451,90	37,00	452,04	3933,84	344,99	467,73	1228,67	5223,31	1606,17	29552,81
2.	Tapanuli Selatan	53287,57	191,93	1281,52	105,12	639,47	10377,89	3385,12	1225,69	3930,91	7447,26	2592,81	84465,29
3.	Tapanuli Tengah	7031,14	29,69	2438,01	12,23	168,14	1679,11	1244,92	329,30	369,30	2556,27	573,63	16432,22
4.	Tapanuli Utara	28830,41	52,42	281,12	83,76	16796,93	5994,70	3434,99	1677,72	2158,79	9560,45	2343,28	71214,57
5.	Labuhan Batu	48616,64	112,97	6597,99	126,55	675,31	6466,21	5079,96	660,76	2100,26	4081,51	1878,64	76396,80
6.	A s a h a n	58745,69	217,31	4631,40	160,96	17135,22	6353,55	3324,39	840,54	2446,13	5410,77	2661,65	101927,61
7.	Simalungun	50348,68	92,23	6792,78	93,65	1535,29	6870,38	6929,36	656,51	1606,59	8427,17	2607,15	85959,79
8.	D a i r i	8577,18	38,65	37,19	22,51	173,65	2424,04	1326,78	555,03	781,89	2408,35	831,77	18177,04
9.	K a r o	16687,54	61,05	140,20	66,09	267,37	2341,56	2683,05	952,11	694,36	3391,32	754,33	28038,98
10.	Deli Serdang	59408,25	458,68	2862,05	144,24	7028,71	11524,01	4124,34	1385,34	2399,20	11758,84	4262,08	105355,74
11.	Langkat	47697,64	219,97	7972,00	107,81	2535,84	6269,78	7617,48	624,85	2660,04	5104,02	2409,25	83218,68
12.	Sibolga	3410,04	—	148,75	162,94	203,97	2513,67	2563,18	871,42	411,00	809,48	231,37	11325,82
13.	Tanjung Balai	2299,58	26,87	190,83	139,09	99,23	586,45	1983,56	289,58	259,62	639,07	163,54	6677,42
14.	Pematang Siantar	653,95	1,99	6860,59	481,97	686,33	3467,12	2769,06	1702,57	1645,19	2002,41	589,68	20860,86
15.	Tebing Tinggi	478,83	55,41	1168,31	198,53	1135,62	1180,82	2034,59	499,50	348,31	1031,03	359,85	8490,80
16.	M e d a n	12067,30	13,60	2642,28	7797,01	8555,73	84394,39	52031,16	7000,11	8989,75	13096,62	5350,86	221938,81
17.	B i n j a i	526,88	37,99	1490,90	263,81	485,12	1252,36	1469,46	372,43	577,10	1261,09	300,70	8037,84
	SUMATERA UTARA	414426,37	1658,87	65987,82	10003,27	58573,97	157629,88	10236,39	20111,19	32607,59	85208,97	2916,76	97807,08

vii. 1981

No.	Kabupaten/ Kotamadya	LAPANGAN USAHA											Jumlah (Produk Domestik Regional - Bruto)
		Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	N i a s	17697,49	48,69	464,70	48,21	627,43	4278,14	339,03	651,06	1249,56	5627,47	1732,67	32764,45
2.	Tapanuli Selatan	50288,31	194,41	1478,54	137,60	857,99	10492,22	4182,22	1538,34	4001,06	8384,88	2795,13	8431 4,83
3.	Tapanuli Tengah	7045,34	30,22	2777,03	16,52	245,68	1803,13	1553,91	578,73	378,89	2585,33	623,89	17638,67
4.	Tapanuli Utara	33445,94	52,88	306,26	112,40	14608,21	6263,21	3951,66	2144,23	2193,28	11216,07	2523,34	76817,55
5.	Labuhan Batu	52685,95	114,33	7538,90	205,00	944,92	6644,29	5625,34	945,36	2123,28	4150,14	2013,73	82991,24
6.	A s a h a n	77242,77	219,93	4792,47	201,83	15674,79	6531,85	414,75	1061,49	2447,99	6336,98	2826,02	121477,87
7.	Simalungun	49830,84	93,34	7698,52	117,35	1904,96	7009,44	8017,92	922,55	1644,73	9505,48	2826,02	89571,15
8.	D a i r i	8450,09	39,29	39,70	25,77	249,46	2712,13	1713,87	700,61	803,34	3528,11	904,94	19167,31
9.	K a r o	14908,80	61,61	135,30	81,35	359,0	2457,87	3401,91	1445,25	710,96	3994,63	818,46	28393,21
10.	Deli Serdang	63733,06	462,36	3485,55	188,85	9464,33	12005,36	5315,31	2092,35	2423,48	13451.51	4561,78	117183,94
11.	Langkat	41364,25	225,97	8311,30	175,78	3866,61	6491,46	8423,41	742,32	2679,64	5792,70	2569,67	80643,11
12.	Sibolga	2983,10	—	158,80	192,08	272,14	2566,82	13551,82	1210,72	414,88	971,93	248,29	10370,58
13.	Tanjung Balai	2813,37	27,03	203,72	195,72	124,73	675,13	2295,14	403,57	263,58	787,26	174,79	7964,04
14.	Pematang Siantar	1009,40	2,02	7755,44	641,89	880,67	3785,13	3180,44	2566,96	1608,97	2439,55	607,53	24478,00
15.	Tebing Tinggi	500,43	54,40	1435,61	270,01	1825,59	1423,43	2352,46	760,77	353,54	1370,42	384,56	10731,22
16.	M e d a n	7077,43	13,93	25572,49	7962,97	11713,24	88208,54	62009,38	8486,28	9282,84	15482,84	5830,00	241639,94
17.	B i n j a i	612,61	38,45	1495,05	401,40	653,88	1347,41	1855,05	434,15	579,53	1603,69	318,28	9332,50
	SUMATERA UTARA	431689,18	1678,86	73667,38	10974,73	64273,77	164688,69	119710,62	26684,74	33159,55	97192,99	31759.10	1055479,61

viii. 1982

No.	Kabupaten/ Kotamadya	LAPANGAN USAHA: Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	Jumlah (Produk Domestik Regional Bruto)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	N i a s	17889,58	61,48	474,31	54,20	832,76	4479,42	414,55	863,08	1261,16	6053,28	1766,98	34150,80
2.	Tapanuli Selatan	49090,99	195,92	1489,93	155,01	1090,78	10930,78	4370,87	1983,58	4056,69	9117,54	2866,99	85348,82
3.	Tapanuli Tengah	7106,33	41,62	2783,23	18,60	342,03	1880,02	1682,03	774,30	382,95	2741,71	638,51	18391,33
4.	Tapanuli Utara	34533,68	62,87	316,18	126,45	1272,46	6525,18	4405,86	2677,05	2206,01	12009,79	2566,70	66702,23
5.	Labuhan Batu	54606,18	122,25	7576,57	229,12	1259,05	6921,86	6101,90	1435,38	2177,52	4945,84	2086,24	87461,91
6.	A s a h a n	81633,13	229,01	10529,99	225,55	4064,85	6804,61	4456,65	1205,48	2474,91	6709,14	2885,96	121219,28
7.	Simalungun	52026,43	94,04	7737,35	130,39	2309,91	7320,28	8857,93	1017,00	1659,84	9966,94	2882,80	94002,91
8.	D a i r i	8137,69	40,05	41,61	28,84	346,98	2833,67	1994,69	920,15	816,00	3881,41	929,32	19970,41
9.	K a r o	15765,43	62,17	157,84	88,62	465,95	2569,91	3817,68	1610,38	716,79	4548,02	831,33	30634,12
10.	Deli Serdang	67709,96	463,93	3538,56	211,91	12164,22	12518,91	5718,02	2422,40	2462,24	14676,24	4684,55	126570,94
11.	Langkat	42392,73	227,44	8467,11	196,79	5536,85	6763,62	9416,32	1153,76	2687,66	6386,58	2604,63	85833,49
12.	Sibolga	2944,86	—	166,44	214,01	346,98	2686,57	1415,47	1762,96	420,83	1107,44	254,04	11319,60
13.	Tanjung Balai	2547,13	27,86	213,52	219,21	153,66	705,13	2900,43	754,93	265,09	903,15	179,04	8869,15
14.	Pematang Siantar	1105,54	2,09	7791,35	704,04	1075,65	3966,38	3425,55	3557,67	1618,44	2967,50	616,37	26830,58
15.	Tebing Tinggi	551,07	56,42	1446,07	303,13	2800,65	1492,77	2825,36	1004,61	355,24	1562,76	390,70	12752,78
16.	M e d a n	7051,74	14,46	25707,93	8862,18	15282,11	92065,09	67323,64	11202,78	9449,02	18310,35	6011,49	261280,79
17.	B i n j a i	677,44	39,88	1509,50	451,30	837,71	1401,65	2114,57	617,41	583,02	1666,53	322,46	10221,47
	SUMATERA UTARA	415769,91	1741,49	79947,49	12219,35	50182,34	171865,85	131241,52	34962,92	33593,41	107518.23	32518,11	1101560,61

ix. 1983

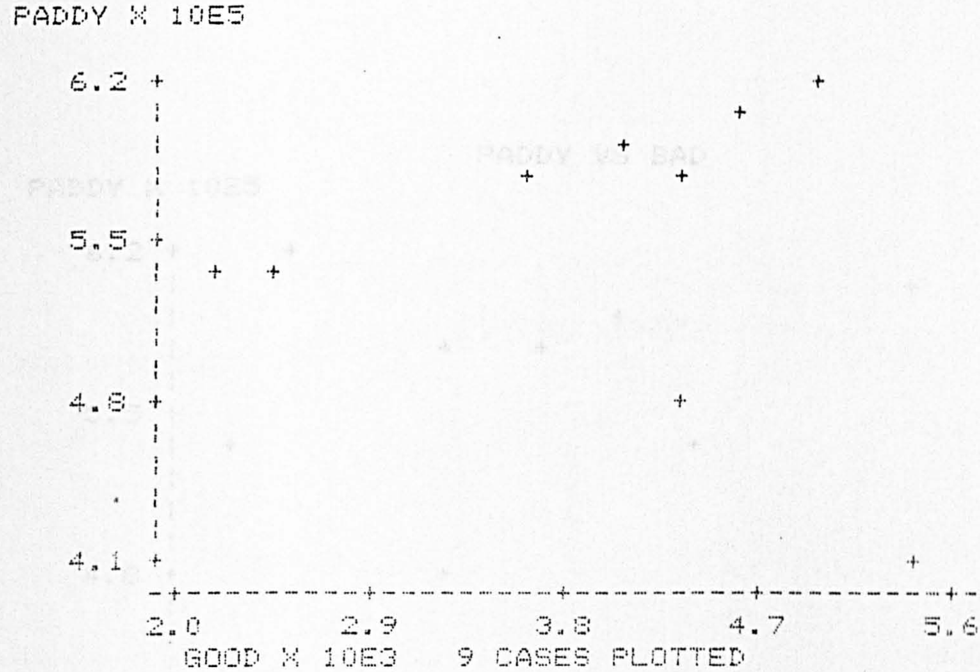
No.	Kabupaten/ Kotamadya	LAPANGAN USAHA: Pertanian	Penggalian	Industri	Listrik Gas dan Air minum	Bangunan	Perdagangan Hotel dan Restoran	Pengangkutan & Komunikasi	Bank dan Lembaga keuangan lainnya	Sewa Rumah	Pemerintahan	Jasa-Jasa	Jumlah (Produk Domestik Regional - Bruto)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1.	N i a s	18128,97	68,71	483,76	62,65	819,27	4969,02	516,78	980,32	1290,32	6092,18	1916,91	35329,43
2.	Tapanuli Selatan	49775,55	218,98	1527,59	177,05	1070,98	12461,68	5358,46	2453,49	4166,88	9176,14	3108,80	89495,60
3.	Tapanuli Tengah	7233,50	46,52	2860,02	20,18	335,61	2093,25	2043,80	940,94	392,26	2759,33	693,20	19418,61
4.	Tapanuli Utara	35037,29	70,27	320,97	143,72	1253,59	7355,72	4588,88	3580,60	2229,67	12086,97	2783,41	69451,09
5.	Labuhan Batu	55381,52	136,64	7776,71	260,42	1238,78	7649,16	6567,20	1504,31	2243,44	4977,62	2263,51	89999,31
6.	A s a h a n	82778,42	255,96	41016,70	257,23	3997,66	6377,56	5250,24	1529,54	2518,71	6752,25	3130,01	153864,28
7.	Simalungun	52759,38	105,11	7941,60	147,63	2270,28	1857,80	9472,18	1383,49	1675,70	10030,99	3126,48	97070,64
8.	D a i r i	8273,32	44,77	41,98	33,22	340,54	3090,97	2352,18	1138,52	829,25	3906,35	1007,97	21059,07
9.	K a r o	16004,13	69,49	160,41	108,41	458,99	2856,21	4249,20	2474,99	729,46	4577,25	901,87	32590,41
10.	Deli Serdang	68673,09	518,54	3616,92	242,48	11963,38	13987,60	6282,51	3982,00	2508,38	14770,55	5082,30	131627,75
11.	Langkat	42994,15	254,21	7860,93	224,42	5448,67	7473,10	9108,46	1274,55	2745,80	6427,63	2825,86	86637,78
12.	Sibolga	2983,82	-	167,93	244,53	340,54	2895,34	1420,66	2001,05	430,11	1114,55	279,40	11877,93
13.	Tanjung Balai	2576,94	31,14	215,43	249,88	153,00	762,96	2946,60	768,02	264,95	908,96	198,06	9075,74
14.	Pematang Siantar	1130,24	2,34	7998,37	792,26	1056,17	4362,57	3707,09	4079,08	1655,05	2986,57	675,52	28445,26
15.	Tebing Tinggi	542,51	63,08	1482,86	346,20	2753,95	1584,61	320,95	1156,02	354,40	1536,57	427,95	13450,10
16.	M e d a n	7143,09	16,16	26383,79	10042,23	15028,25	107968,63	71282,58	12449,88	9785,79	18428,03	6592,48	285120,91
17.	B i n j a i	678,14	44,57	1546,42	516,15	824,21	1584,60	2310,88	626,31	588,38	1677,25	353,67	10750,58
	SUMATERA UTARA	452094,06	1946,49	111402,39	13868,66	49353,87	195630,78	140659,45	42323,65	34408,55	108209,19	35367,40	1185264,49

Appendix II. Distances Between Municipalities/District Towns in North Sumatera (kms)

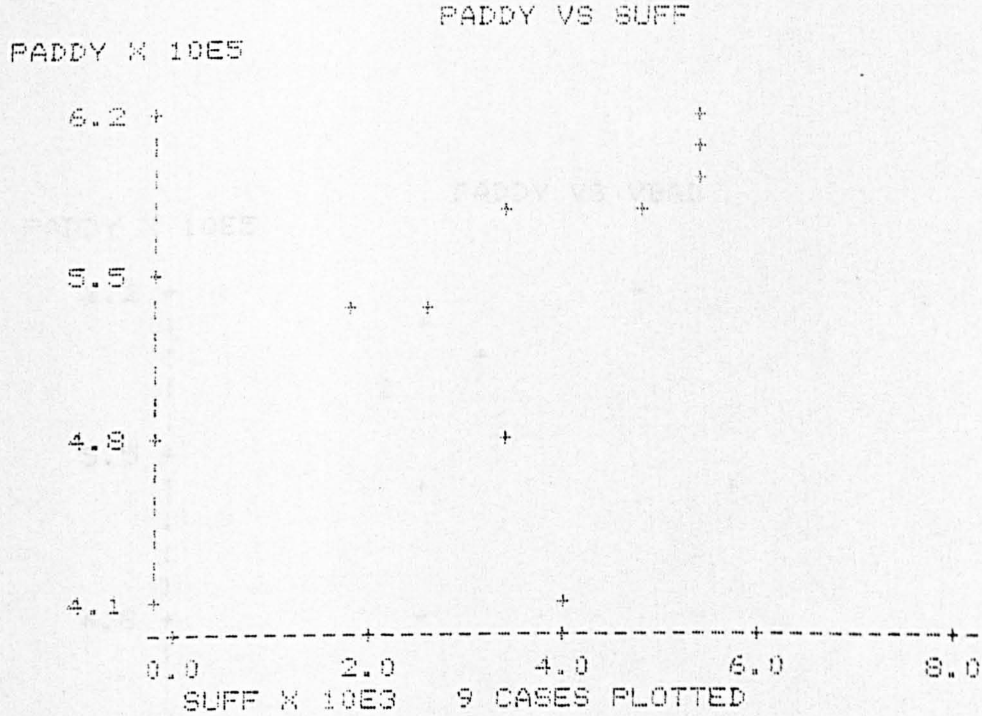
Towns	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Lubuk Pakam	-														
2. Stabat	72	-													
3. Kabanjahe	105	119	-												
4. P. Siantar	99	171	214	-											
5. Kisaran	144	216	249	139	-										
6. Rantau Parapat	259	331	364	254	115	-									
7. Sibolga	320	392	425	221	352	237	-								
8. M e d a n	29	43	76	128	173	288	349	-							
9. P. Sidempuan	408	980	513	309	264	149	88	437	-						
10. Tarutung	254	326	218	155	418	303	66	283	154	-					
11. Sidikalang	182	196	77	373	326	441	207	153	295	141	-				
12. T. Balai	157	229	262	152	13	128	373	186	277	431	339	-			
13. Binjei	51	21	98	150	195	310	371	22	459	305	175	164	-		
14. T.Tinggi	52	124	157	47	92	207	268	81	356	202	234	105	103	-	
15. Belawan	55	69	102	154	107	314	375	26	463	309	179	212	48	170	-

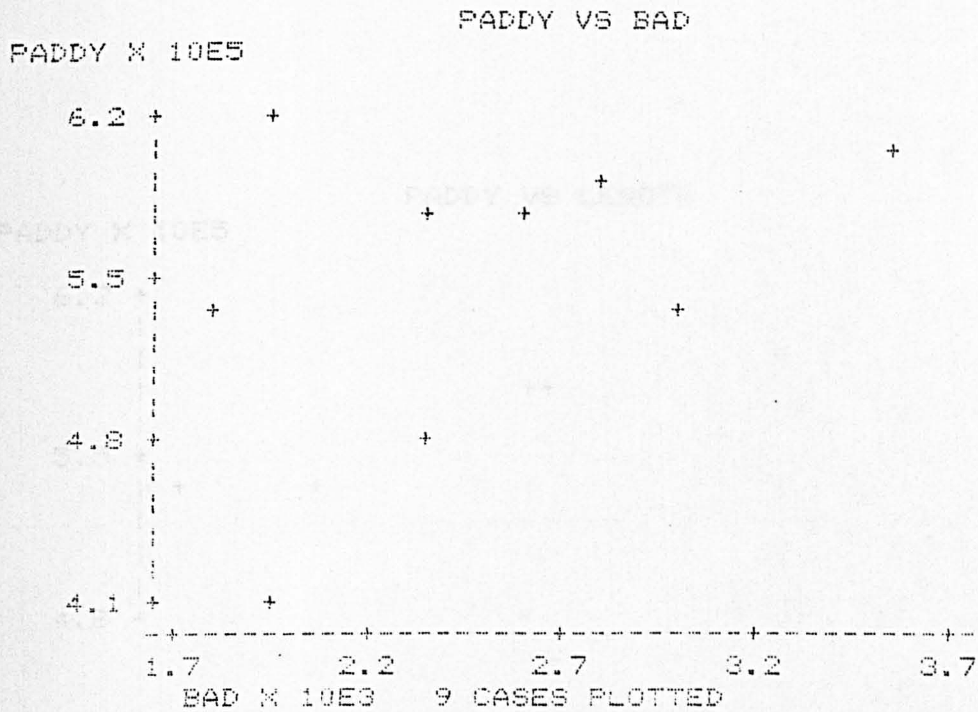
APPENDIX III. XY Graphical Plots between Road and Development Indicators

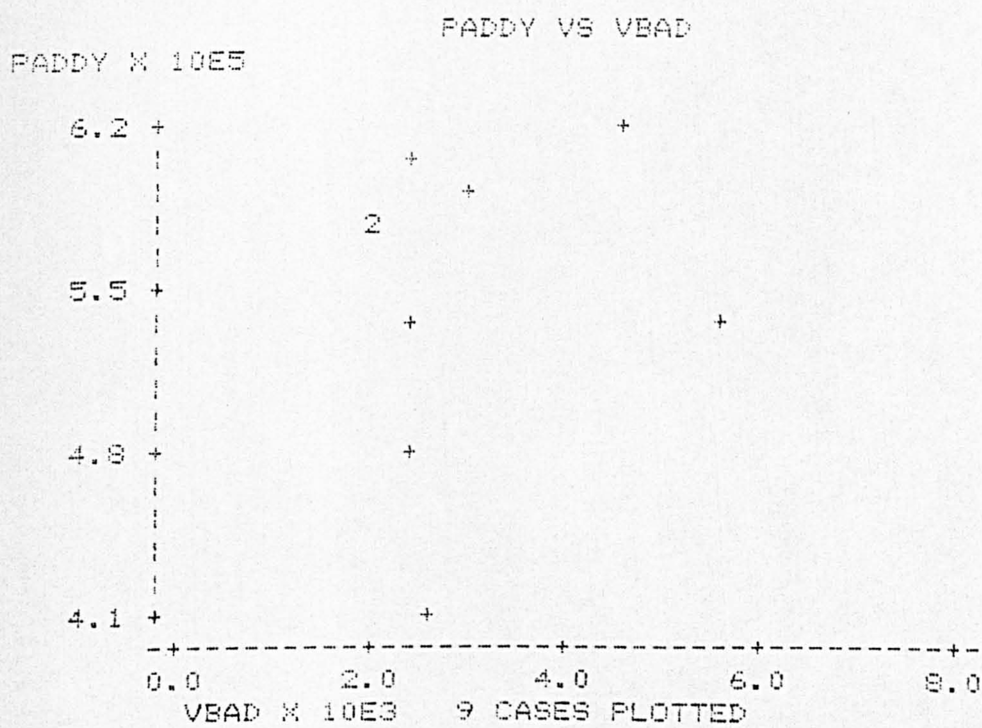
PADDY VS GOOD



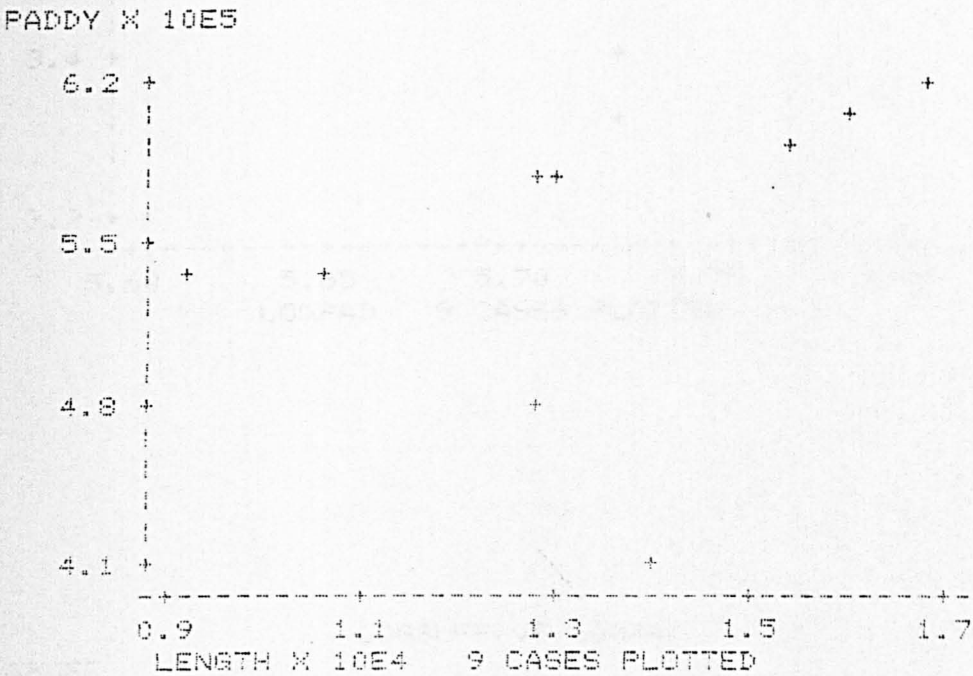
PADDY VS SUFF



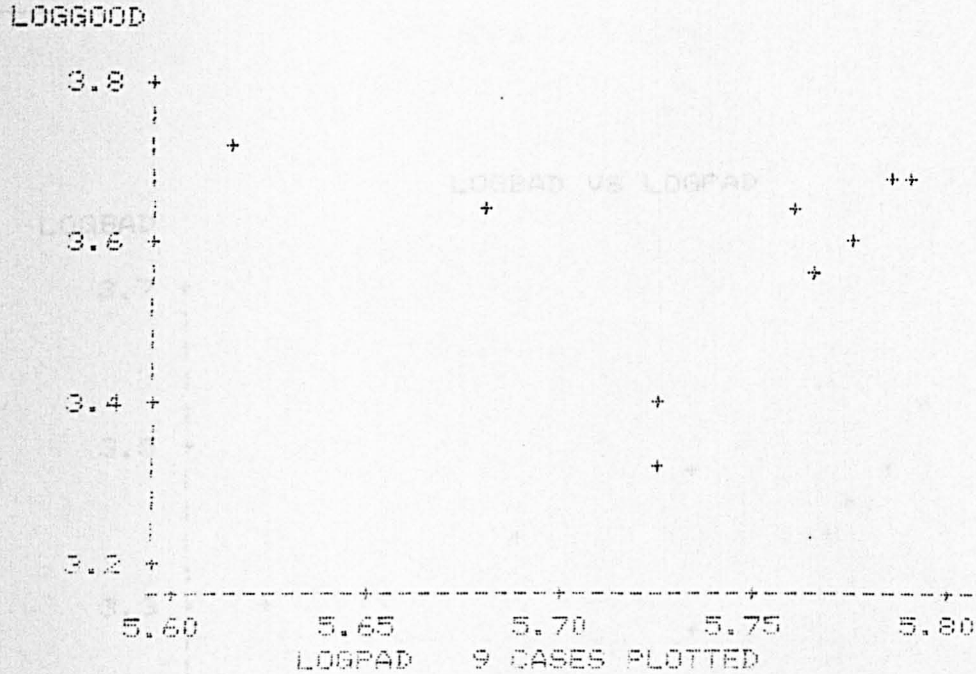

PADDY VS BAD
PADDY X 10E5
6.2
5.5
4.8
4.1
1.7
2.2
2.7
3.2
3.7
BAD X 10E3   9 CASES PLOTTED


PADDY VS VBAD
PADDY X 10E5
6.2
5.5
4.8
4.1
0.0
2.0
4.0
6.0
8.0
VBAD X 10E3   9 CASES PLOTTED

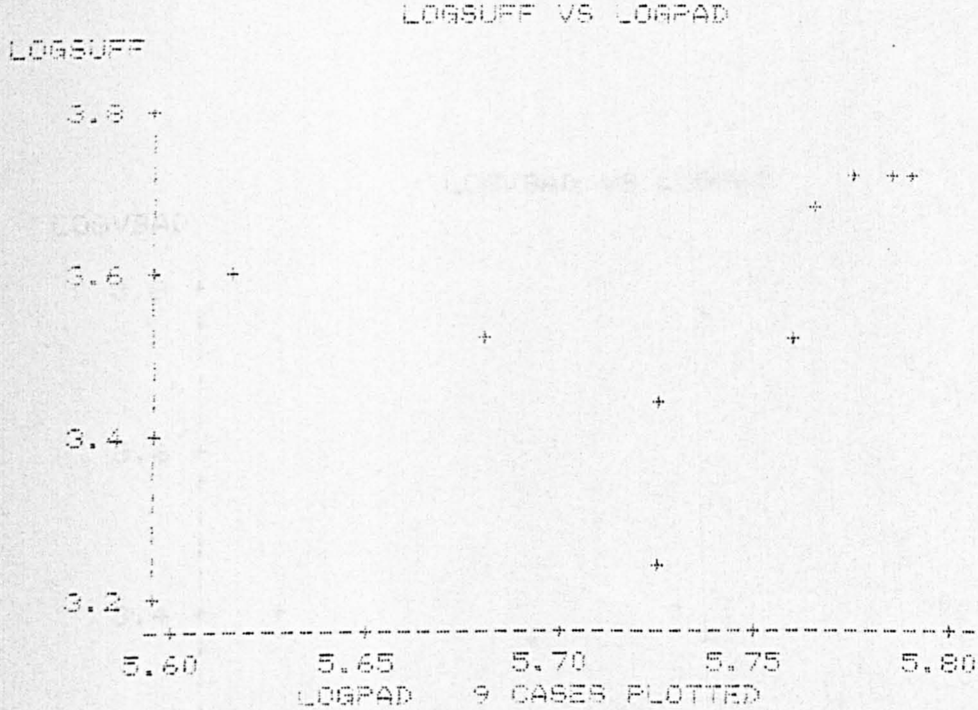
PADDY VS LENGTH

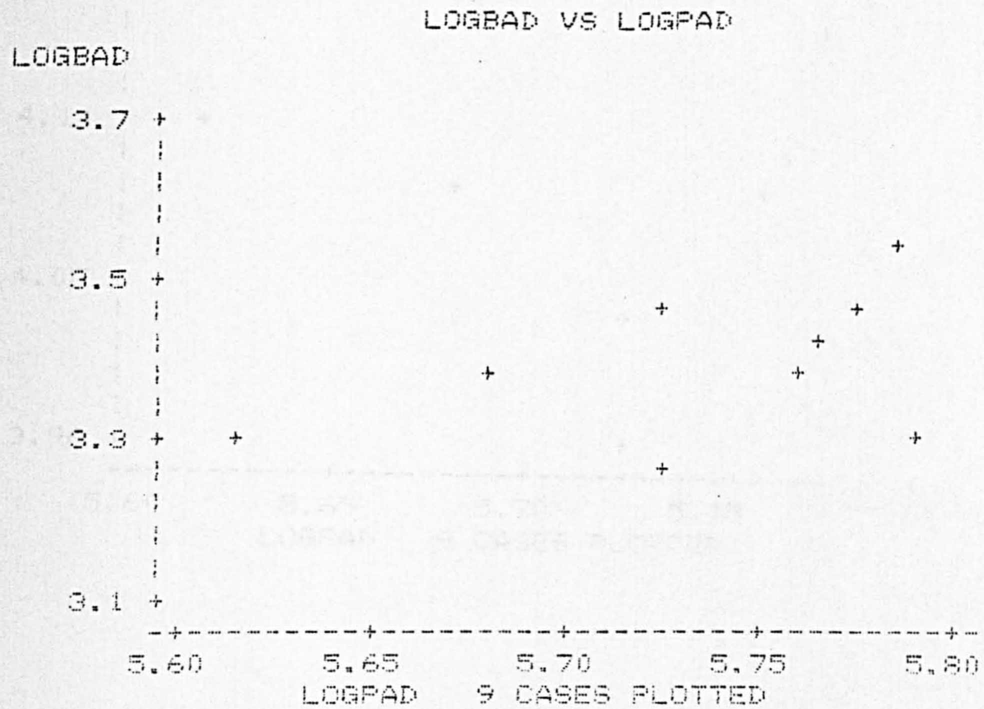


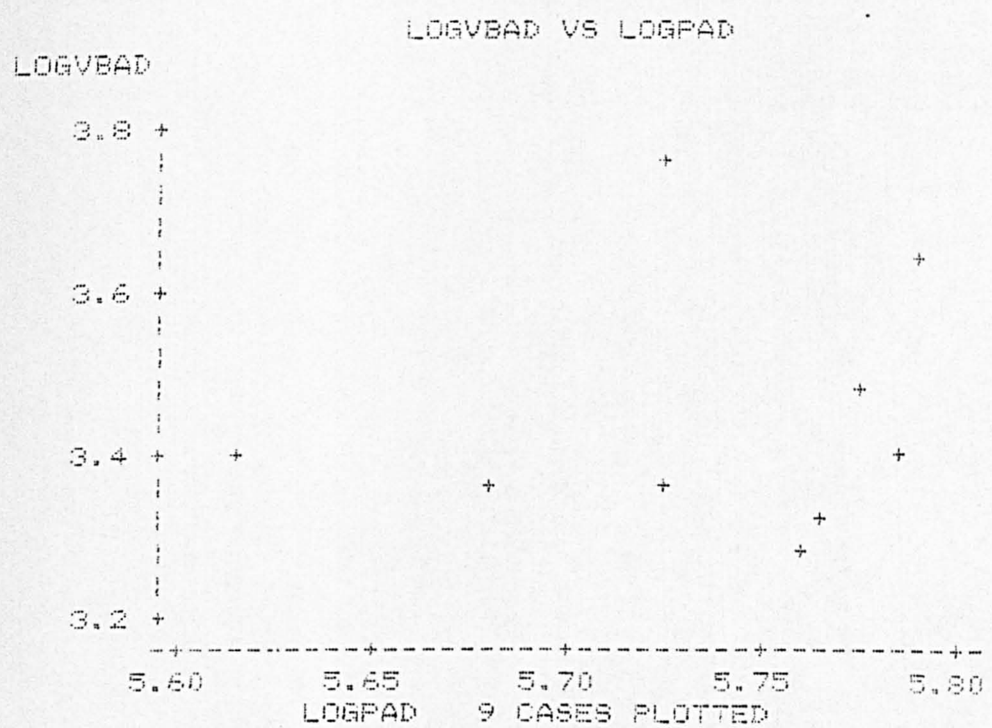
LOGGOOD VS LOGPAD



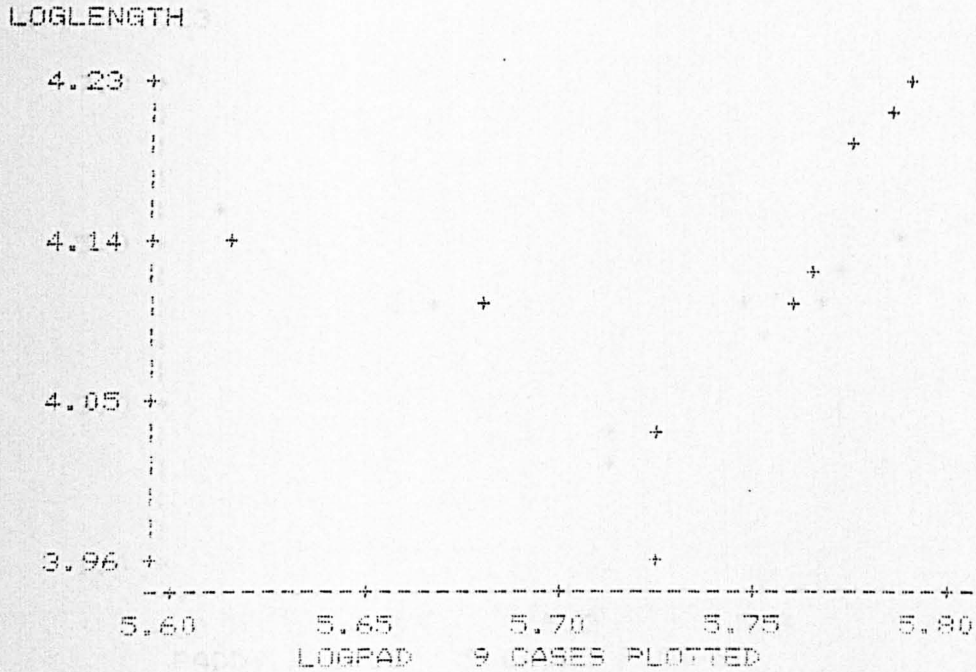
LOGSUFF VS LOGPAD



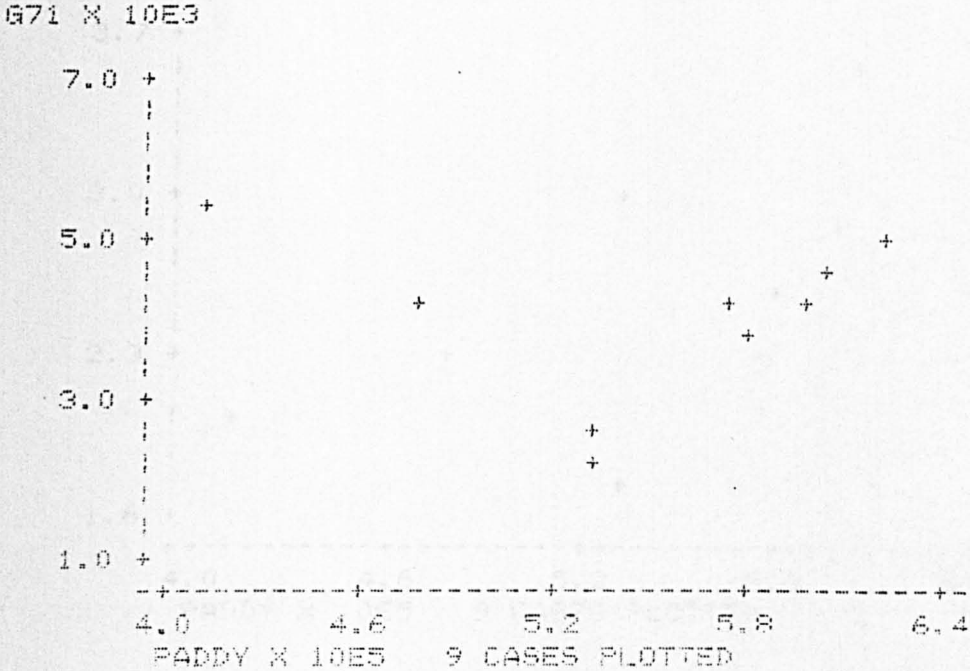

LOGBAD VS LOGPAD
LOGBAD
3.7
3.5
3.3
3.1
5.60
5.65
5.70
5.75
5.80
LOGPAD 9 CASES PLOTTED


LOGVBAD VS LOGPAD
LOGVBAD
3.8
3.6
3.4
3.2
5.60
5.65
5.70
5.75
5.80
LOGPAD 9 CASES PLOTTED

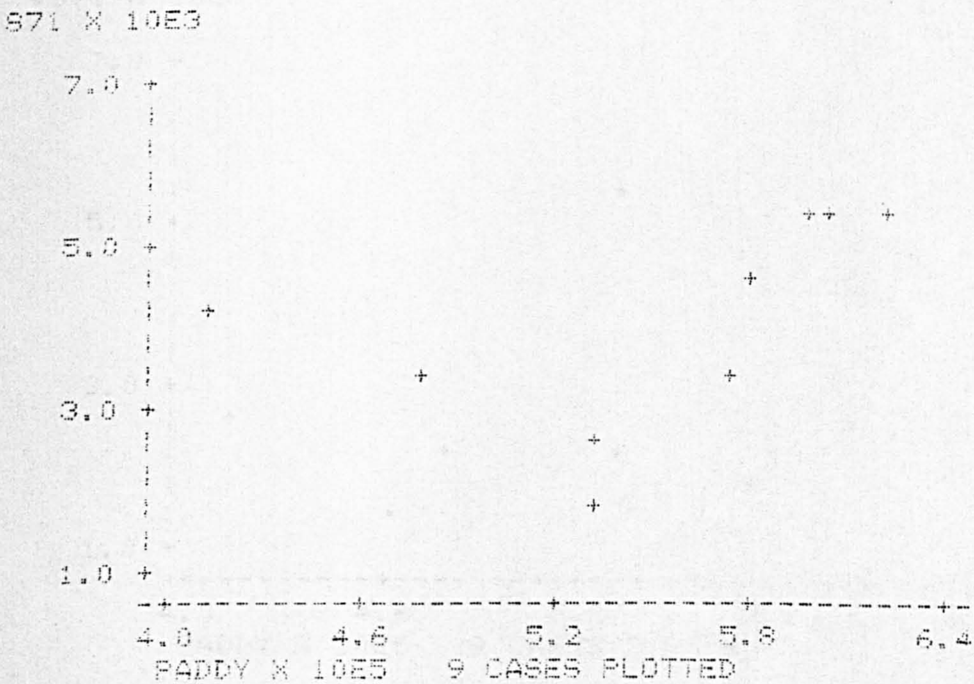
LOGLENGTH VS LOGPAD

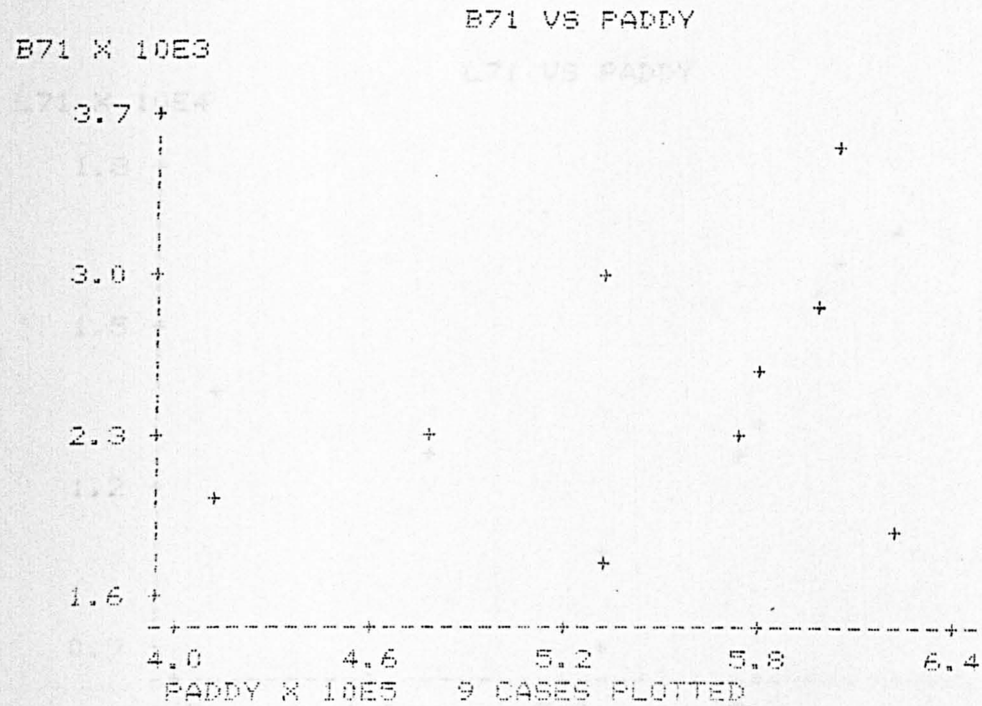


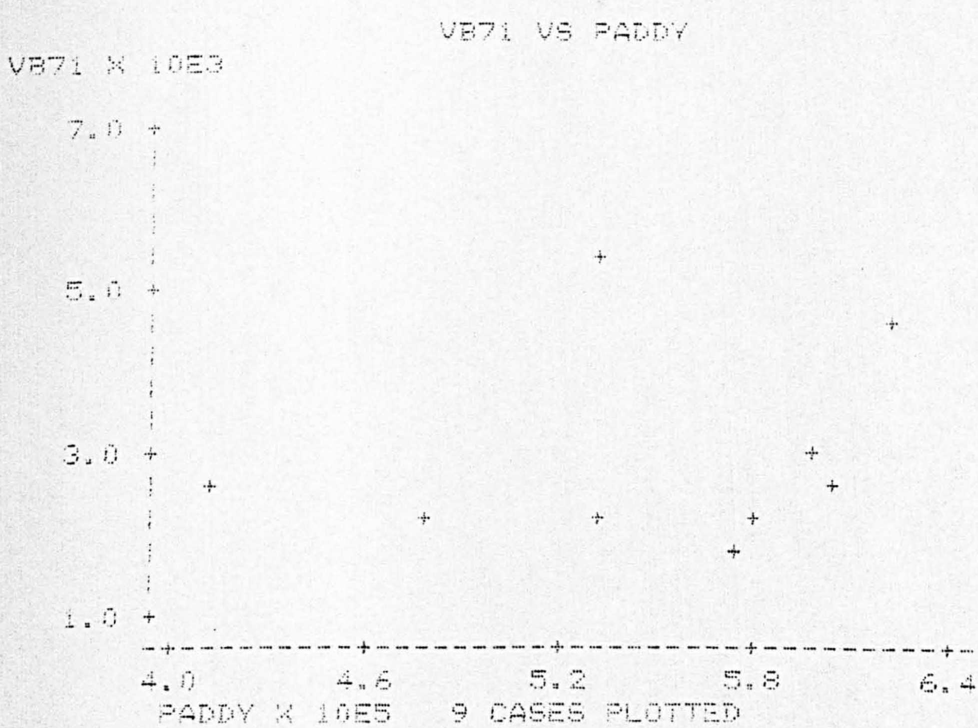
G71 VS PADDY

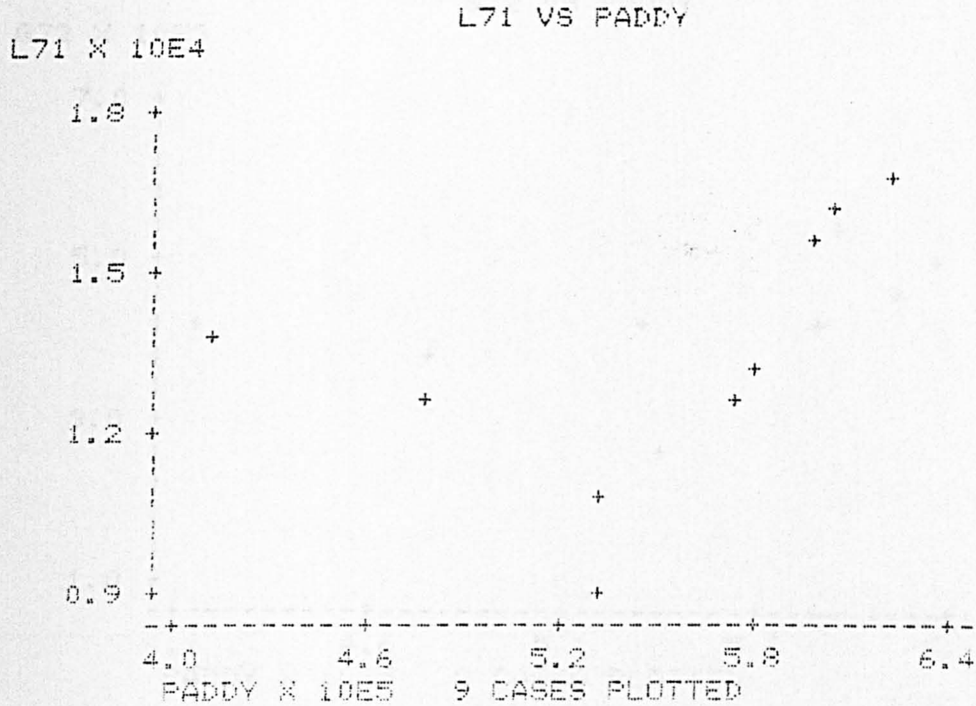


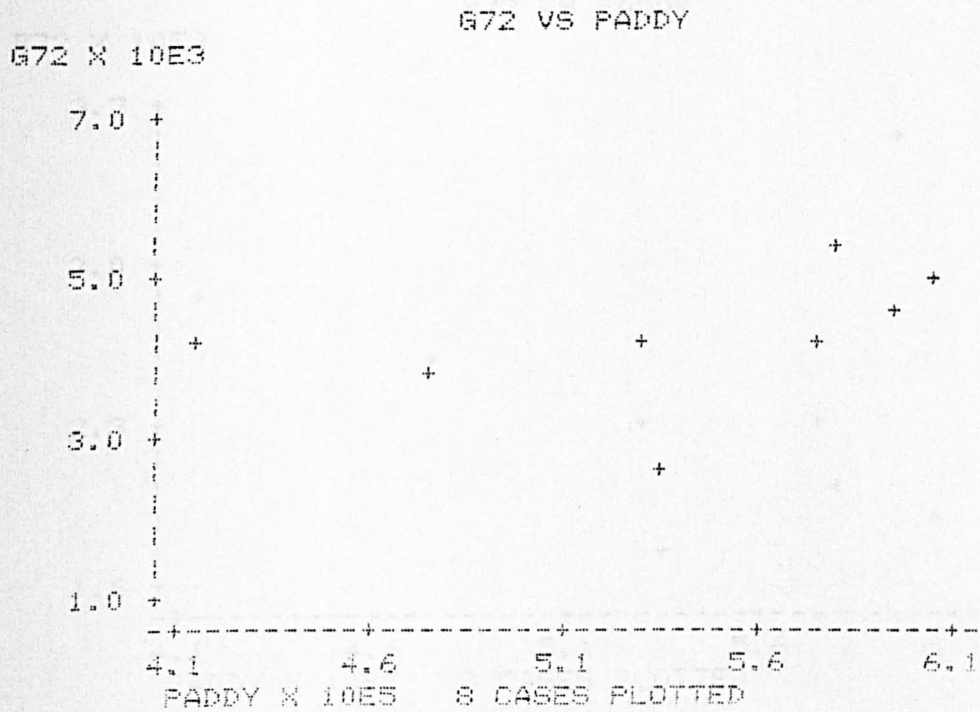
S71 VS PADDY

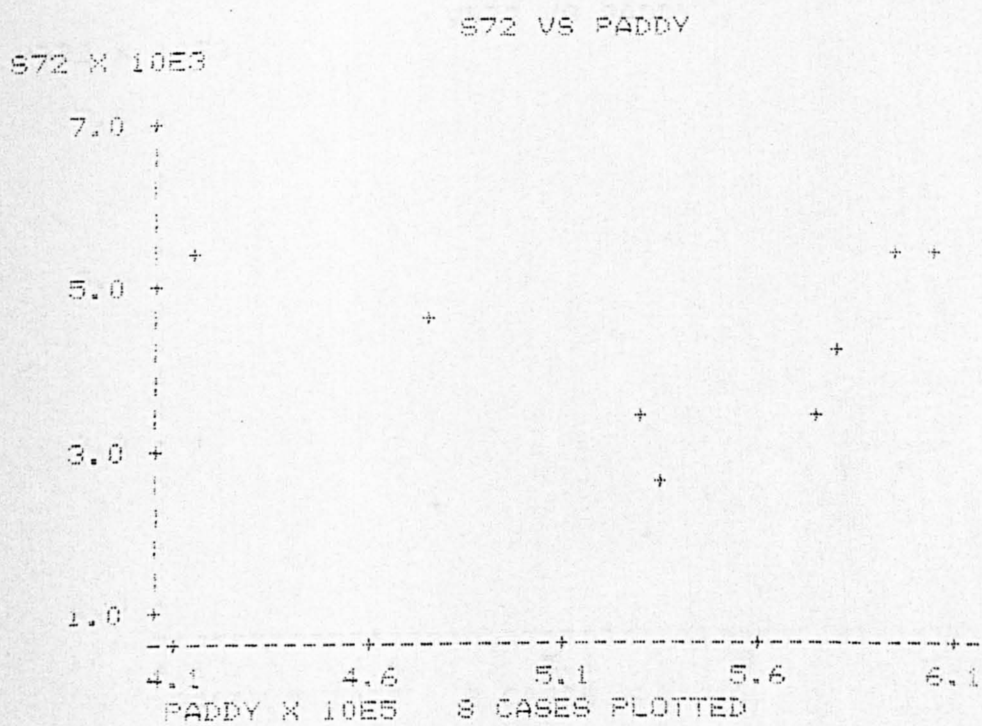


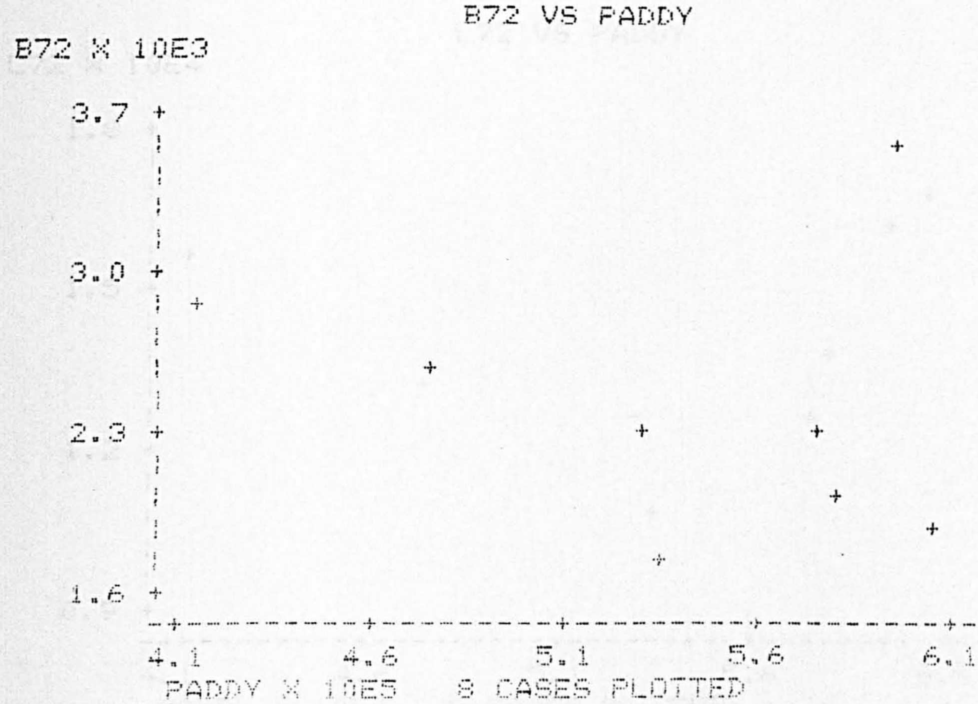

B71 VS PADDY
B71 X 10E3
3.7
3.0
2.3
1.6
4.0
4.6
5.2
5.8
6.4
PADDY X 10E5   9 CASES PLOTTED


VB71 VS PADDY
VB71 X 10E3
7.0
5.0
3.0
1.0
4.0
4.6
5.2
5.8
6.4
PADDY X 10E5   9 CASES PLOTTED

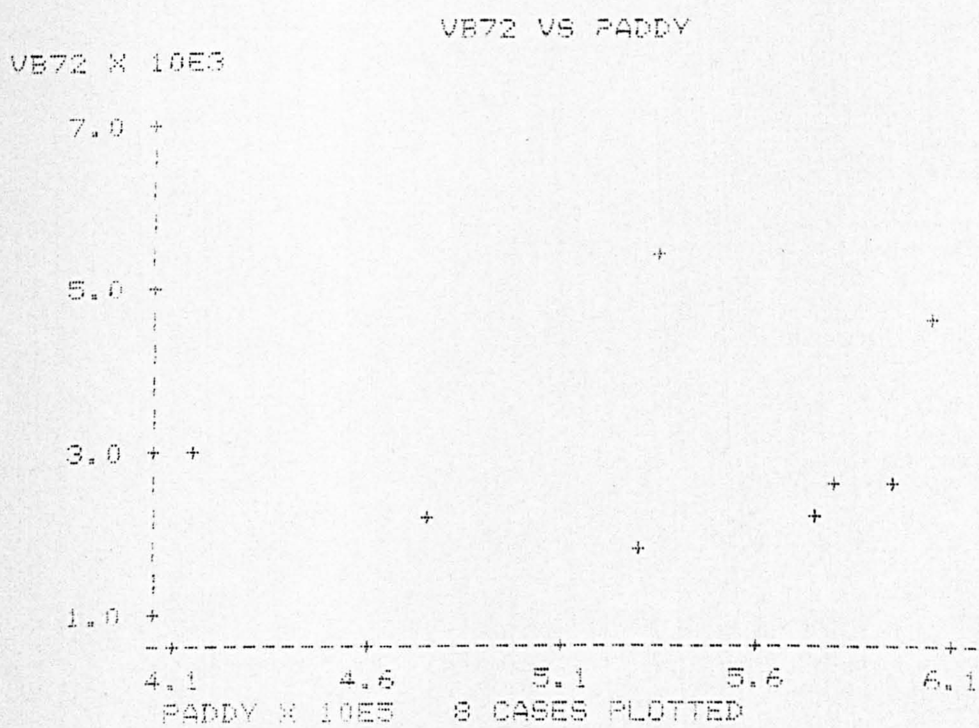

L71 VS PADDY
L71 X 10E4
1.8
1.5
1.2
0.9
4.0
4.6
5.2
5.8
6.4
PADDY X 10E5   9 CASES PLOTTED


G72 VS PADDY
G72 X 10E3
7.0
5.0
3.0
1.0
4.1
4.6
5.1
5.6
6.1
PADDY X 10E5 8 CASES PLOTTED

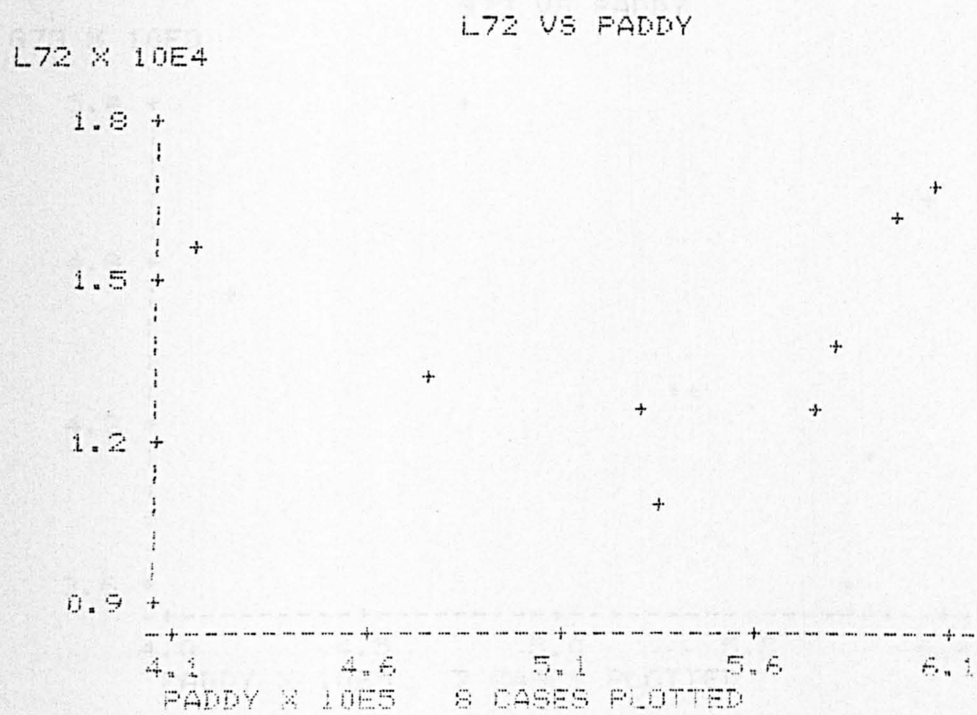

S72 VS PADDY
S72 X 10E3
7.0
5.0
3.0
1.0
4.1
4.6
5.1
5.6
6.1
PADDY X 10E5 8 CASES PLOTTED

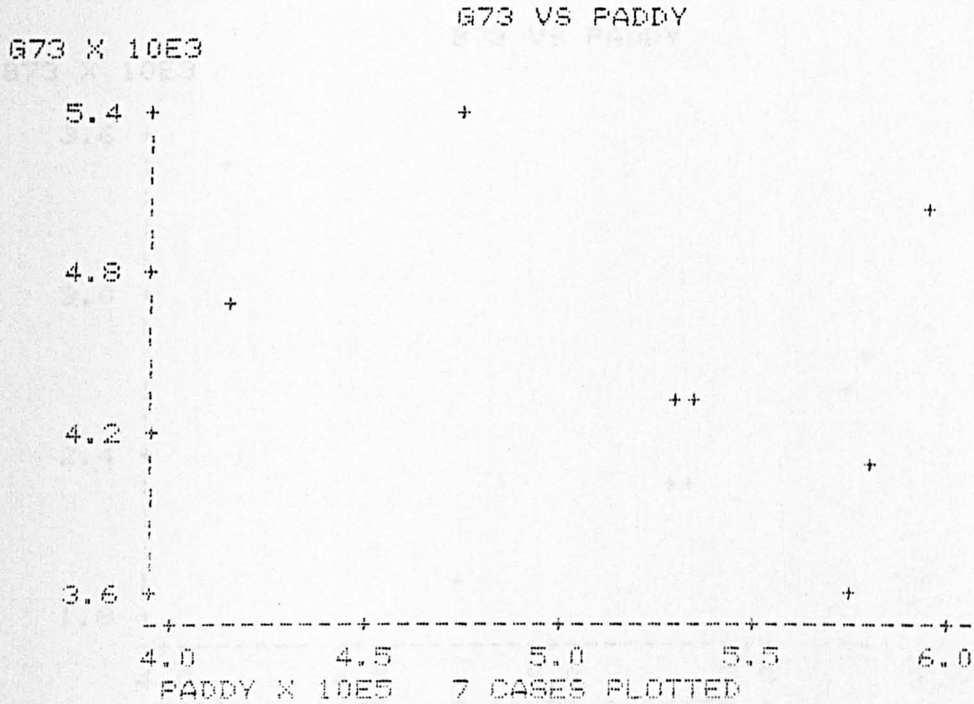


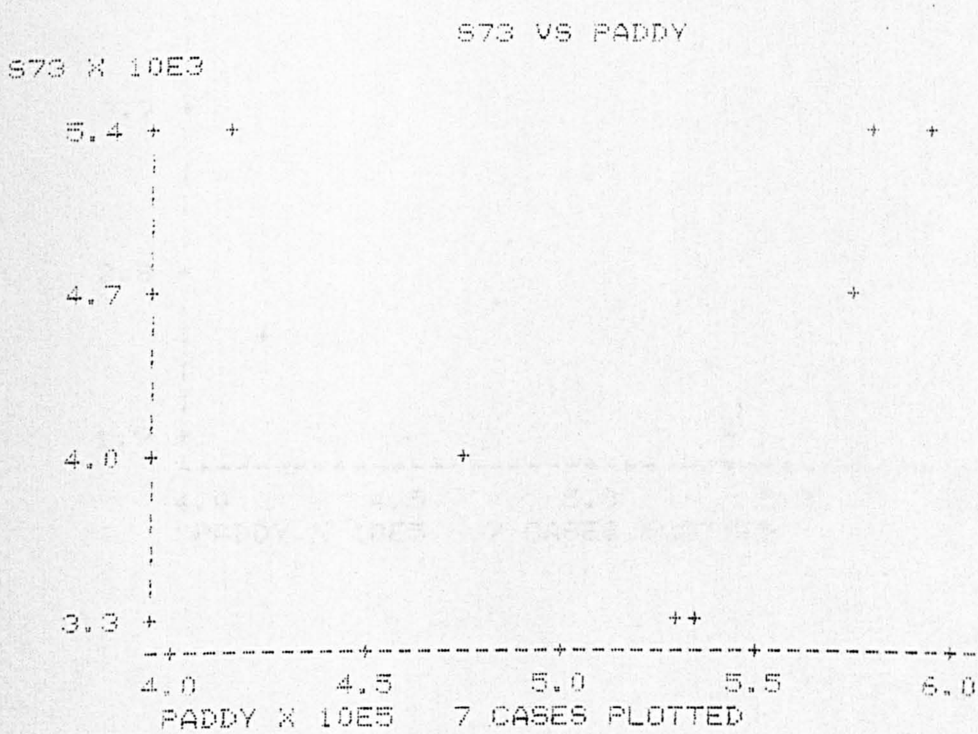
B72 VS PADDY
B72 X 10E3
3.7
3.0
2.3
1.6
4.1
4.6
5.1
5.6
6.1
PADDY X 10E5 8 CASES PLOTTED



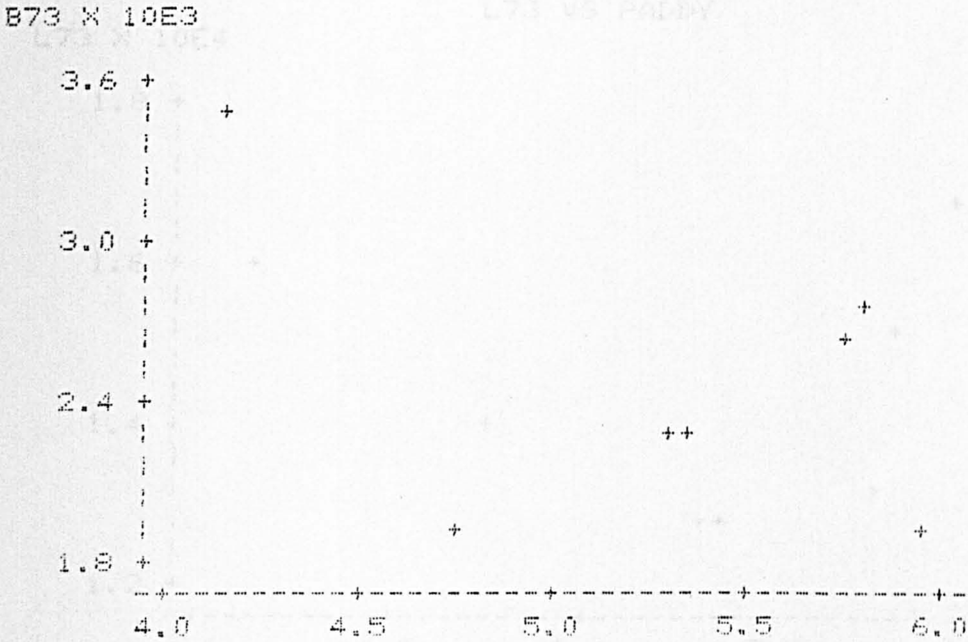
VB72 VS PADDY
VB72 X 10E3
7.0
5.0
3.0
1.0
4.1
4.6
5.1
5.6
6.1
PADDY X 10E5 8 CASES PLOTTED


L72 VS PADDY
L72 X 10E4
1.8
1.5
1.2
0.9
4.1
4.6
5.1
5.6
6.1
PADDY X 10E5
8 CASES PLOTTED


G73 VS PADDY
G73 X 10E3
5.4
4.8
4.2
3.6
4.0
4.5
5.0
5.5
6.0
PADDY X 10E5 7 CASES PLOTTED

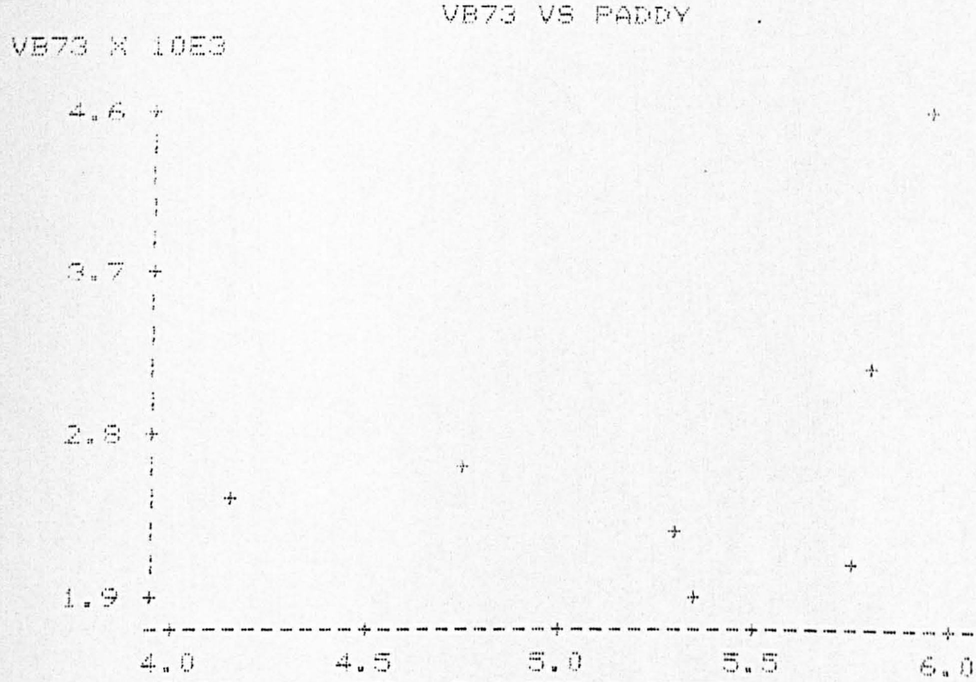

S73 VS PADDY
S73 X 10E3
5.4
4.7
4.0
3.3
4.0
4.5
5.0
5.5
6.0
PADDY X 10E5 7 CASES PLOTTED

B73 VS PADDY



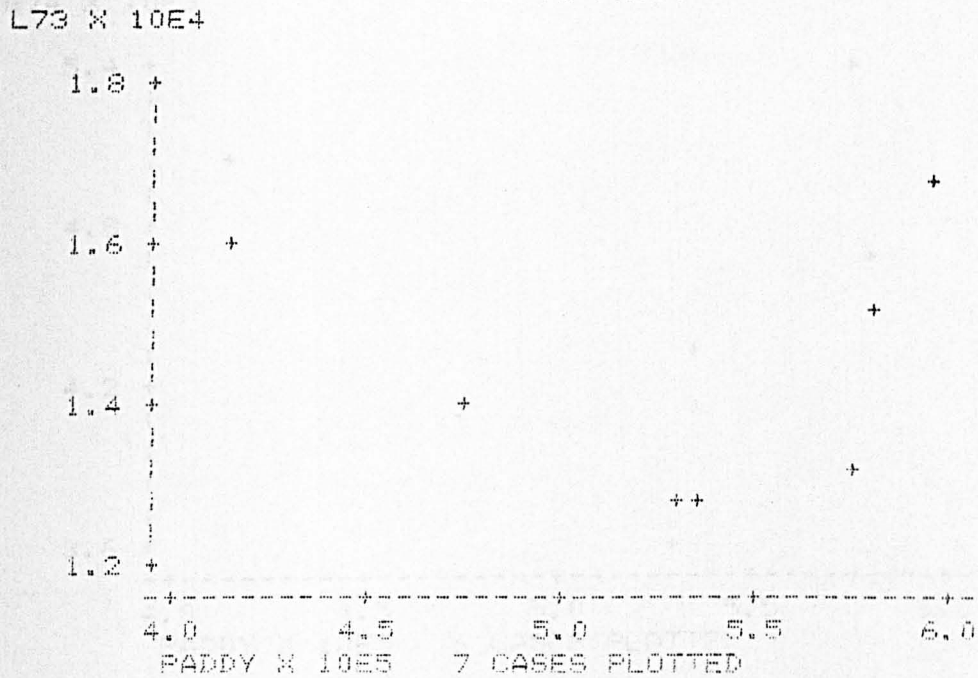
PADDY X 10E5   7 CASES PLOTTED

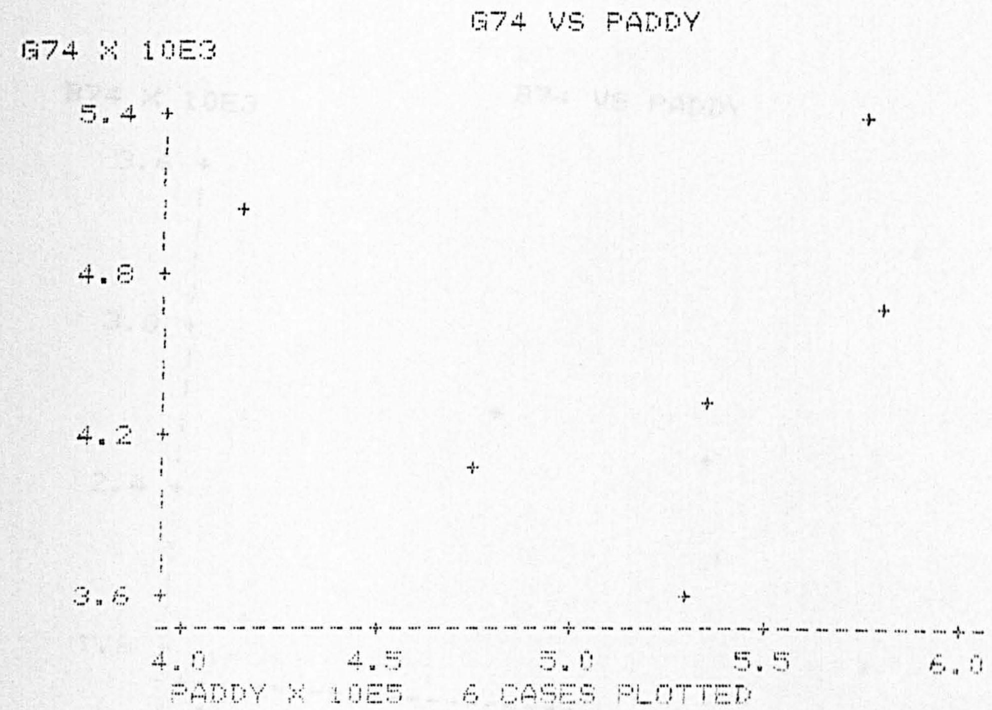
VB73 VS PADDY

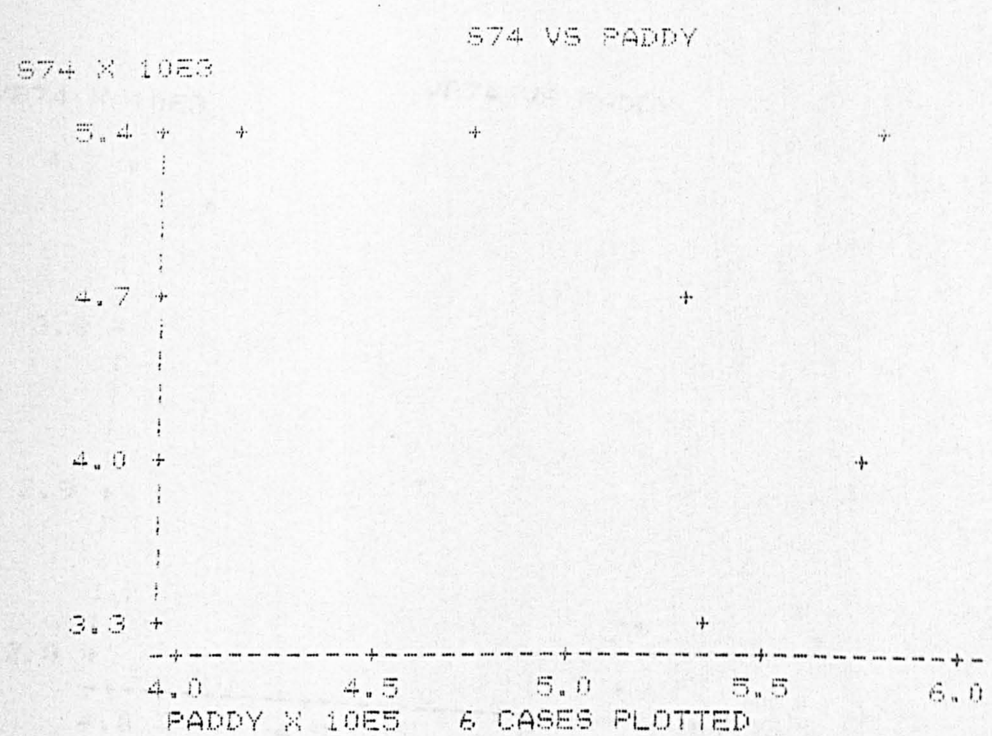


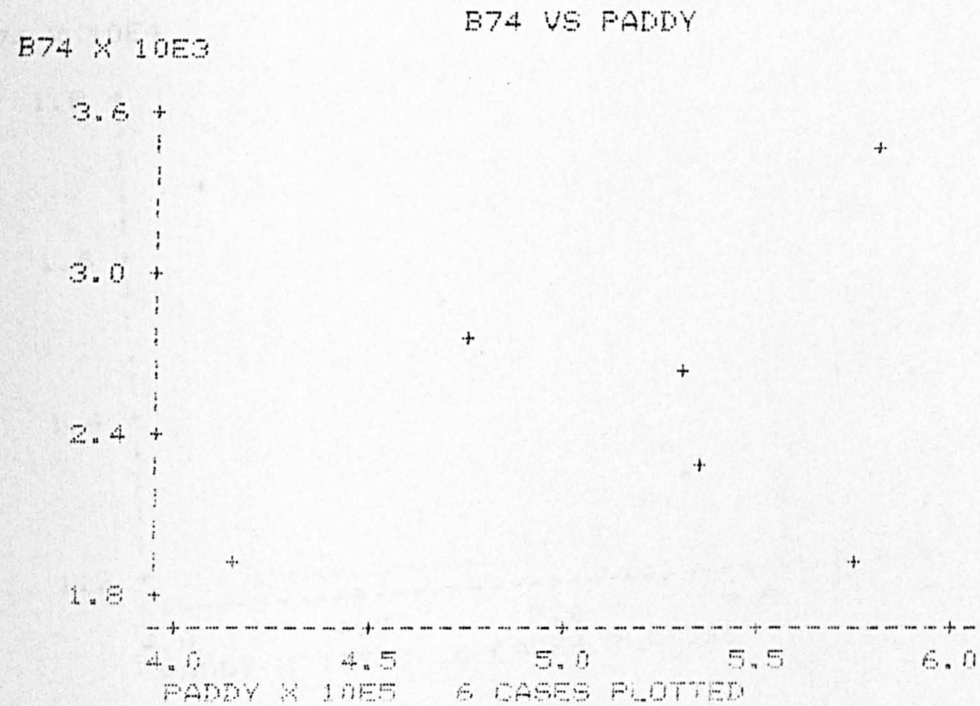
PADDY X 10E5   7 CASES PLOTTED

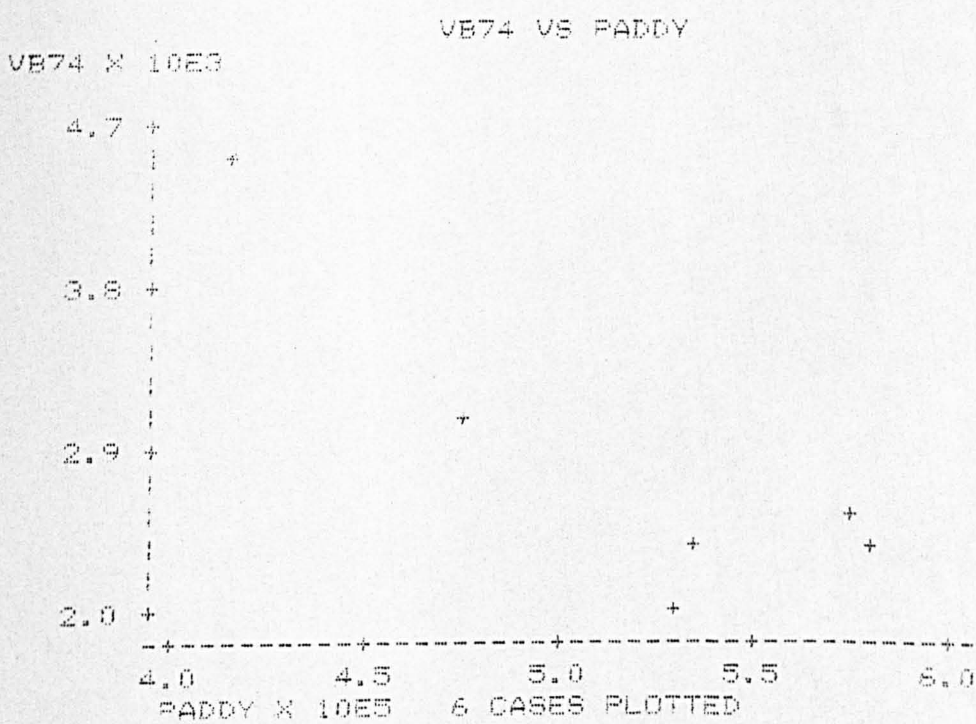
L73 VS PADDY



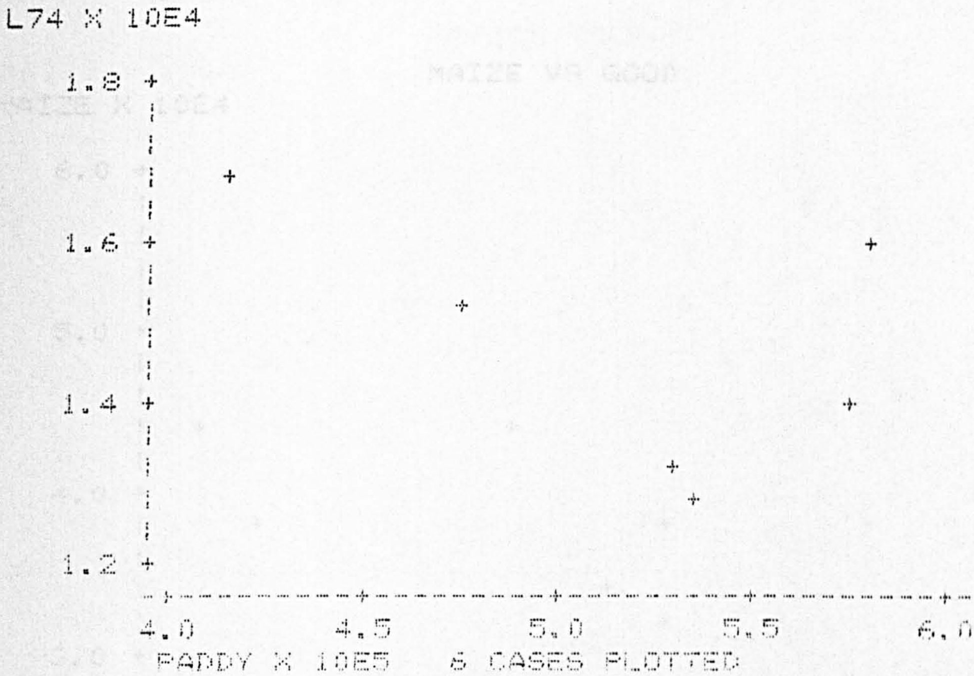

G74 VS PADDY
G74 X 10E3
5.4
4.8
4.2
3.6
4.0
4.5
5.0
5.5
6.0
PADDY X 10E5
6 CASES PLOTTED

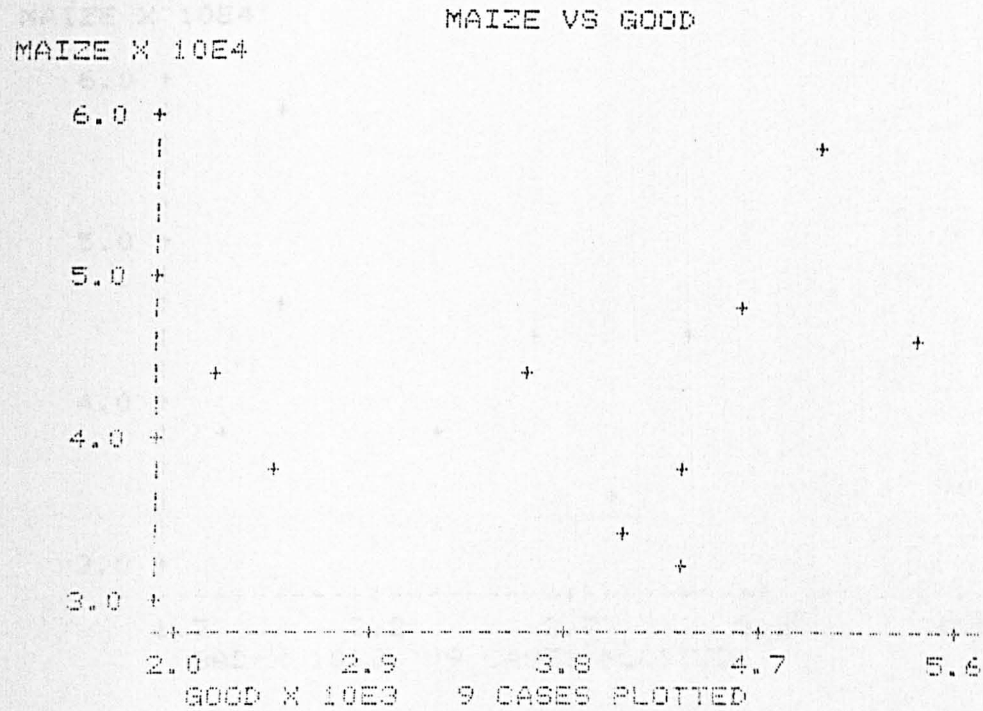

S74 VS PADDY
S74 X 10E3
5.4
4.7
4.0
3.3
4.0
4.5
5.0
5.5
6.0
PADDY X 10E5
6 CASES PLOTTED

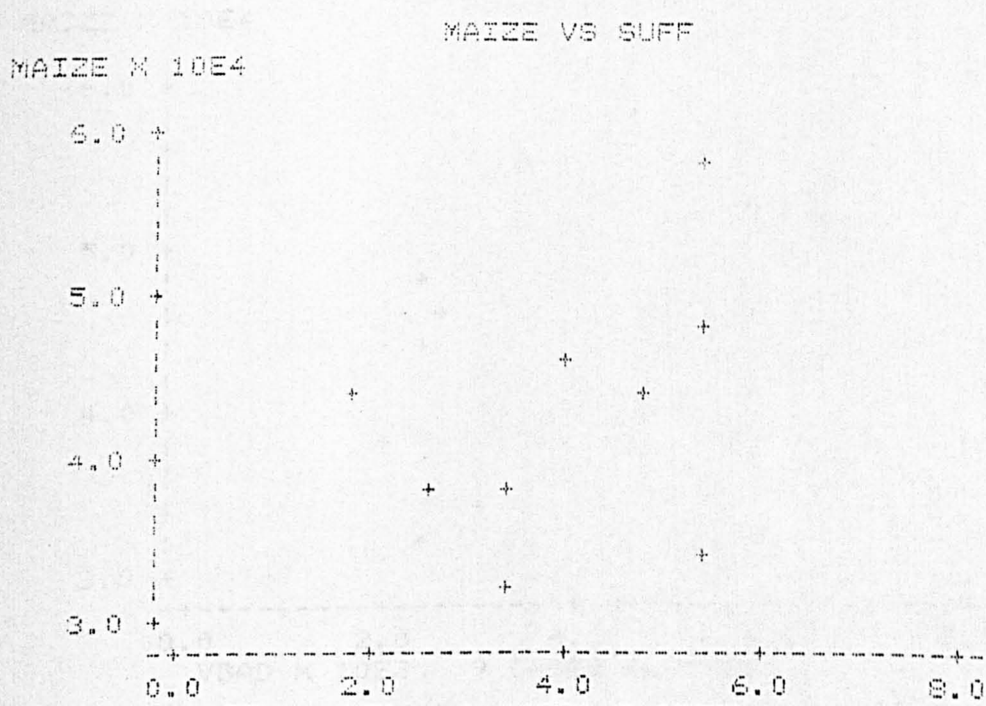

B74 VS PADDY
B74 X 10E3
3.6
3.0
2.4
1.8
4.0
4.5
5.0
5.5
6.0
PADDY X 10E5 6 CASES PLOTTED

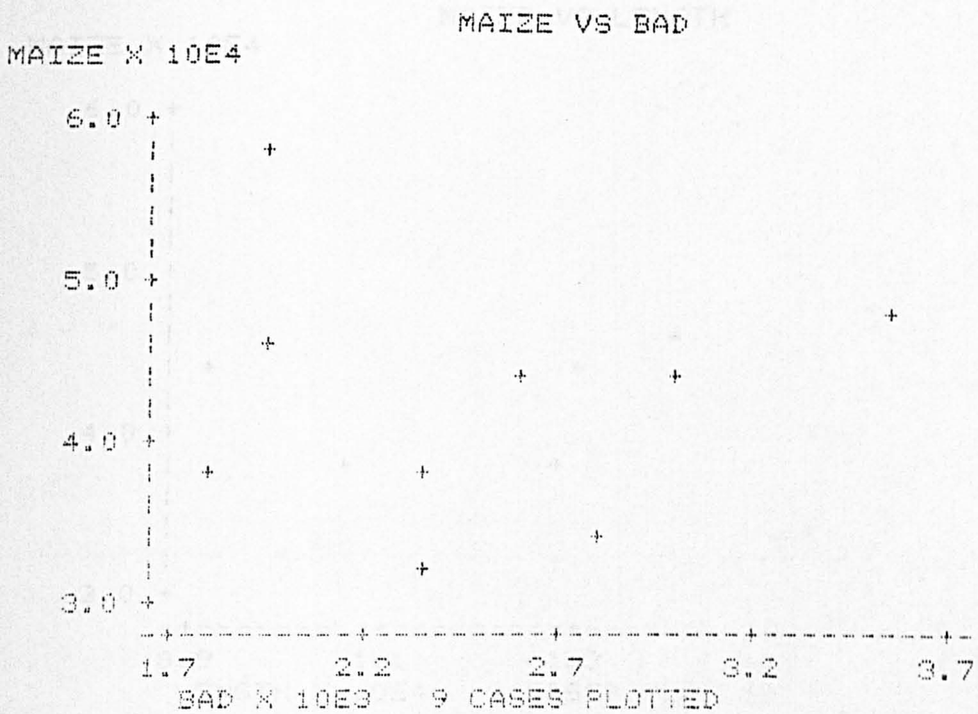

VB74 VS PADDY
VB74 X 10E3
4.7
3.8
2.9
2.0
4.0
4.5
5.0
5.5
6.0
PADDY X 10E5 6 CASES PLOTTED

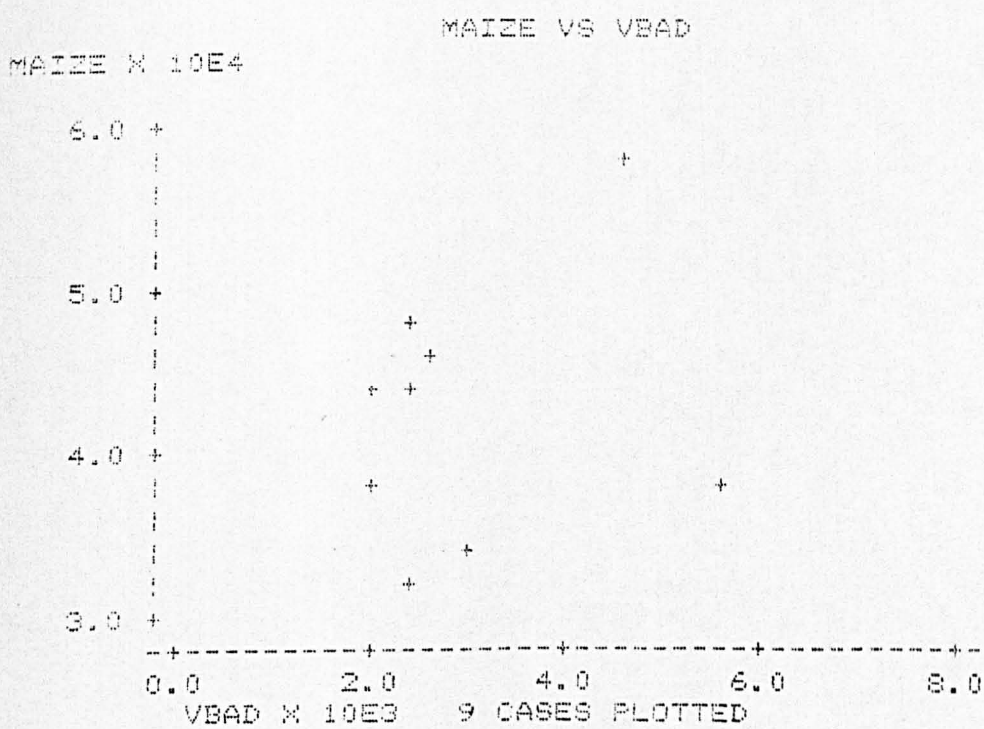
L74 VS PADDY

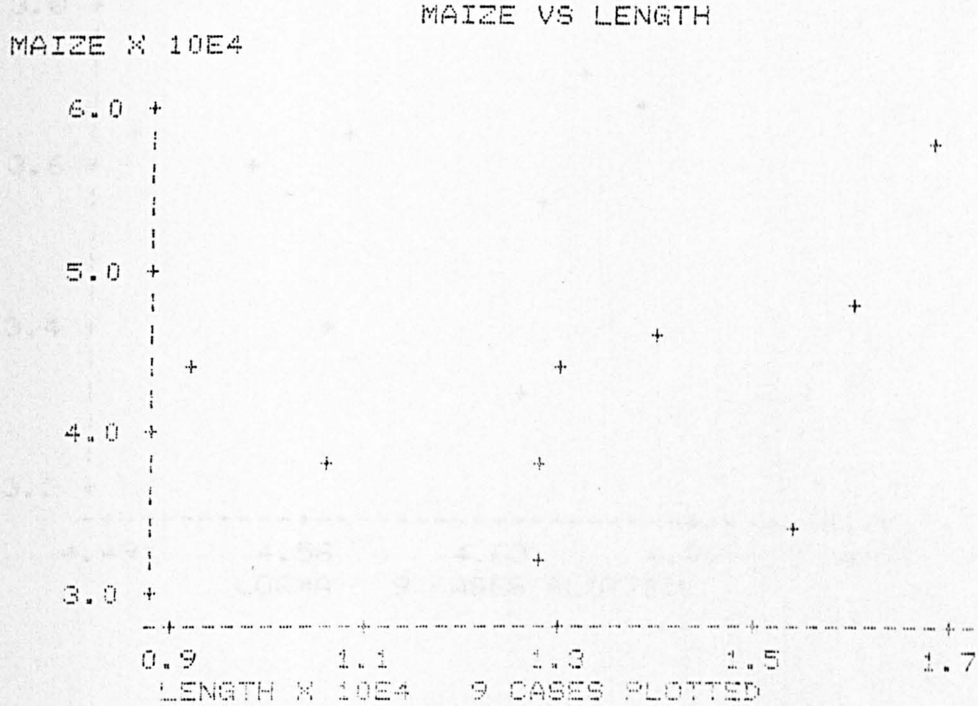



MAIZE VS GOOD
MAIZE X 10E4
6.0
5.0
4.0
3.0
2.0
2.9
3.8
4.7
5.6
GOOD X 10E3   9 CASES PLOTTED

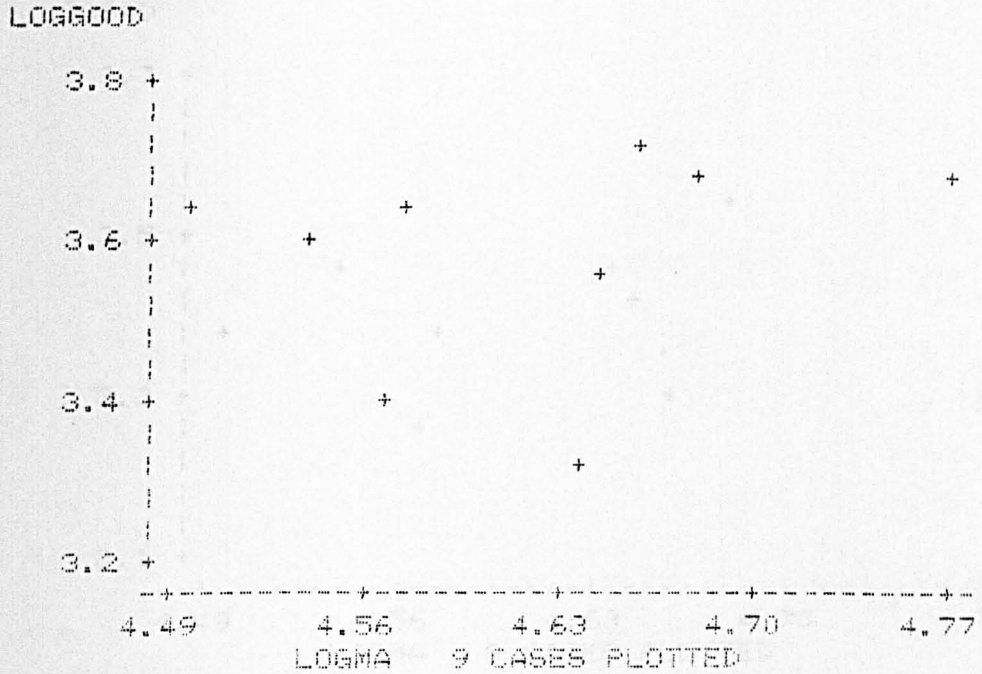

MAIZE VS SUFF
MAIZE X 10E4
6.0
5.0
4.0
3.0
0.0
2.0
4.0
6.0
8.0
SUFF X 10E3   9 CASES PLOTTED


MAIZE VS BAD
MAIZE X 10E4
6.0
5.0
4.0
3.0
1.7
2.2
2.7
3.2
3.7
BAD X 10E3   9 CASES PLOTTED

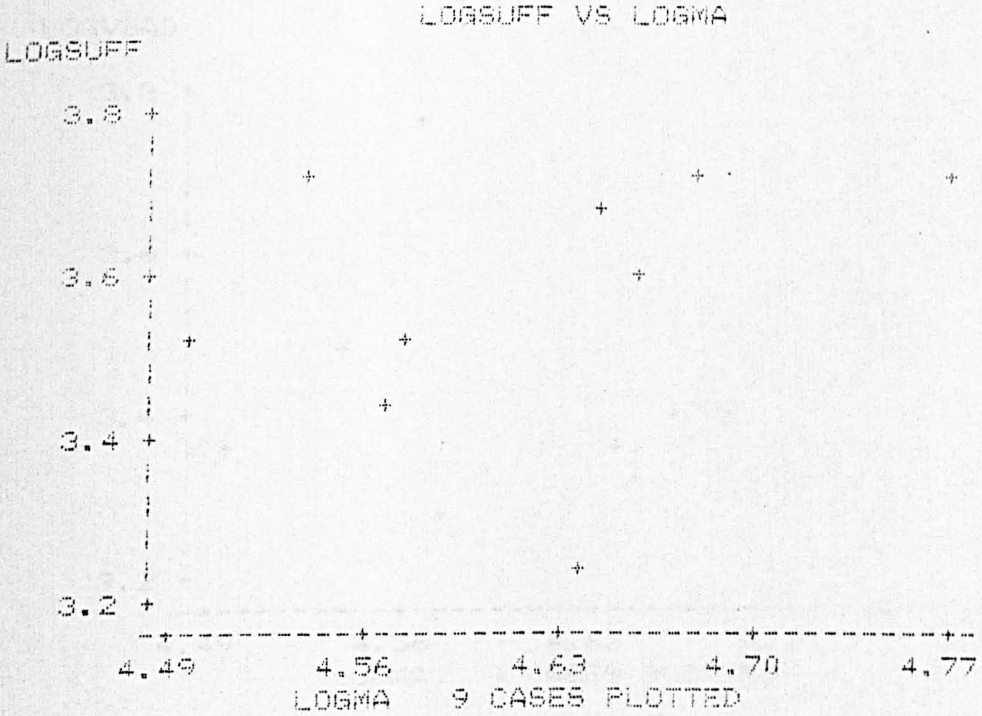

MAIZE VS VBAD
MAIZE X 10E4
6.0
5.0
4.0
3.0
0.0
2.0
4.0
6.0
8.0
VBAD X 10E3   9 CASES PLOTTED

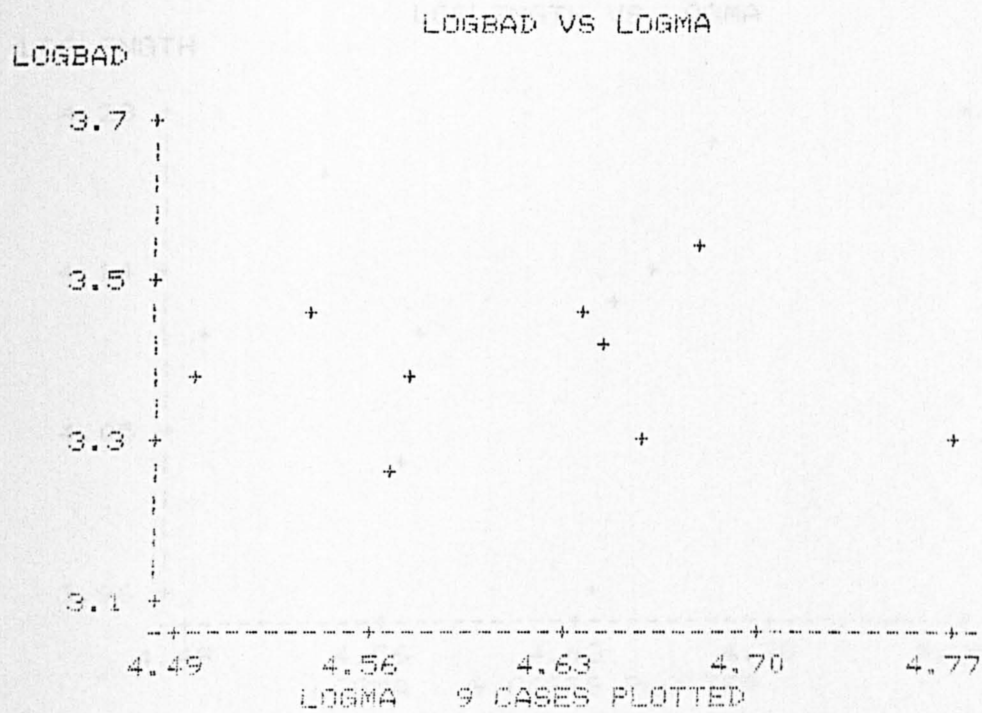

MAIZE VS LENGTH
MAIZE X 10E4
6.0
5.0
4.0
3.0
0.9
1.1
1.3
1.5
1.7
LENGTH X 10E4   9 CASES PLOTTED

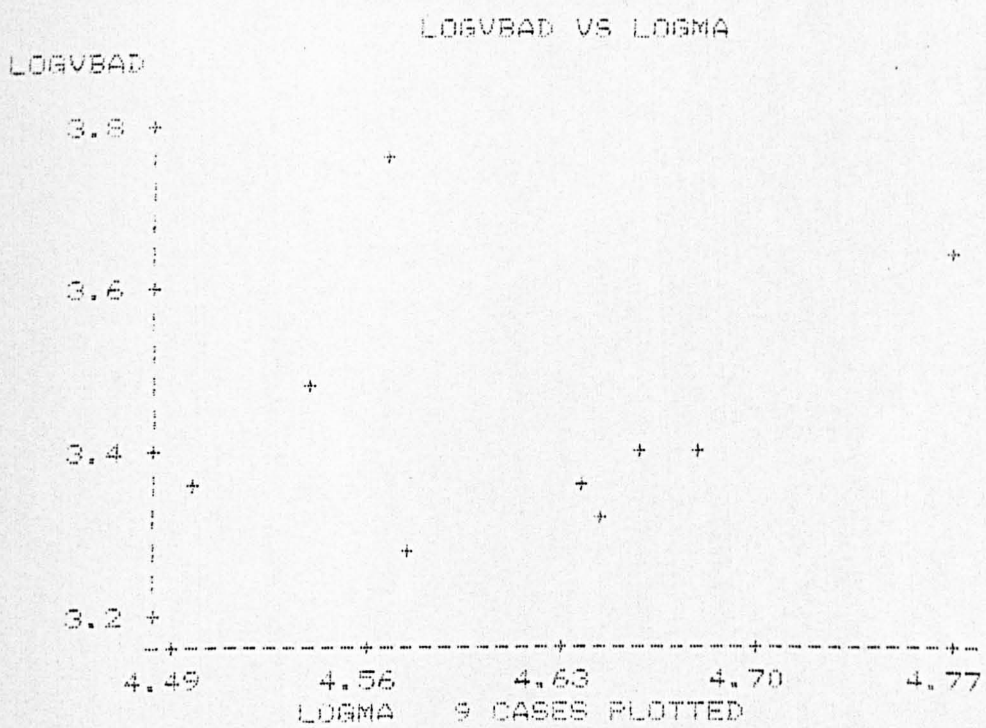
LOGGOOD VS LOGMA



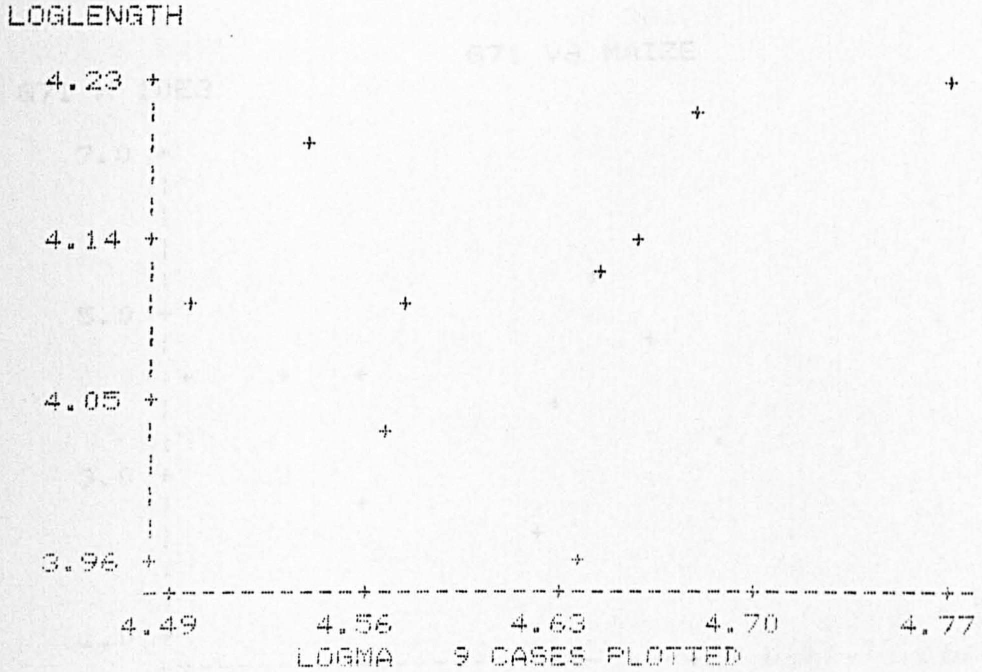
LOGSUFF VS LOGMA

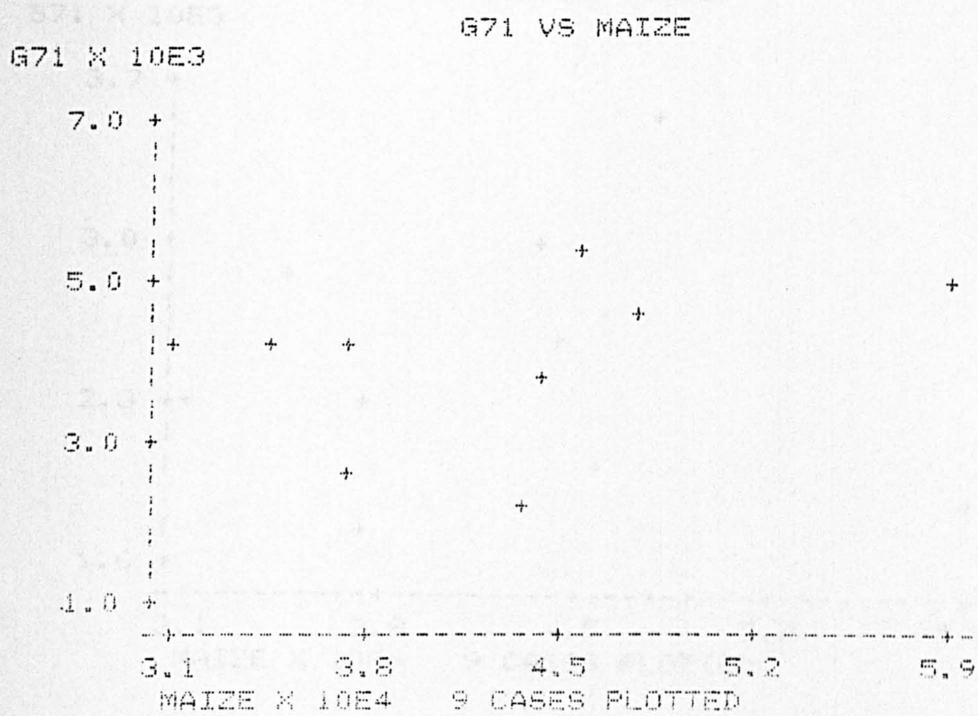


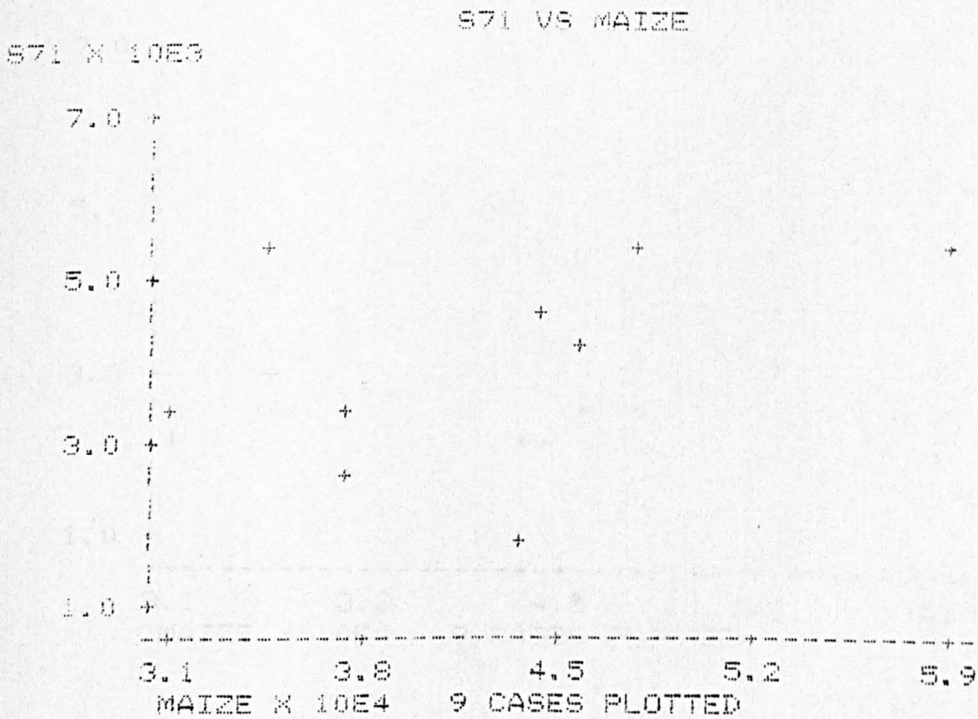

LOGBAD VS LOGMA
LOGBAD
3.7
3.5
3.3
3.1
4.49
4.56
4.63
4.70
4.77
LOGMA 9 CASES PLOTTED


LOGVBAD VS LOGMA
LOGVBAD
3.8
3.6
3.4
3.2
4.49
4.56
4.63
4.70
4.77
LOGMA 9 CASES PLOTTED

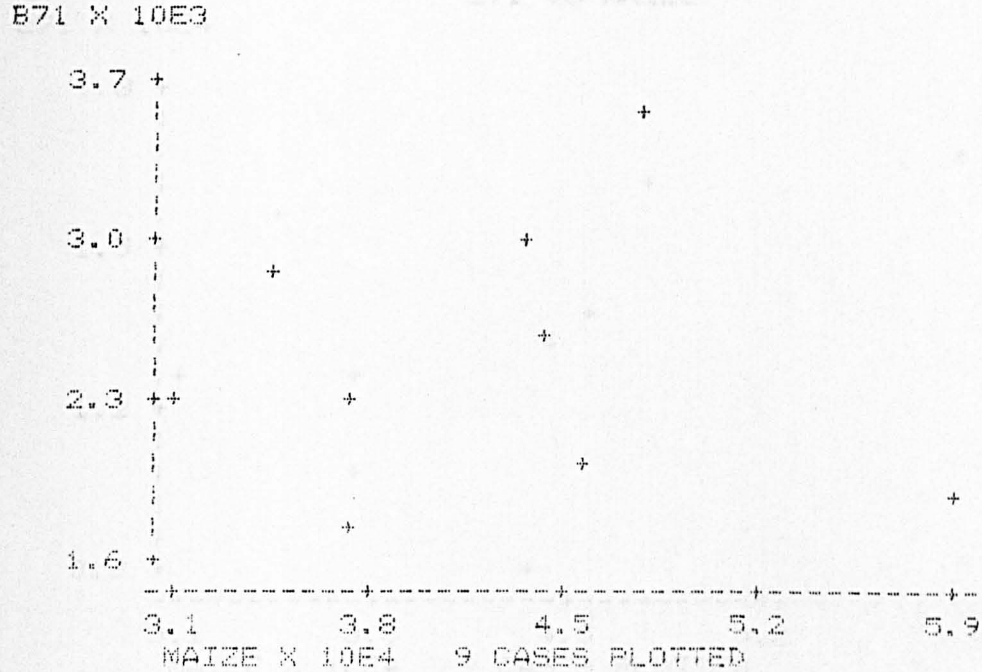
LOGLENGTH VS LOGMA



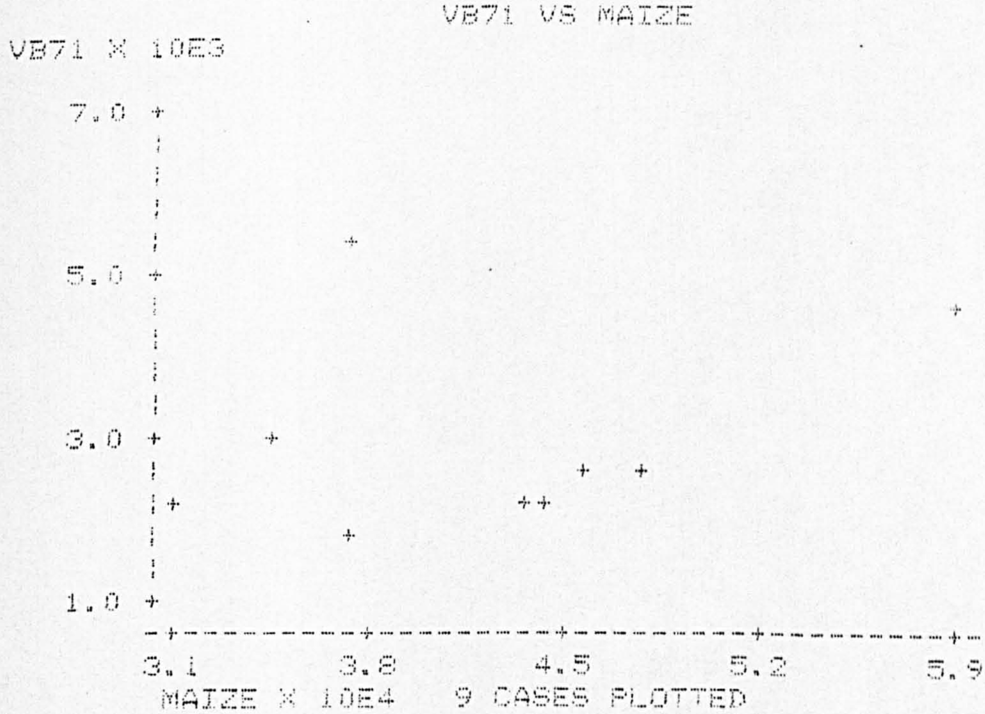

G71 VS MAIZE
G71 X 10E3
7.0
5.0
3.0
1.0
3.1
3.8
4.5
5.2
5.9
MAIZE X 10E4   9 CASES PLOTTED


S71 VS MAIZE
S71 X 10E3
7.0
5.0
3.0
1.0
3.1
3.8
4.5
5.2
5.9
MAIZE X 10E4   9 CASES PLOTTED

B71 VS MAIZE

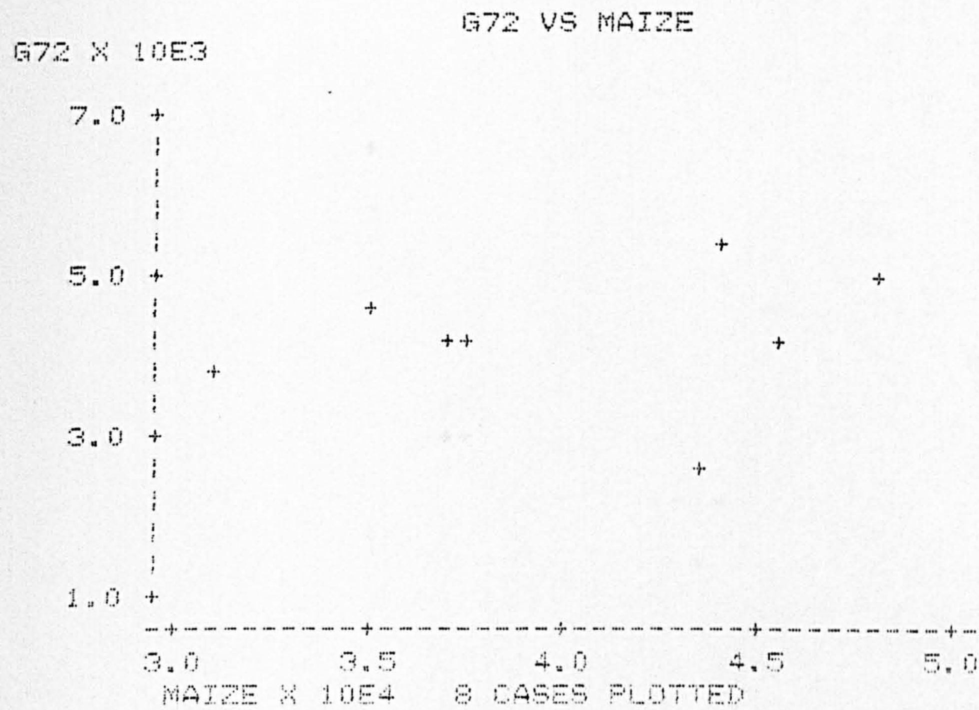


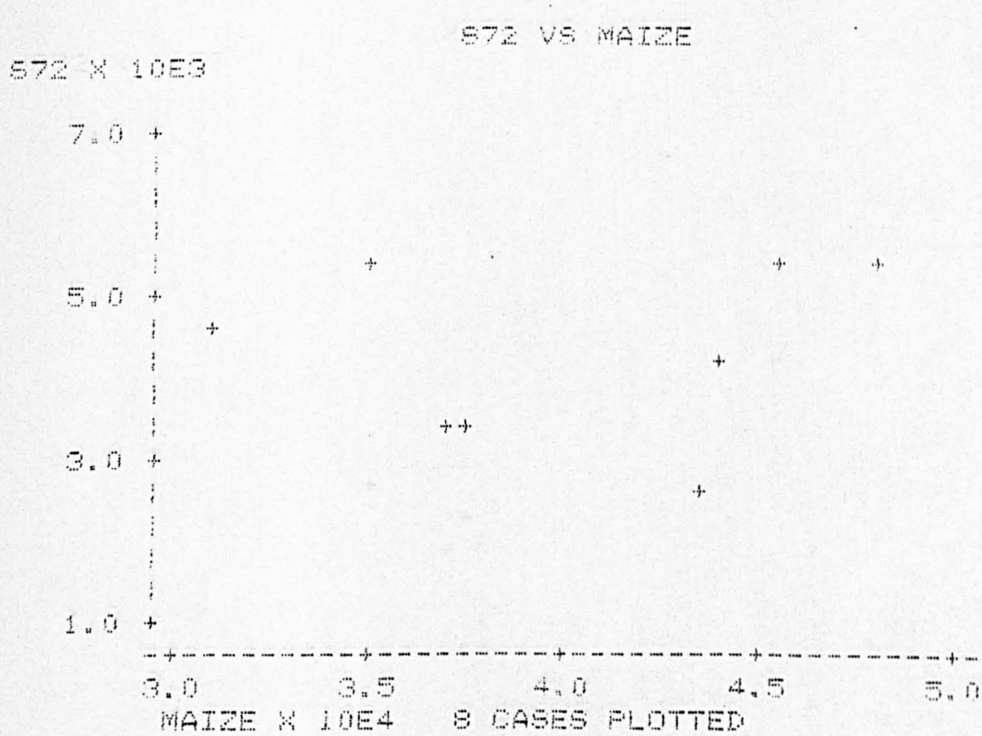
VB71 VS MAIZE

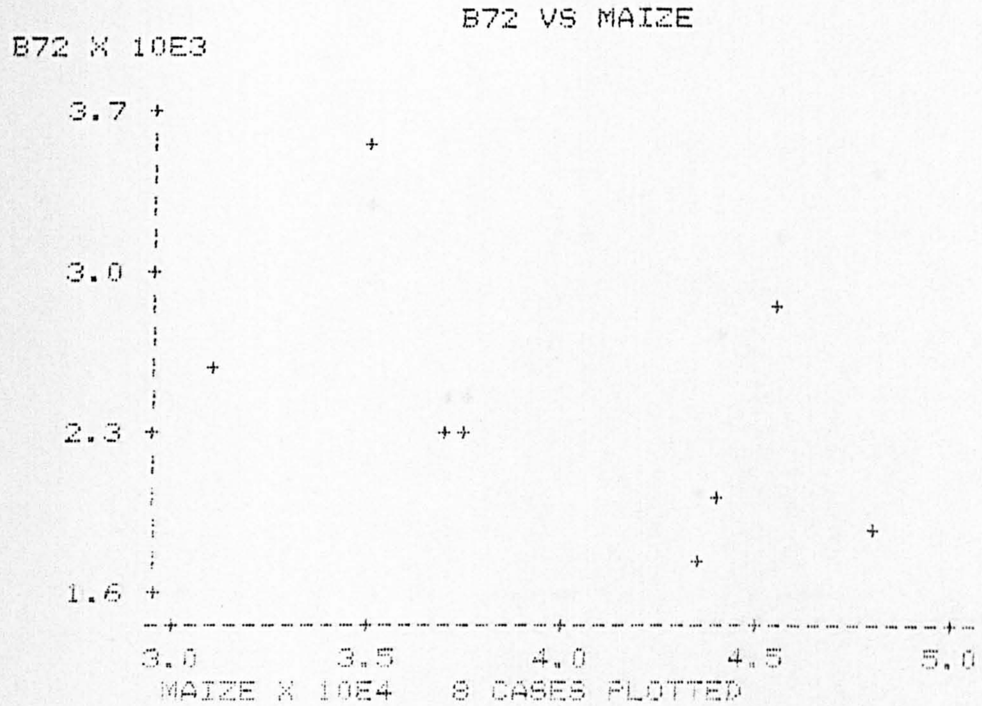


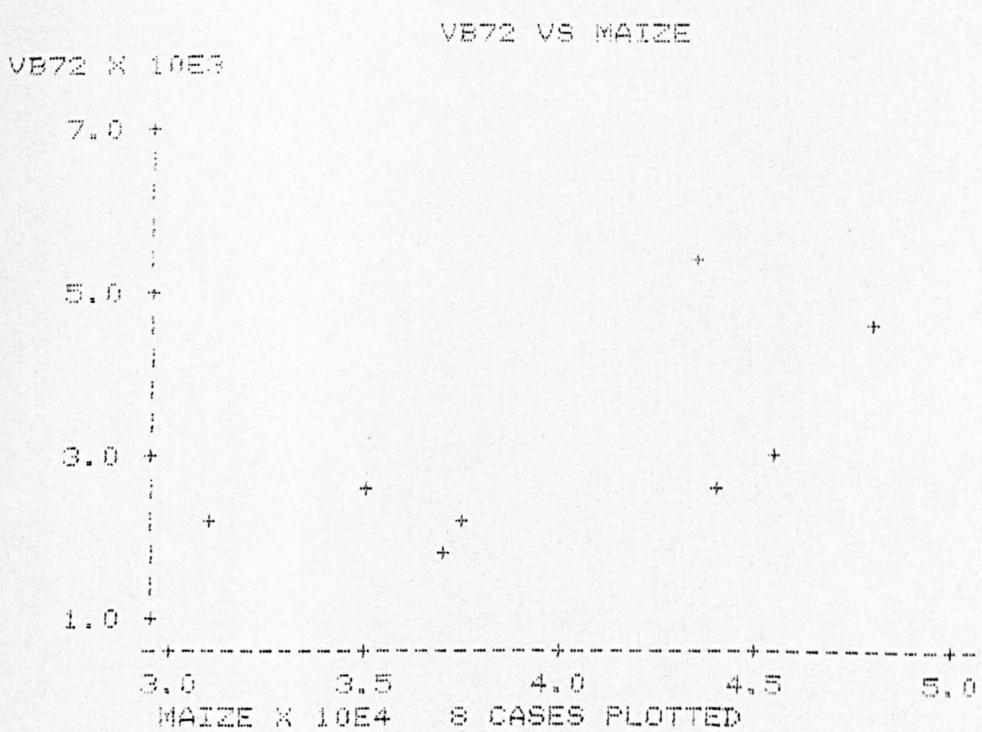
L71 VS MAIZE

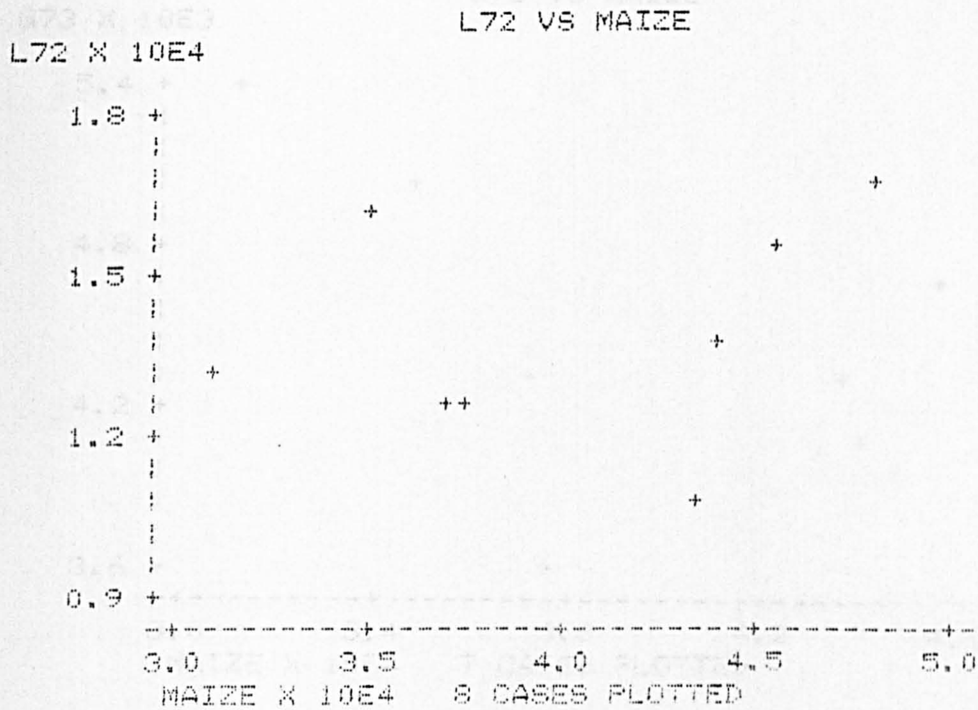
```
L71 X 10E4

    1.8 +
        |
        |                                       +
        |                       +
        |    +
    1.5 +
        |
        |                    +
        |                  +
        |+        +
    1.2 +
        |
        |         +
        |
        |
    0.9 +                 +
       -+---------+---------+---------+---------+-
       3.1       3.8       4.5       5.2       5.9
        MAIZE X 10E4   9 CASES PLOTTED
```


G72 VS MAIZE
G72 X 10E3
7.0
5.0
3.0
1.0
3.0
3.5
4.0
4.5
5.0
MAIZE X 10E4   8 CASES PLOTTED

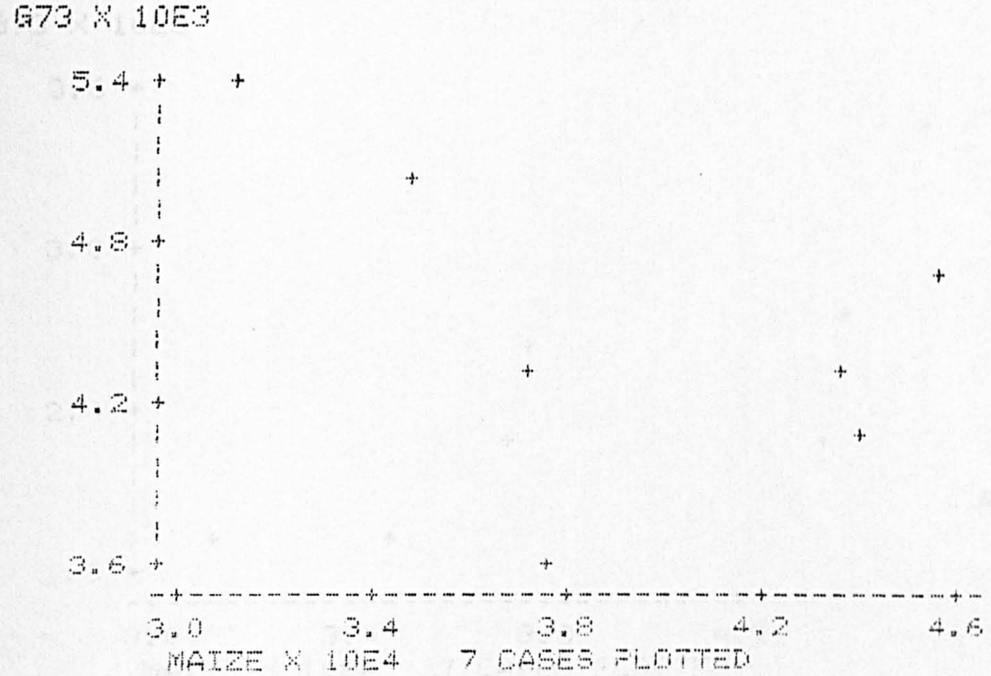

S72 VS MAIZE
S72 X 10E3
7.0
5.0
3.0
1.0
3.0
3.5
4.0
4.5
5.0
MAIZE X 10E4   8 CASES PLOTTED


B72 VS MAIZE
B72 X 10E3
3.7
3.0
2.3
1.6
3.0
3.5
4.0
4.5
5.0
MAIZE X 10E4 8 CASES PLOTTED

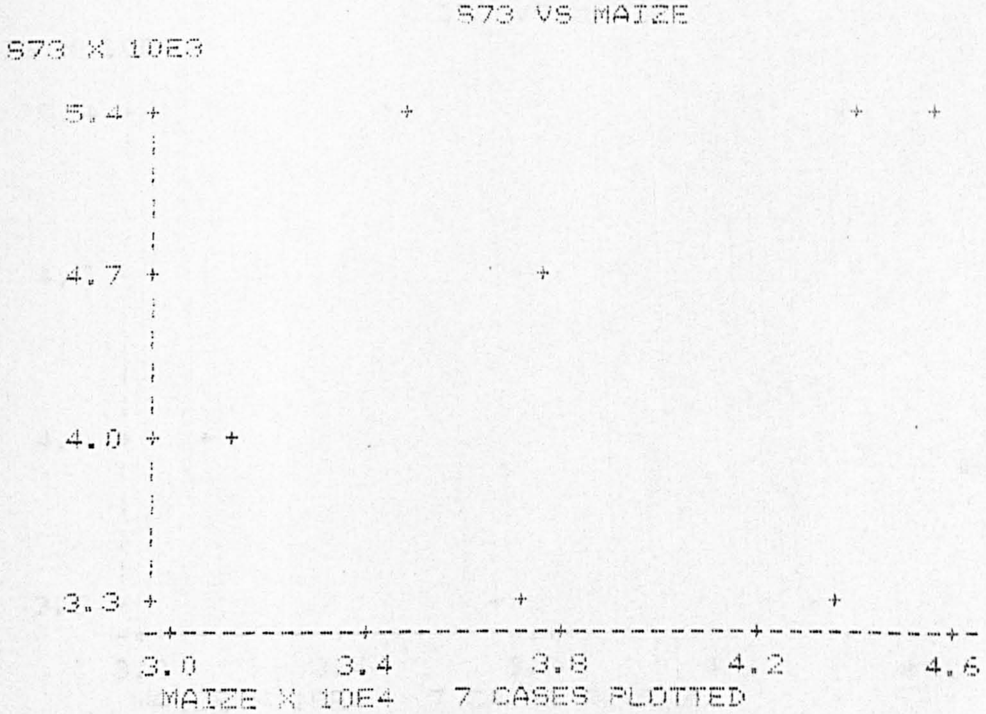

VB72 VS MAIZE
VB72 X 10E3
7.0
5.0
3.0
1.0
3.0
3.5
4.0
4.5
5.0
MAIZE X 10E4 8 CASES PLOTTED

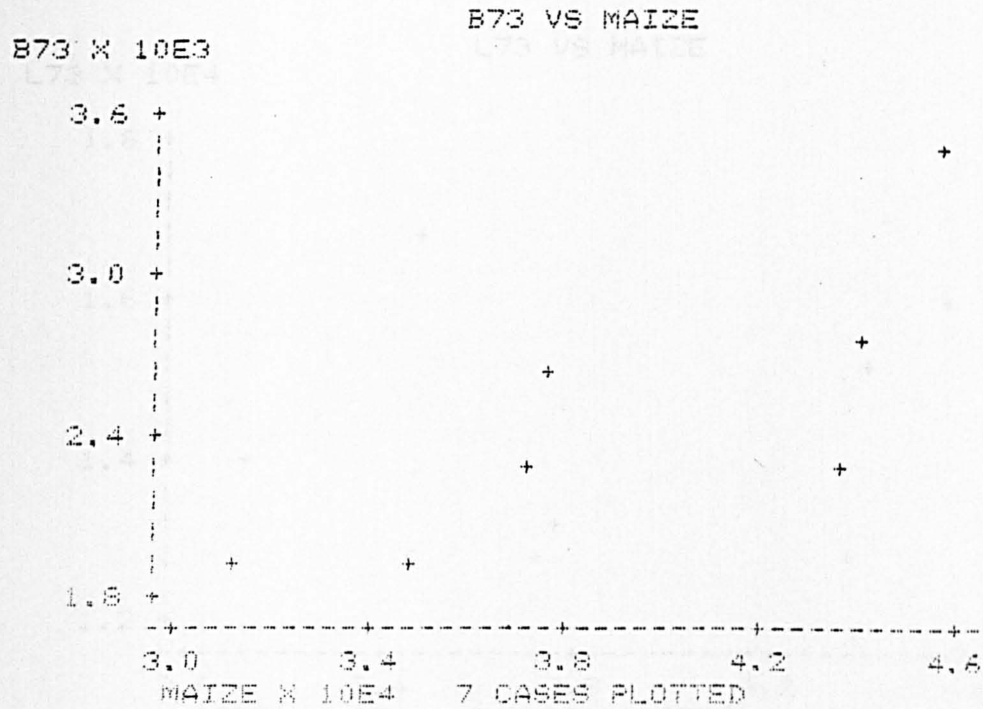

L72 VS MAIZE
L72 X 10E4
1.8
1.5
1.2
0.9
3.0
3.5
4.0
4.5
5.0
MAIZE X 10E4
8 CASES PLOTTED

G73 VS MAIZE



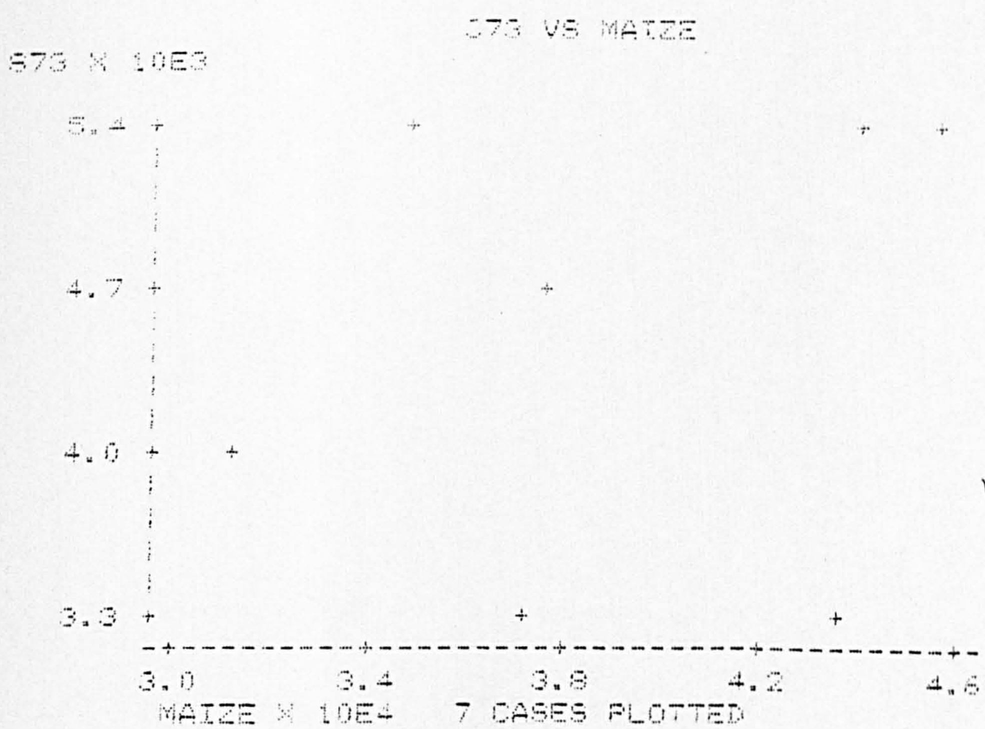
S73 VS MAIZE





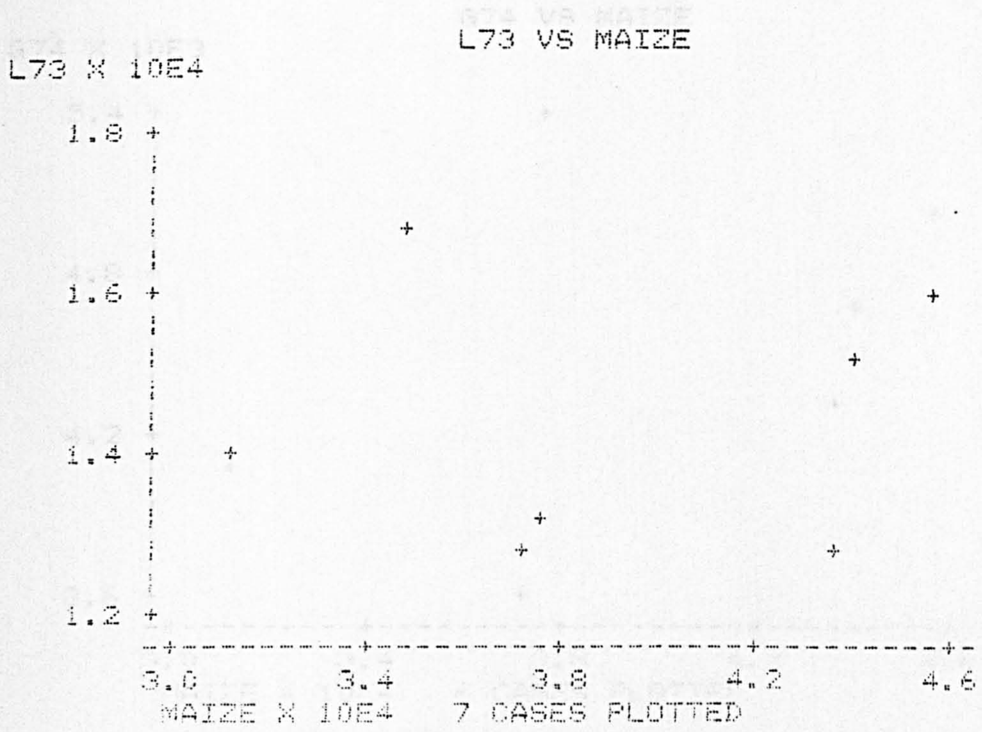
B73 VS MAIZE
B73 X 10E3
3.6
3.0
2.4
1.8
3.0
3.4
3.8
4.2
4.6
MAIZE X 10E4 7 CASES PLOTTED

no rel.

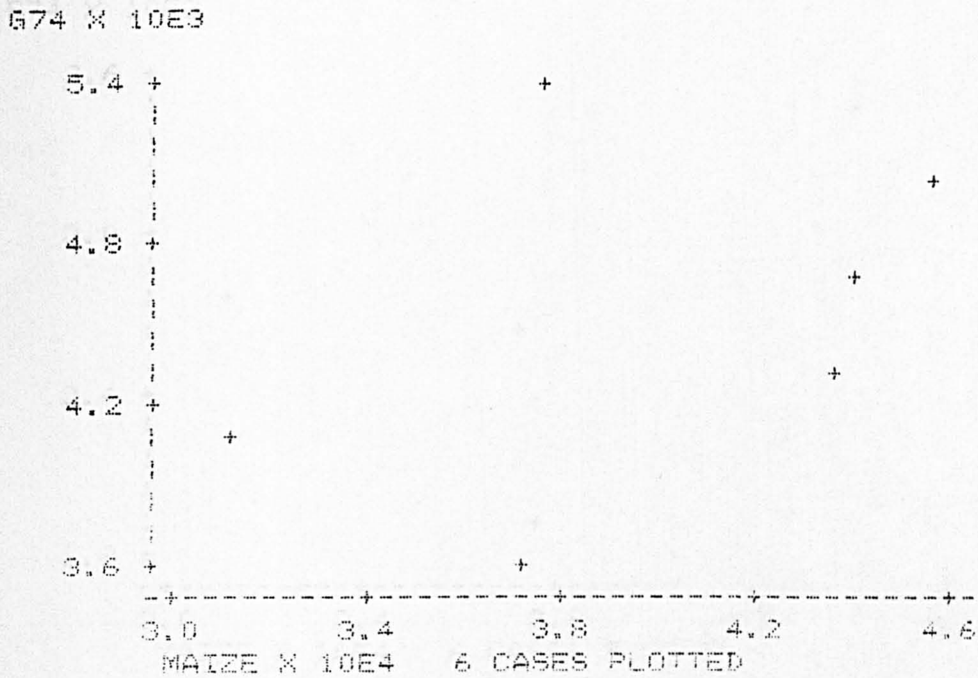


B73 VS MAIZE
B73 X 10E3
5.4
4.7
4.0
3.3
3.0
3.4
3.8
4.2
4.6
MAIZE X 10E4 7 CASES PLOTTED

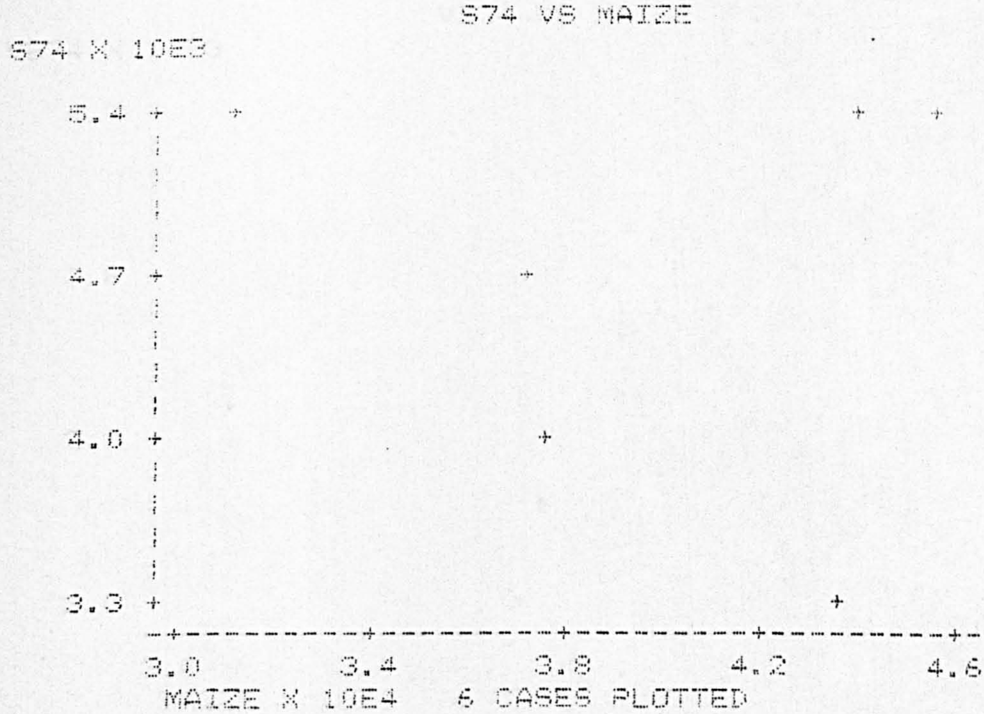
no rel


L73 VS MAIZE
L73 X 10E4
1.8
1.6
1.4
1.2
3.0
3.4
3.8
4.2
4.6
MAIZE X 10E4   7 CASES PLOTTED

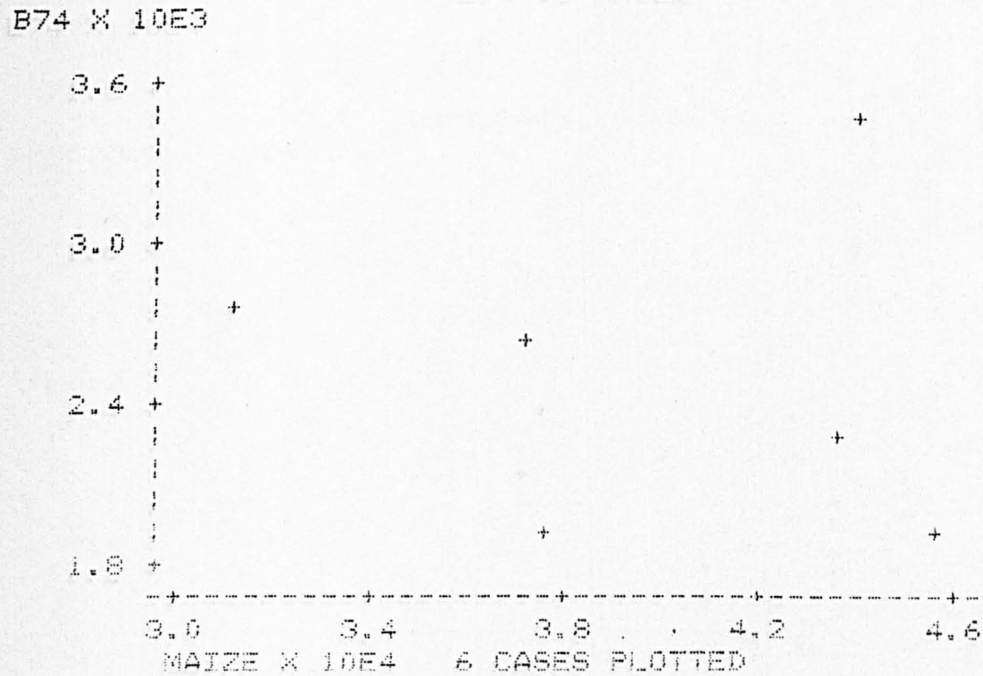
G74 VS MAIZE



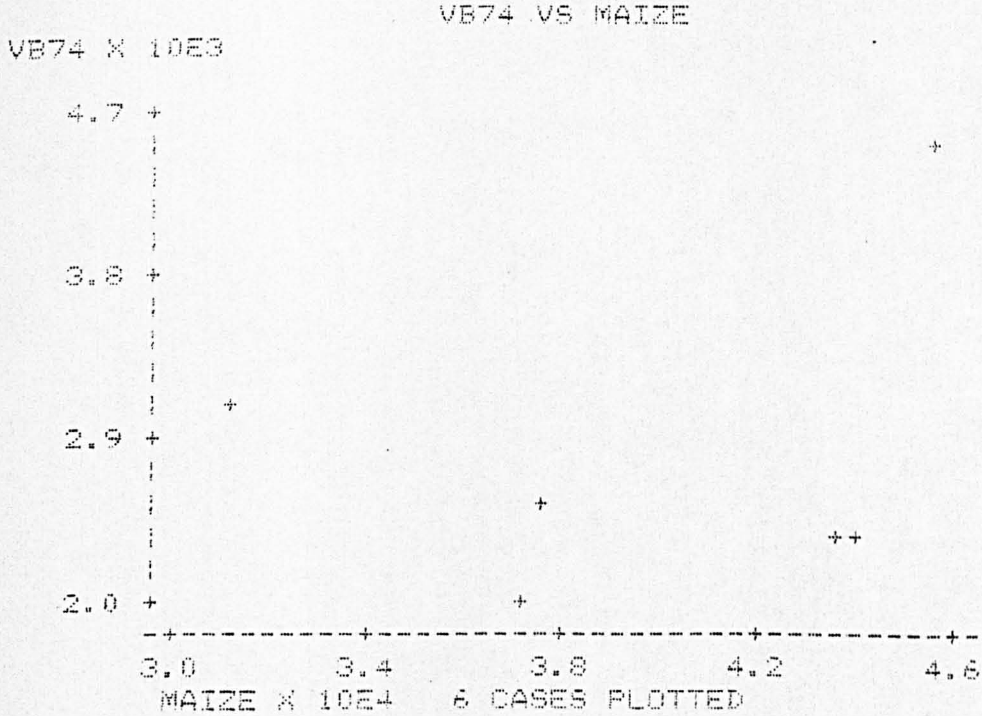
S74 VS MAIZE



B74 VS MAIZE

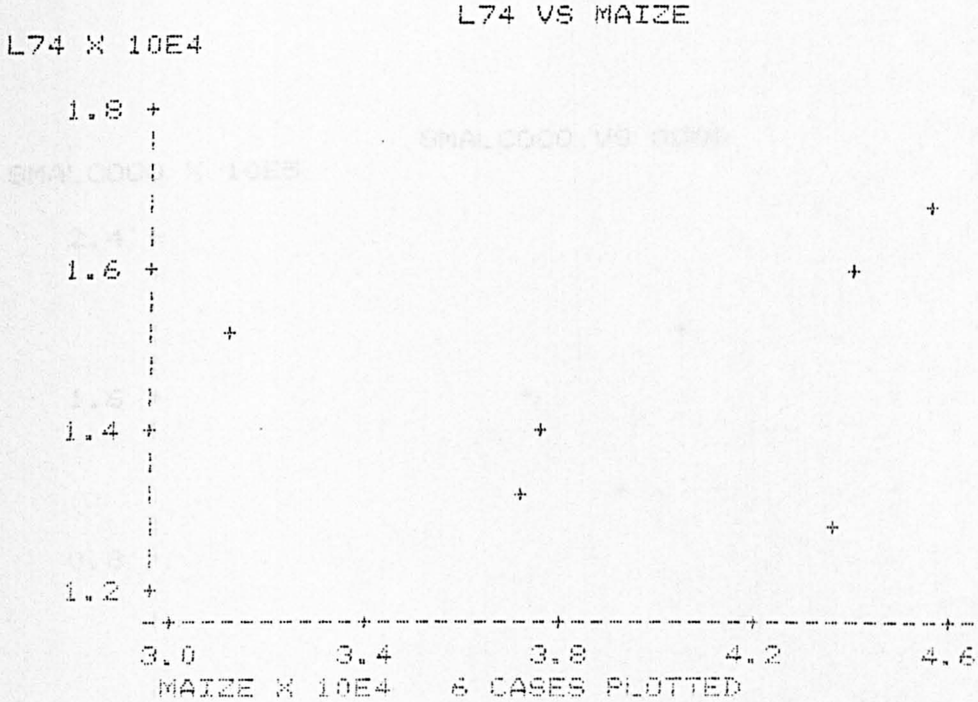


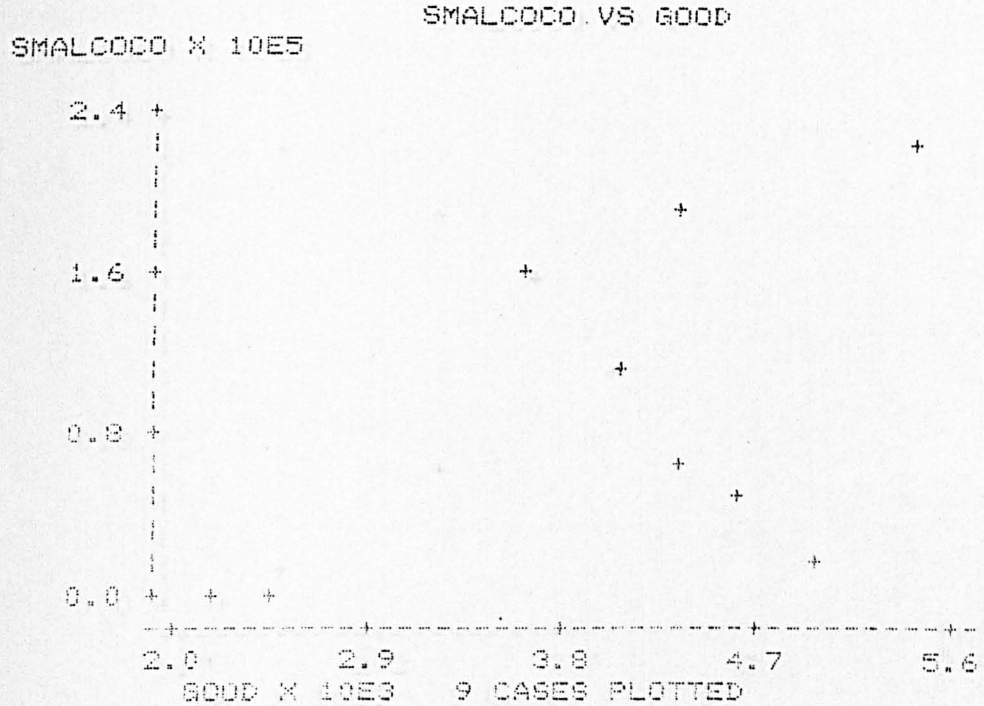
VB74 VS MAIZE

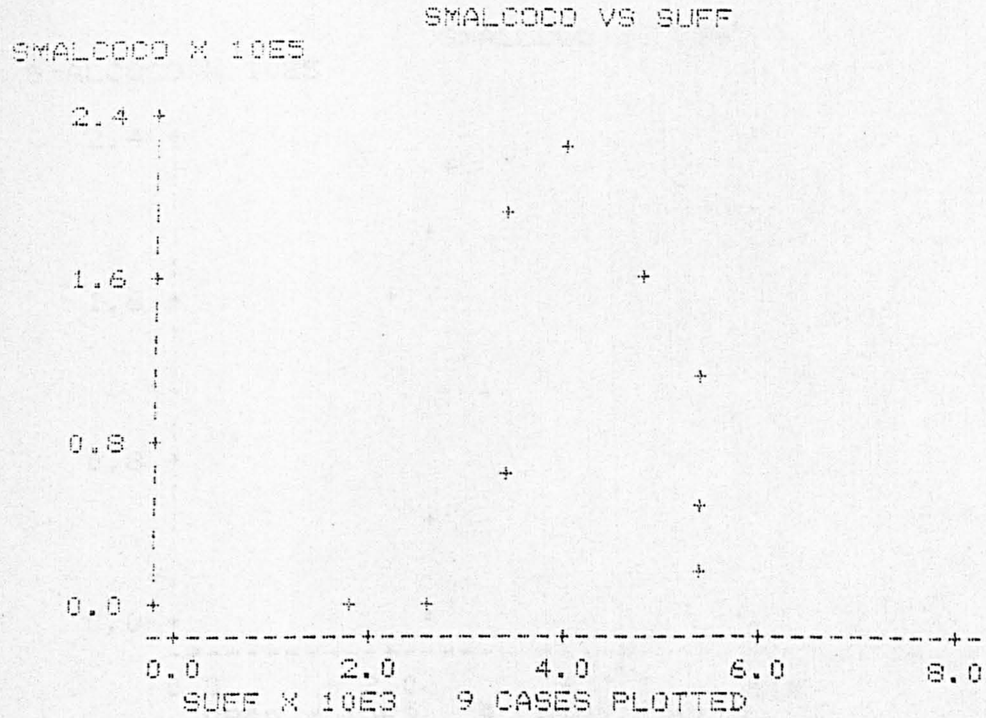


L74 VS MAIZE

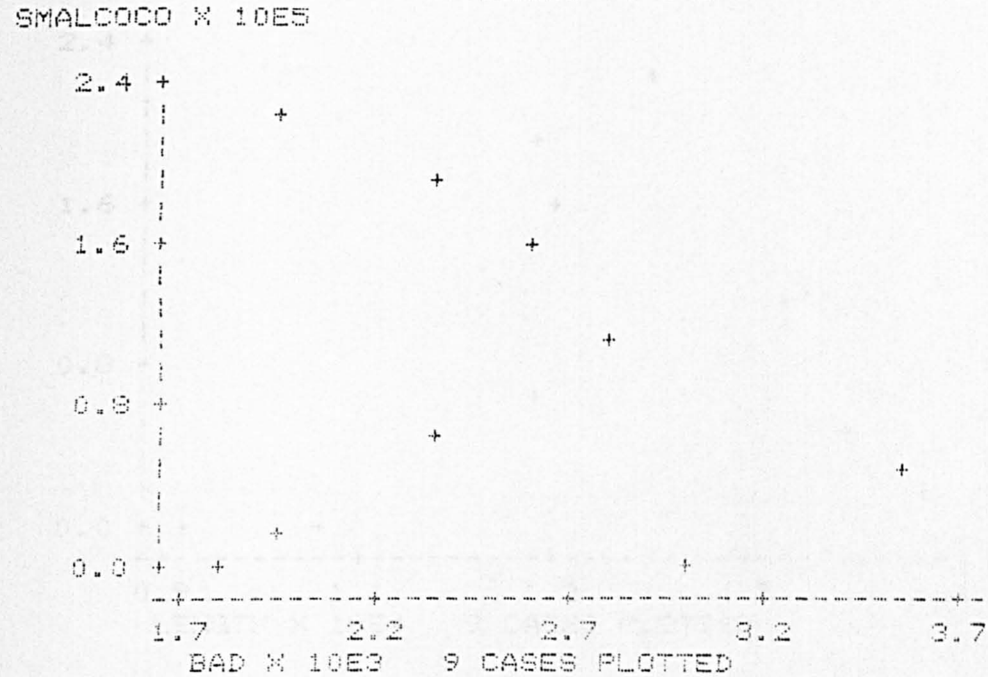
L74 VS MAIZE



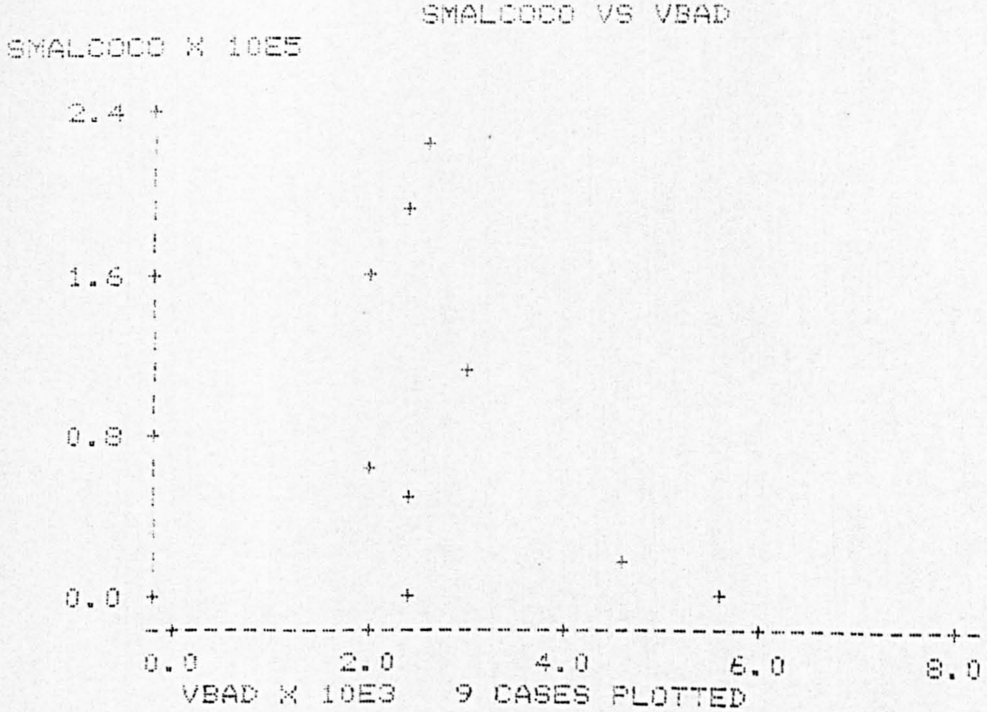

SMALCOCO VS GOOD
SMALCOCO X 10E5
2.4
1.6
0.8
0.0
2.0
2.9
3.8
4.7
5.6
GOOD X 10E3 9 CASES PLOTTED

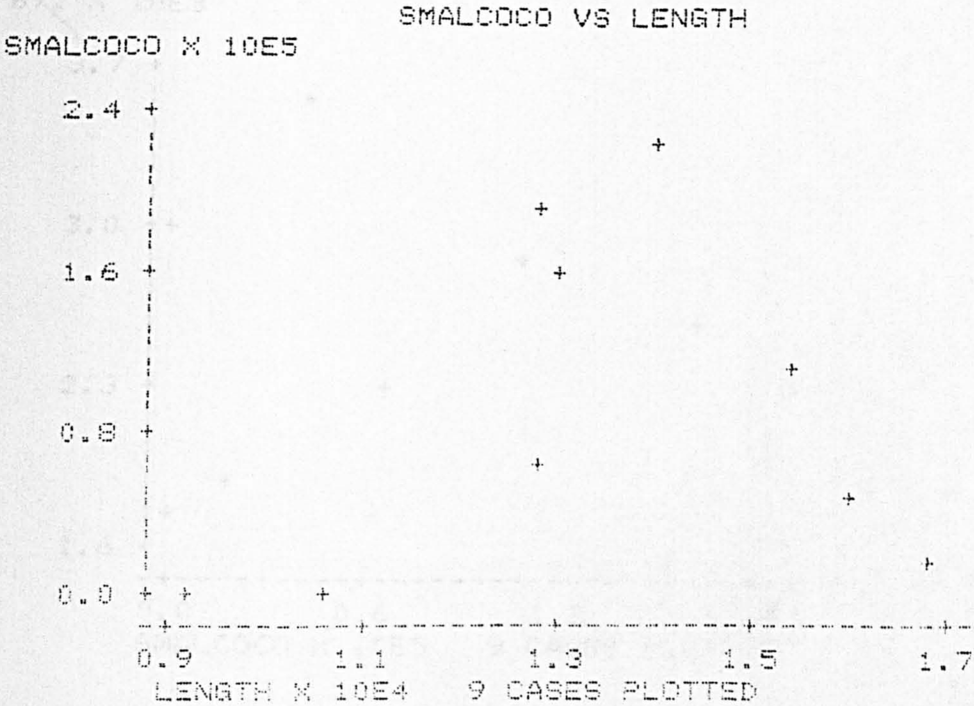

SMALCOCO VS SUFF
SMALCOCO X 10E5
2.4
1.6
0.8
0.0
0.0
2.0
4.0
6.0
8.0
SUFF X 10E3 9 CASES PLOTTED

SMALCOCO VS BAD

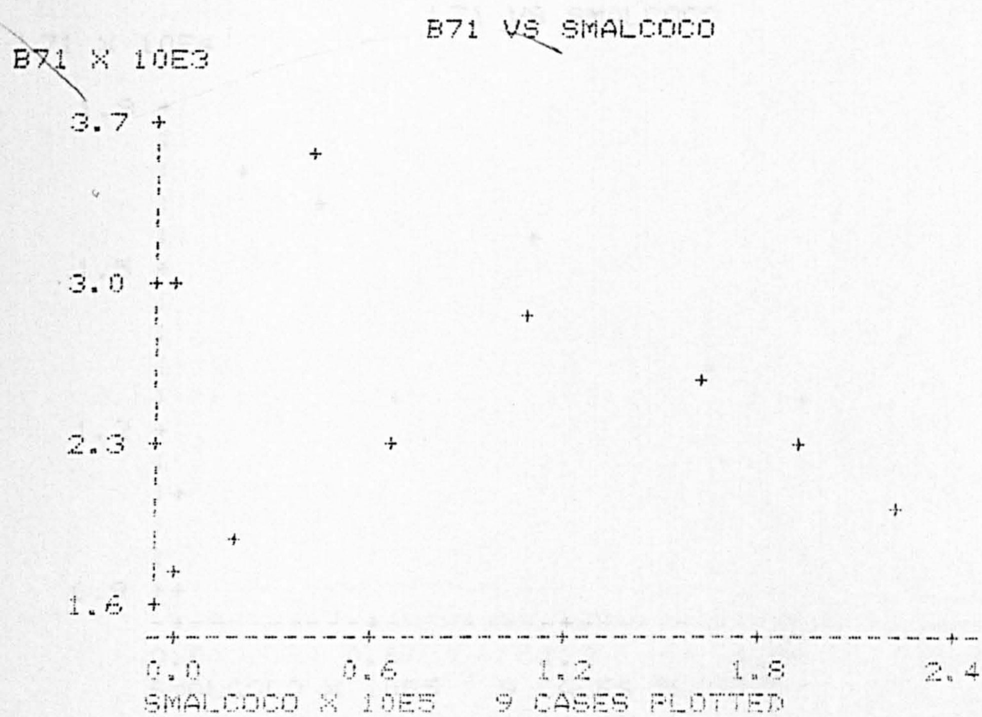


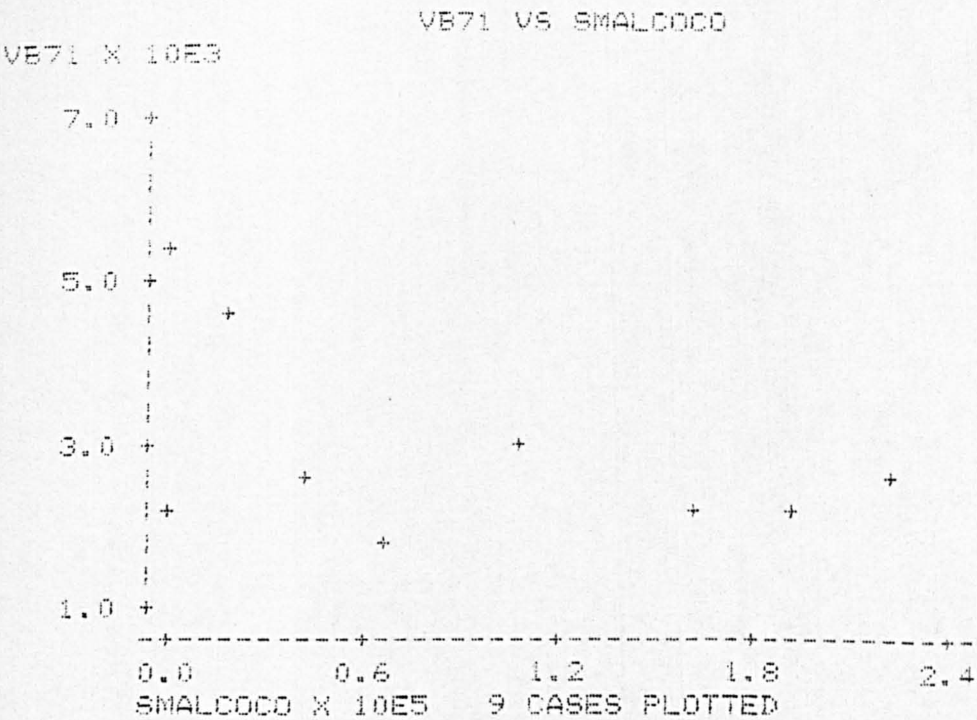
SMALCOCO VS VBAD



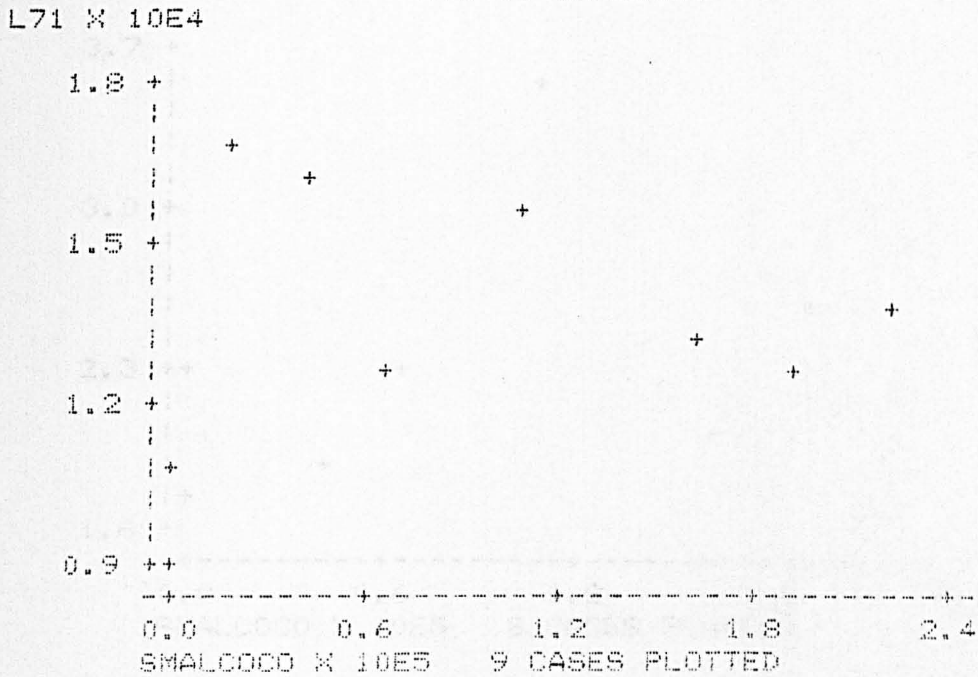


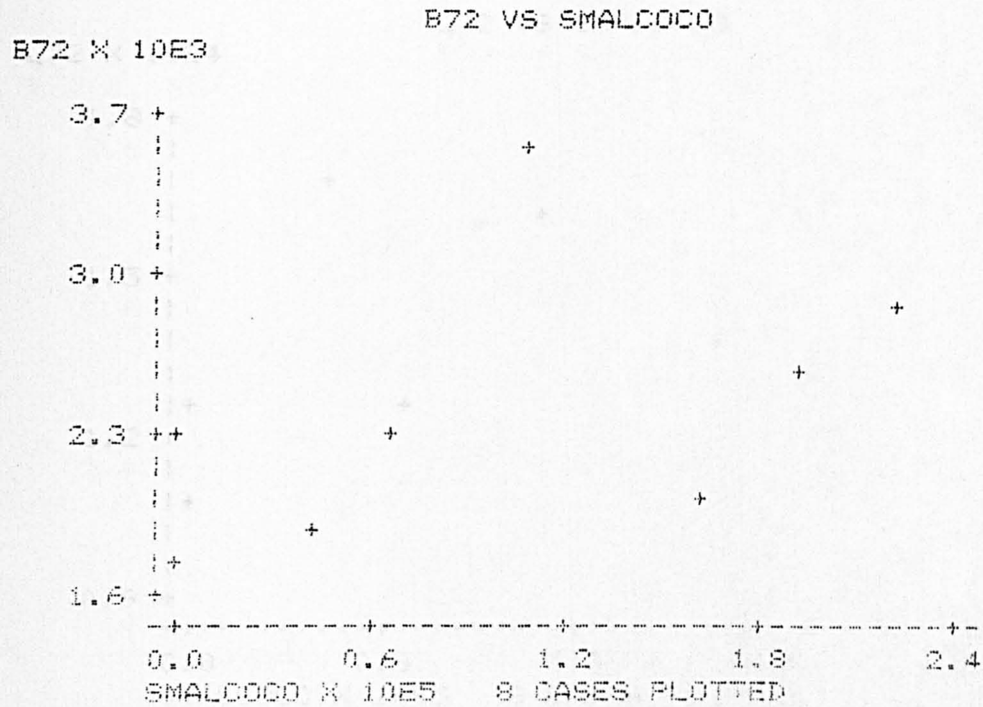
SMALCOCO VS LENGTH
SMALCOCO X 10E5
2.4
1.6
0.8
0.0
0.9
1.1
1.3
1.5
1.7
LENGTH X 10E4   9 CASES PLOTTED

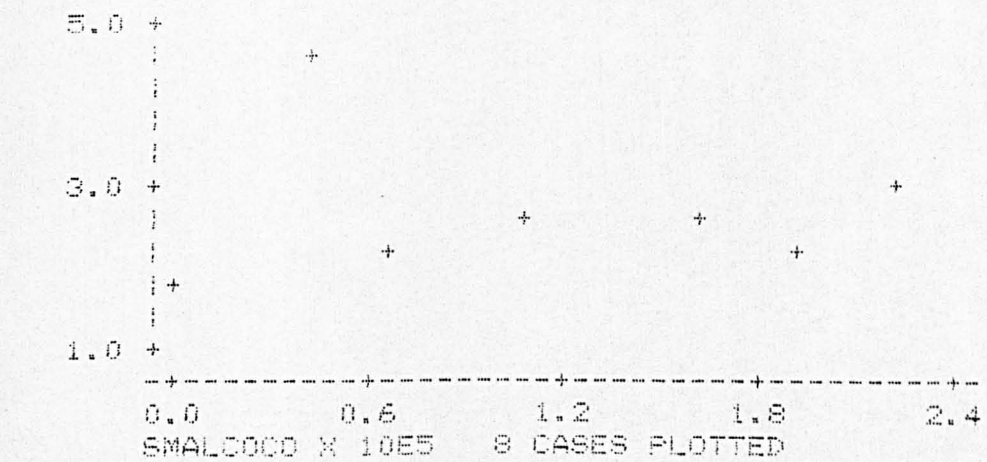

B71 VS SMALCOCO
B71 X 10E3
3.7
3.0
2.3
1.6
0.0
0.6
1.2
1.8
2.4
SMALCOCO X 10E5 9 CASES PLOTTED


VB71 VS SMALCOCO
VB71 X 10E3
7.0
5.0
3.0
1.0
0.0
0.6
1.2
1.8
2.4
SMALCOCO X 10E5 9 CASES PLOTTED

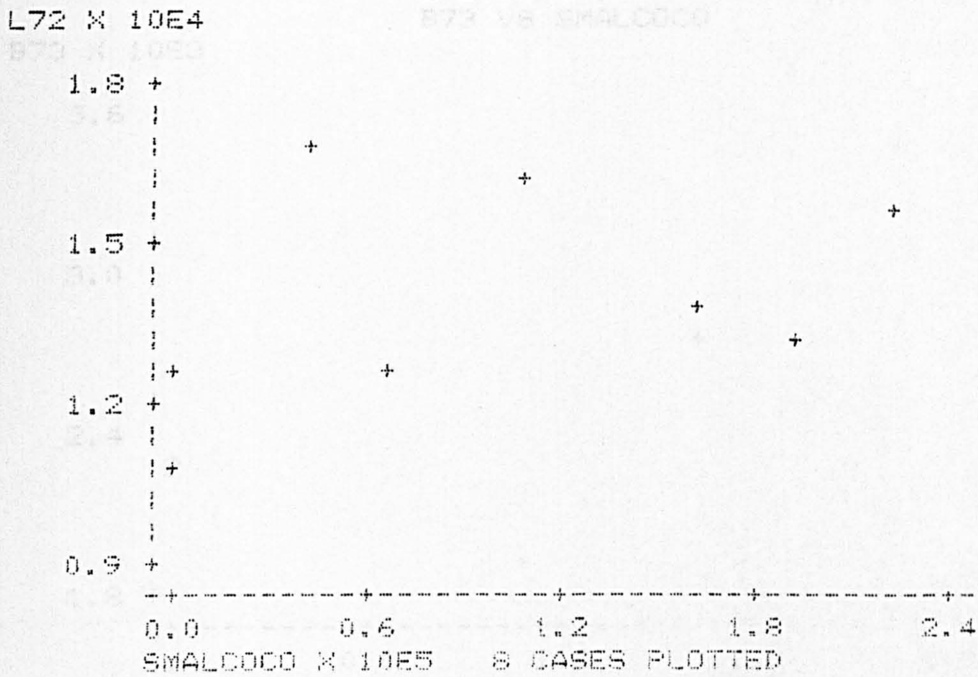
L71 VS SMALCOCO



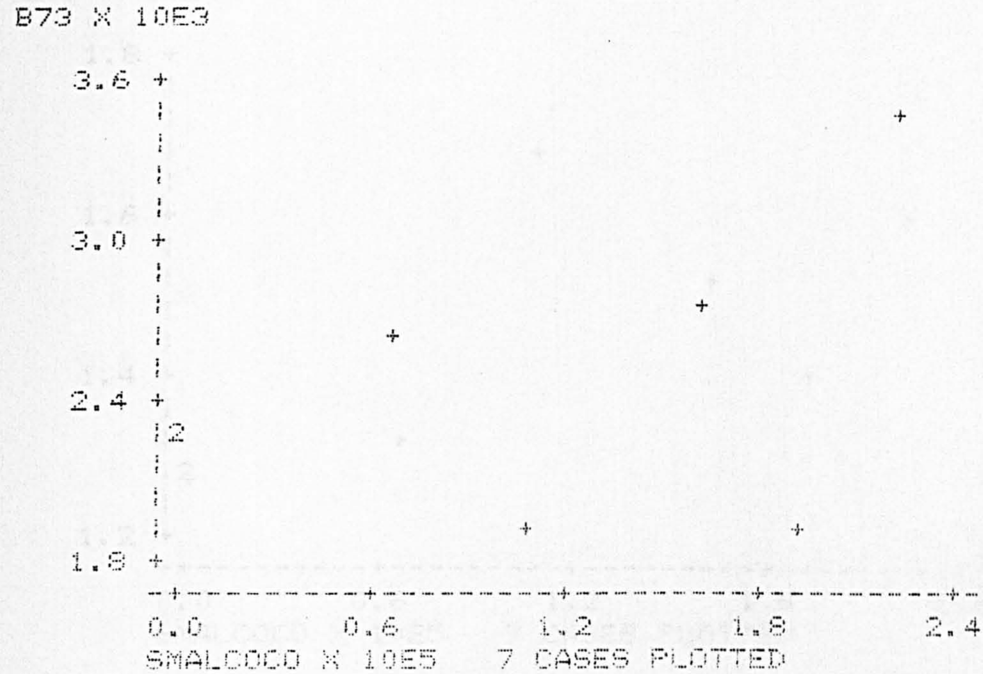

B72 VS SMALCOCO
B72 X 10E3
3.7
3.0
2.3
1.6
0.0
0.6
1.2
1.8
2.4
SMALCOCO X 10E5   8 CASES PLOTTED


VB72 VS SMALCOCO
VB72 X 10E3
7.0
5.0
3.0
1.0
0.0
0.6
1.2
1.8
2.4
SMALCOCO X 10E5   8 CASES PLOTTED

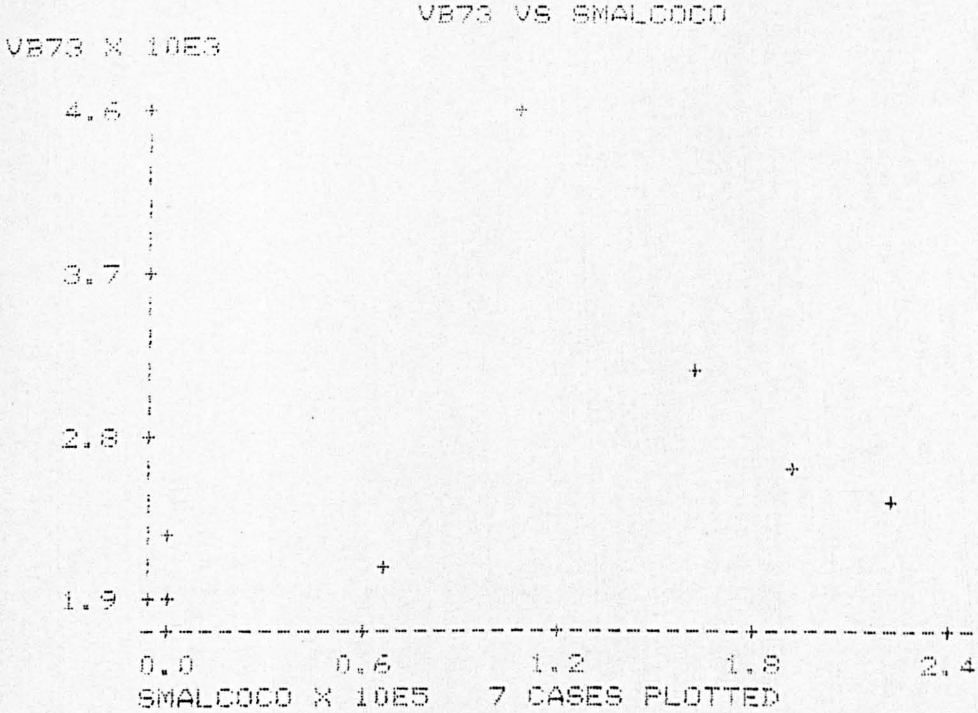
L72 VS SMALCOCO



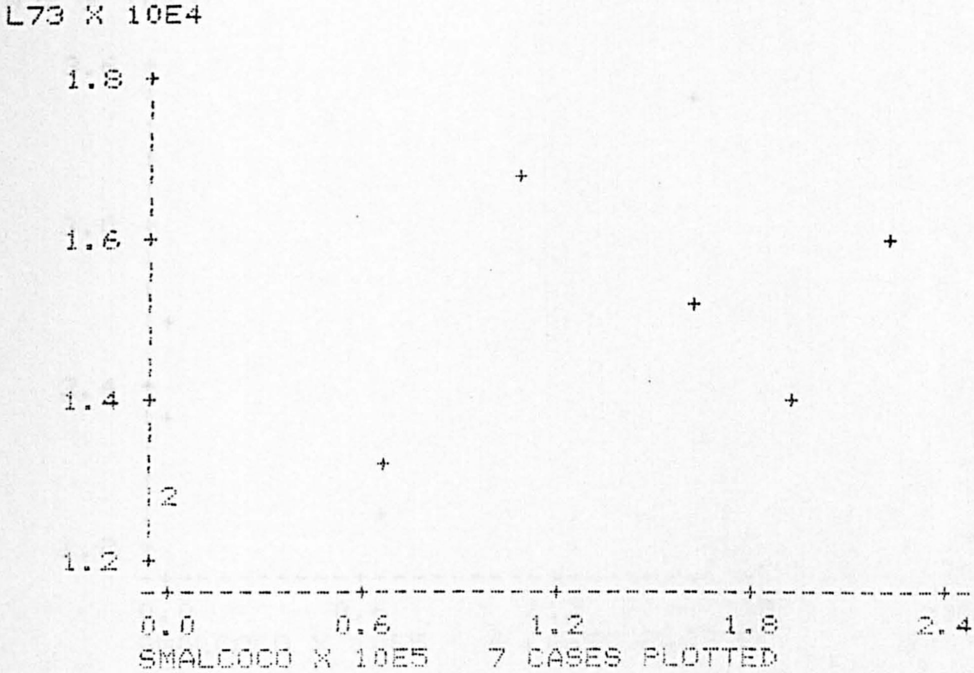
B73 VS SMALCOCO



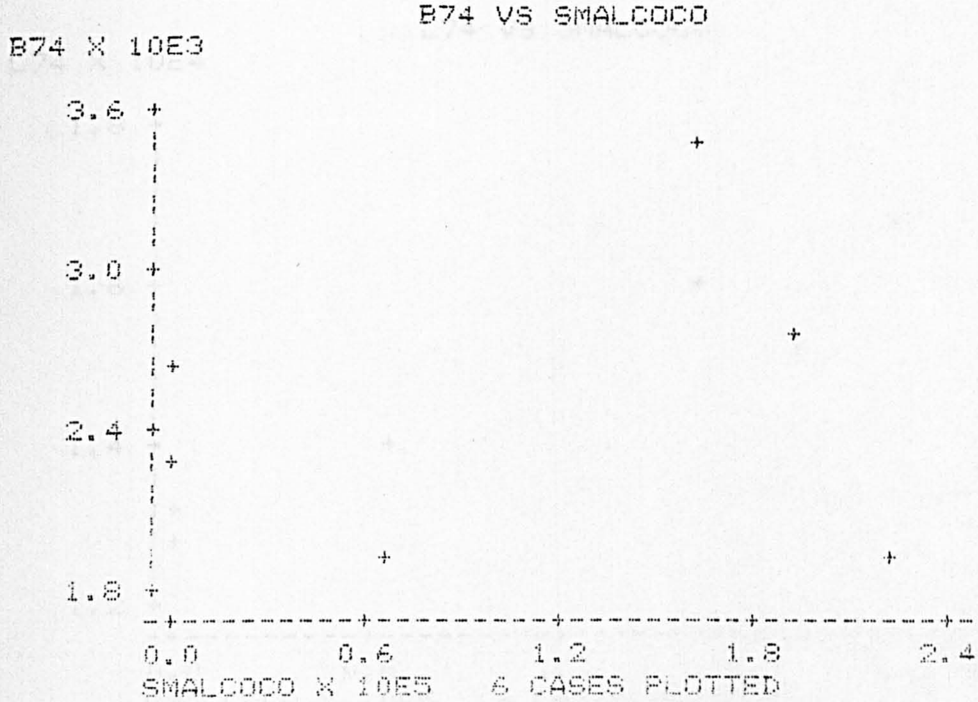
VB73 VS SMALCOCO



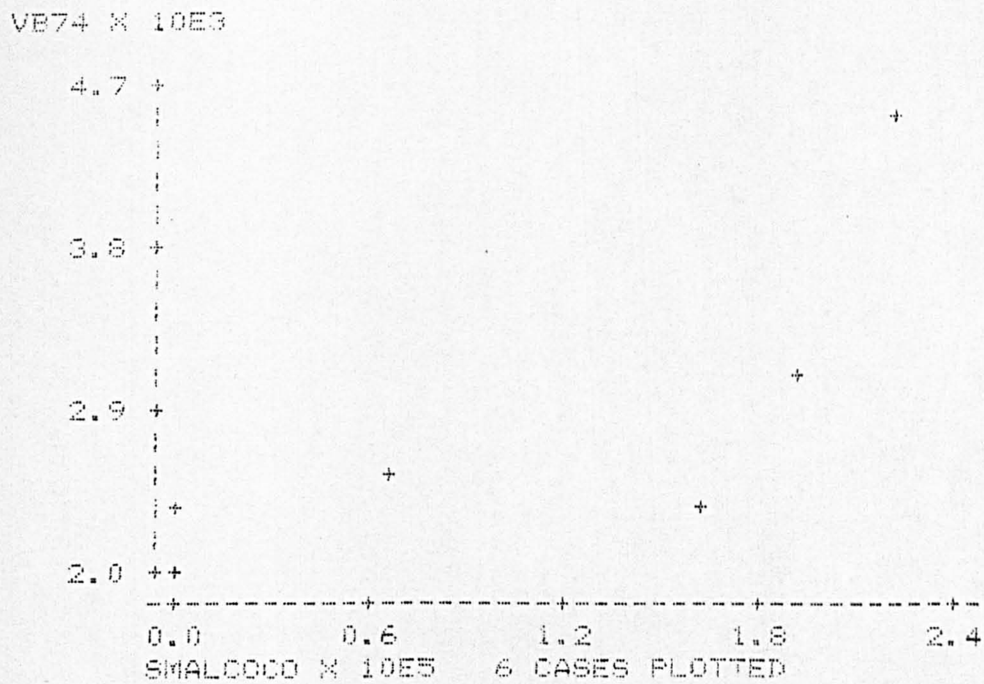
L73 VS SMALCOCO



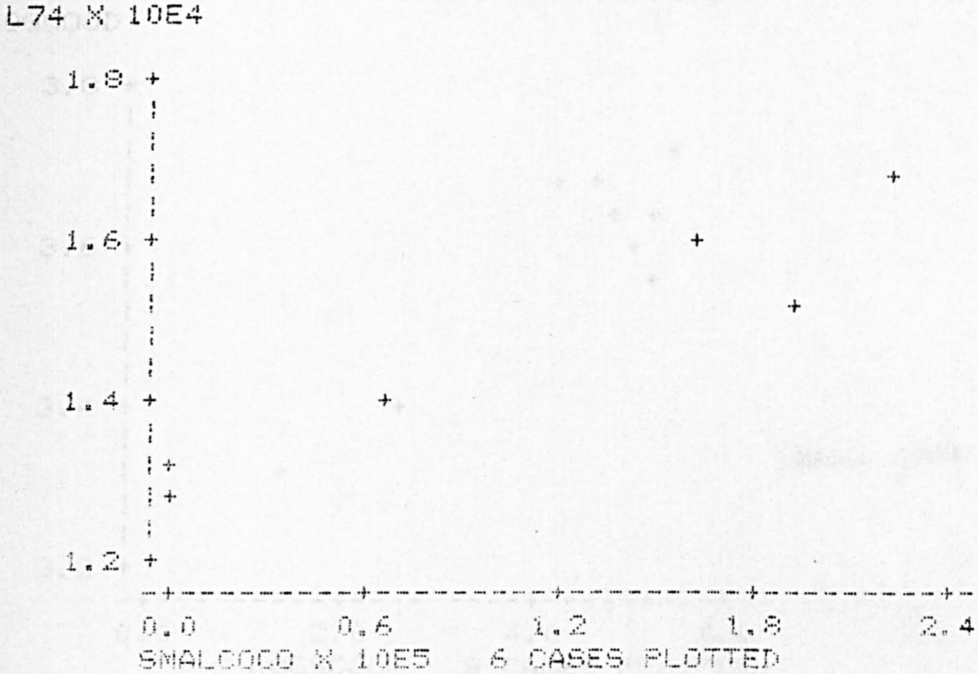
B74 VS SMALCOCO

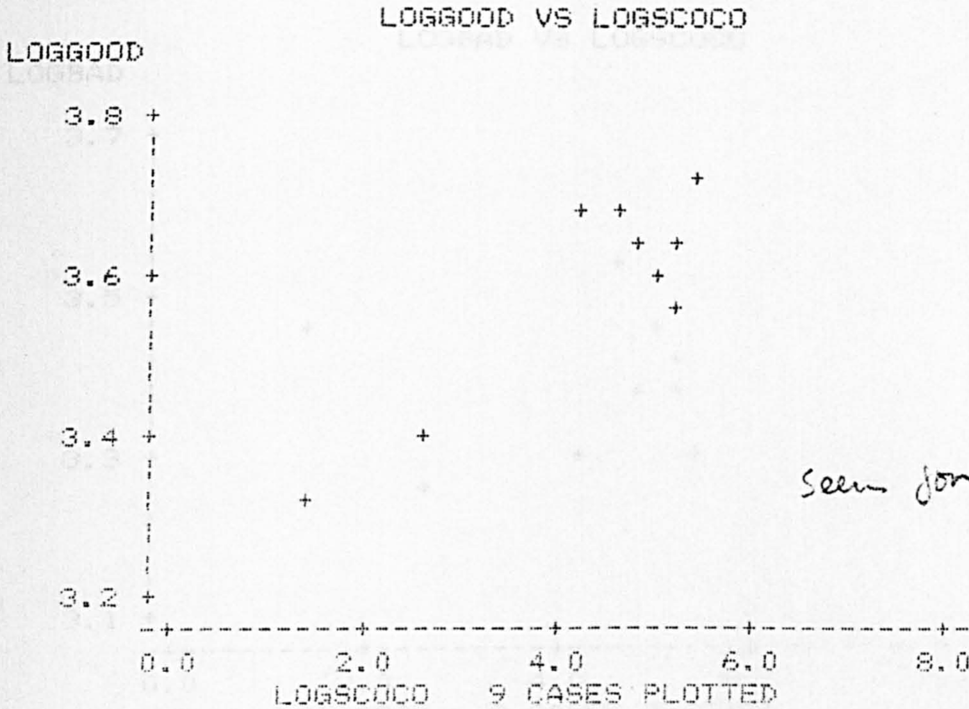


VB74 VS SMALCOCO

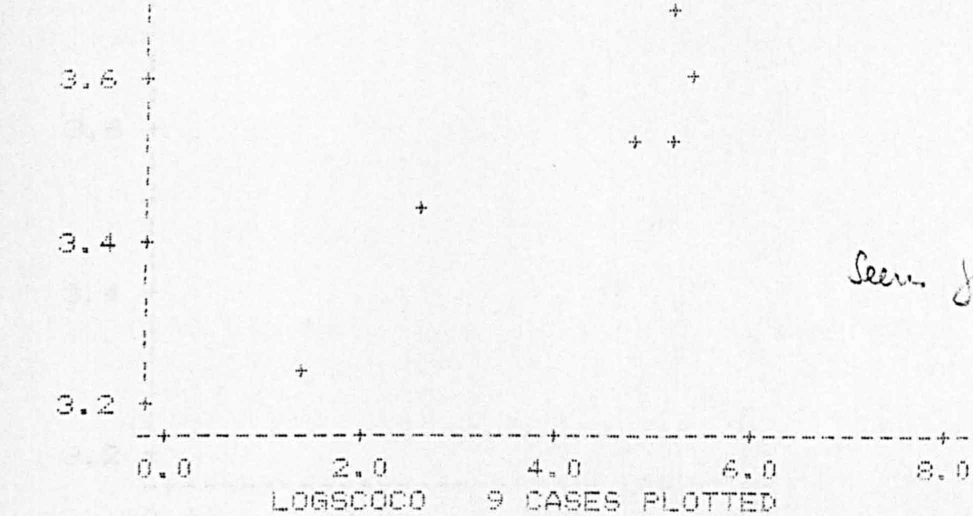


L74 VS SMALCOCO

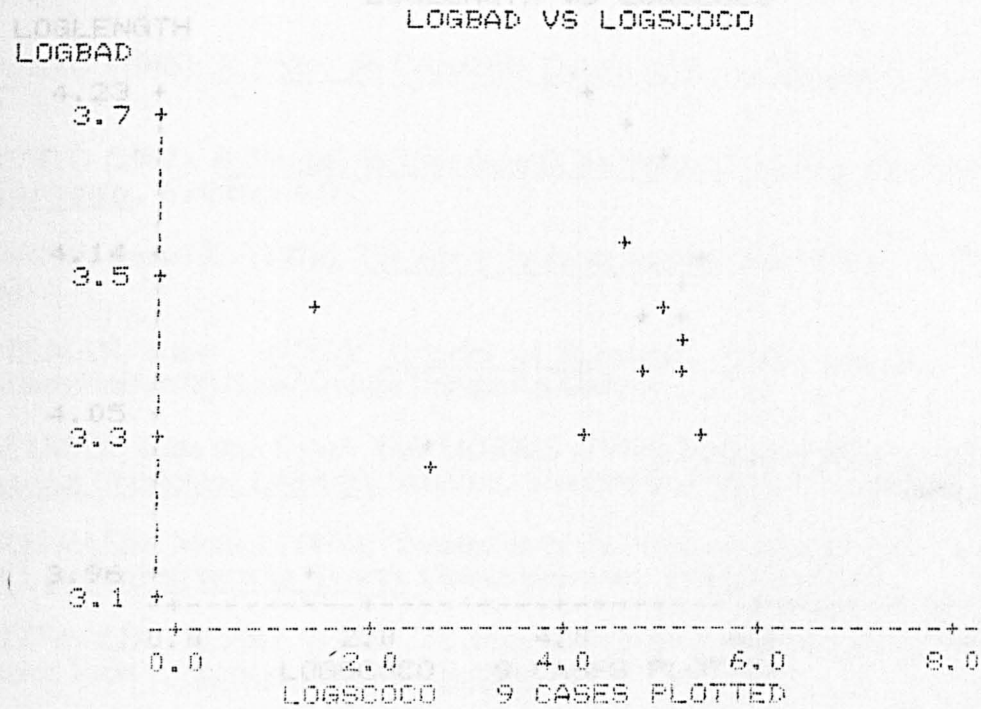


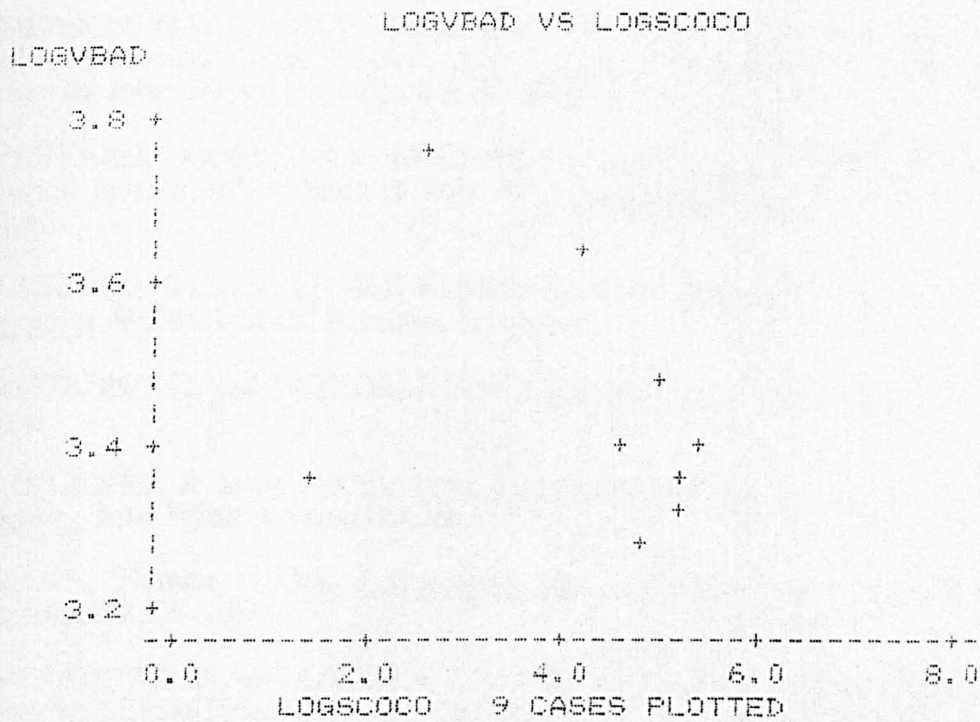


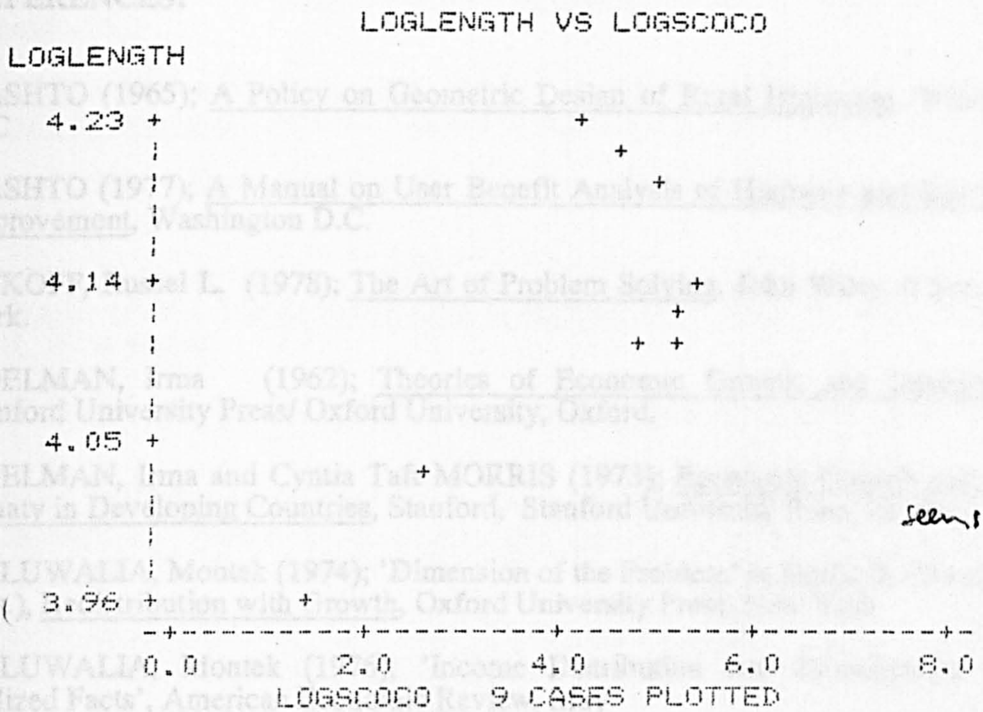
Seen Jond



Seen Jond.


LOGBAD VS LOGSCOCO
LOGBAD
3.7
3.5
3.3
3.1
0.0
2.0
4.0
6.0
8.0
LOGSCOCO 9 CASES PLOTTED


LOGVBAD VS LOGSCOCO
LOGVBAD
3.8
3.6
3.4
3.2
0.0
2.0
4.0
6.0
8.0
LOGSCOCO 9 CASES PLOTTED


LOGLENGTH VS LOGSCOCO
LOGLENGTH
4.23
4.14
4.05
3.96
0.0
2.0
4.0
6.0
8.0
LOGSCOCO 9 CASES PLOTTED

seems good

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