The Role of Rural Electrification in the Development of Sarawak

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Abstract

The introduction of electricity is widely perceived to bring socioeconomic and infrastructural improvements to the rural areas of developing countries. In Malaysia the rural electrification programme is a high profile demonstration of the Government's commitment towards socioeconomic development of the rural areas. Following substantial achievements in the rural electrification of Peninsular Malaysia, attention is now focussed on the economically and infrastructurally less-developed states such as Sarawak, on the island of Borneo. The thesis of this study was that the present form of rural electrification is largely inappropriate for the rural development of Sarawak.

In response to a perceived need for specific policy-directed rural development research, the consequent aims of this study were to examine the developmental role of rural electrification in the state of Sarawak. Data collected during two extended field trips are presented and discussed in context. The progress of the various programmes is analysed and the significance of the introduction of electricity for life in the rural areas investigated. In addition, priorities and perceptions of the government, implementing authorities, local development administrators and villagers with respect to rural electrification are assessed.

The study concludes that, despite government initiatives, acquisition of an electricity supply is a fairly low priority concern for many rural communities. However, the increase in self-esteem and confidence of the community which accompanies a perceived narrowing of the gap between standards of living in town and in the village, is more apparent than predicted. As an outcome of the study specific recommendations are proposed to tackle the electrification of remote settlements in Sarawak.

Declaration of originality

I hereby declare that this thesis is based on my own research work and has been composed by myself.

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Abbreviations and Acronyms

AC	alternating current
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
AWS	Assisted Wiring Scheme
BP	British Petroleum
DC	direct current
EGAT	Electricity Generating Authority of Thailand
EJ	Exajoules (1 Exajoule (EJ) = 10^{12} Megajoules (MJ))
ESCAP	Economic and Social Commission for Asia and the Pacific
FELDA	Federal Land Development Authority
GDP	Gross Domestic Product
GTZ	German Agency for Technical Cooperation
GW	Gigawatts
GWh	Gigawatt-hours
HT	high tension
HV	high voltage
HVDC	high voltage direct current
ISIS	Institute of Strategic and International Studies, Malaysia
ITTO	International Tropical Timber Organisation
JKR	Jabatan Kerja Raya - Department of Public Works
kV	kilovolts
kW	kilowatts
kWh	kilowatt-hours
LLN	National Electricity Board of Malaya (recently privatised and renamed Tenaga Nasional Berhad)
LLS	see SEB

LNG	Liquified Natural Gas
LV	low voltage
MJ	Megajoules
MP	Member of Parliament
MW	Megawatts
NEB	see LLN
NEP	New Economic Policy
NRSE	New and Renewable Sources of Energy
RE	rural electrification
RES	Rural Electrification Scheme
RRA	Rapid Rural Appraisal
SALCRA	Sarawak Land Consolidation and Rehabilitation Authority
SDO	State Development Office
SEB	Sabah Electricity Board
SEDC	Sarawak Economic Development Corporation
SESCo	Sarawak Electricity Supply Corporation
SPU	State Planning Unit
TOE	tonnes of oil equivalent
UKM	Universiti Kebangsaan Malaysia
UNDP	United Nations Development Programme
USAID	U.S. Agency for International Development
V	volts
W	watts

Notes on currency

The Malaysian currency unit is the Malaysian dollar (M$), also known as the *ringgit*.

1 M$ = 100 cents (sen).

Exchange rate on 30 April 1990 £ 1 = M$ 4.44

The shade of their trees was a word of many shades
And a lamp of lightning for the poor in the dark

Dylan Thomas

Chapter 1:

INTRODUCTION

This thesis presents the results of an examination and evaluation of the role played by rural electrification in the socioeconomic development of Sarawak. The State of Sarawak is part of the Federation of Malaysia and is situated on the north-west coast of the island of Borneo (see *Figure 1*). Although the historical and geographical characteristics of Sarawak and Peninsular Malaysia are sufficiently different to merit separate consideration, there has been little rural development research carried out in Sarawak to date and no integrated evaluation of the various rural electrification initiatives.

This opening chapter introduces the concept of rural electrification and briefly reviews the comprehensive body of research and opinion devoted to the subject. An outline of the origins and rationale of the research project and a description of the methodology are included in Section 1.2. and the chapter ends with an explanation of the structure of the thesis.

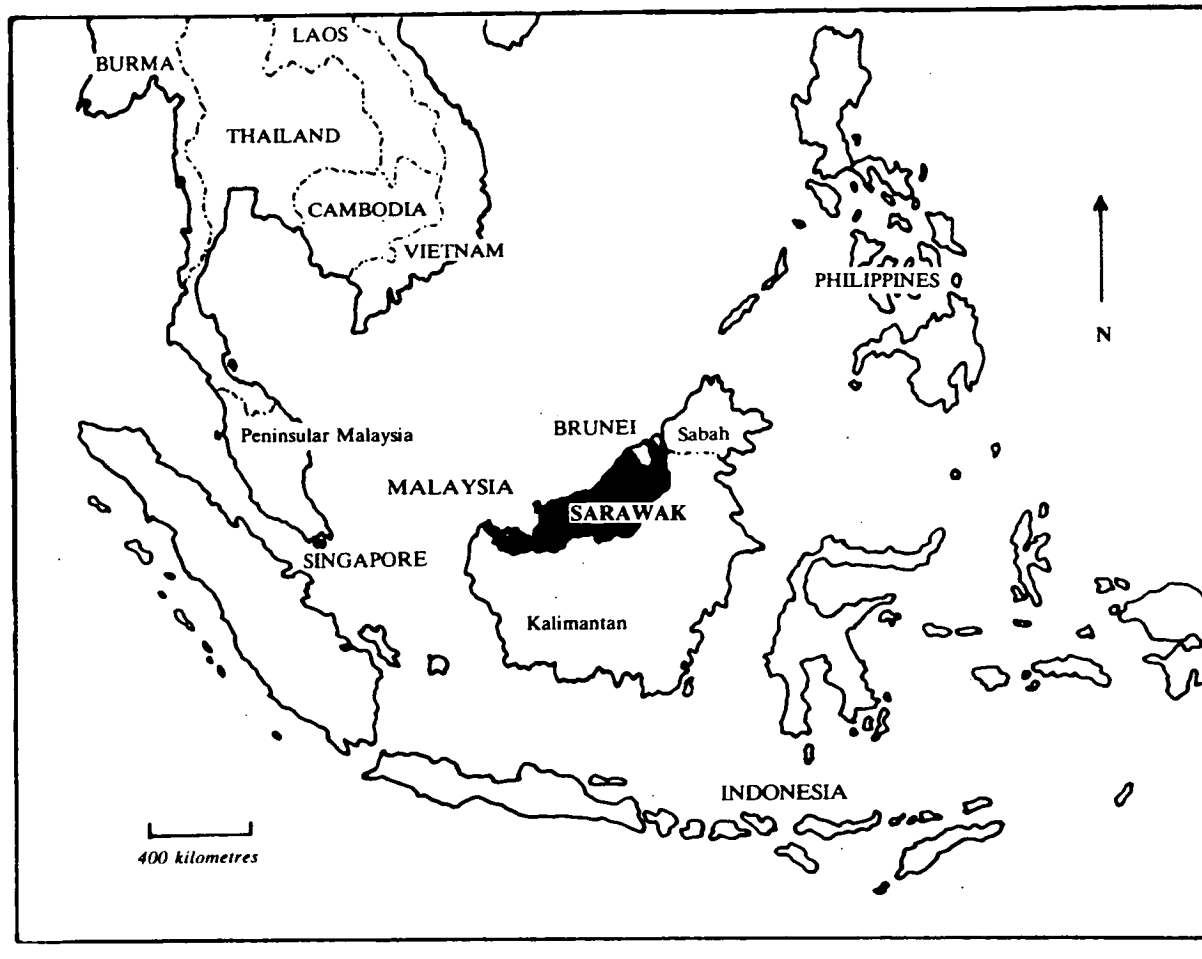

Fig. 1. *Map of Southeast Asia.*

1.1 Rural electrification as a development issue

Rural electrification (RE) is currently regarded as a Third World issue and problem, although the first large scale RE programmes were mounted in industrialised nations, following the Second World War. Until fairly recently, the problem of rural electrification was still an issue in the West, especially in those countries with large rural populations such as Ireland, whose electrification programme was officially declared complete in 1976 (Foley 1989, 98). There is now extensive literature dealing with the subject of rural electrification and its costs and benefits. This section presents a brief review of the main features and arguments.

1.1.1 Concept of rural electrification

Rural electrification has been defined as the provision of an electricity supply to areas of low electricity demand and highly dispersed potential consumers (Spencer 1988, 4). However, in different national and regional contexts the term "rural electrification" is used to describe a variety of activities ranging from the extension of the national grid to supply a densely populated suburban district, to the installation of solar photovoltaic panels to provide lighting for a remote village. Part of the problem of pinpointing a working definition is due to the variety of official uses of the word "rural". This term has itself long been the subject of academic debate (Vu 1960, 61; Hoggart 1990). Furthermore, reports on the progress of rural electrification programmes may use figures referring to the number of households or alternatively the number of villages electrified. In addition to these figures being hard to compare, the question also arises of how many households must have access to electricity before a village can be considered to be "electrified" (UNDP/ESCAP 1990, 21).

Practically speaking, most countries have some degree of rural electrification but are in different phases of developing it. The process of rural electrification is usually

considered to comprise three stages (World Bank 1975, 4; Pearce 1987, 329). The first stage is the private use of small generators by businesses and certain wealthy individuals. The second stage consists of the setting up of private or public autogenerators (autonomous generators) and an associated micronetwork to serve a very localised demand. The final stage is the introduction of a central grid supply via a transmission network. This may then be extended further to supply more isolated load centres.

Rural electrification does not necessarily progress through all three stages in sequence but depends upon the policies and programmes of the particular country. Traditionally, the term rural electrification is used to refer only to the last stage of the process, or central grid connection (UNDP/ESCAP 1990, 21).

1.1.2 Rural electrification strategies

Rural electrification programmes generally begin with a strategy of supplying the larger demand centres. This is then followed by the construction of marginal extensions to supply smaller centres or those consumers located close to the network. Small autogenerators may also be installed to meet the demands of the more isolated rural settlements. As the network expands these autogenerators are often replaced by extending the public supply.

Thus, in most countries, the approach to rural electrification has been to expand gradually the electricity supply grid into rural areas. However, in China the strategy has been to install separate generators for each centre of population and gradually incorporate them into an integrated network (Wirtshafter & Shih 1990). This decentralised approach is compatible with China's highly devolved system of administration.

The decision of whether, and when, to electrify small demand centres and whether to extend the network or use autogenerators depends on government priorities and resources, the costs of each option and the perceived benefits.

1.1.3 Characteristics of rural electrification

General characteristics of rural electrification projects include:

- consumers are often relatively highly dispersed, leading to higher distribution costs than for urban areas;
- levels of electricity consumption and growth rate of consumption are generally low;
- the load factor is generally low*, where the main load is provided by domestic consumers and demand is concentrated in a few evening hours;
- opportunities for "productive" uses are few.

The combined effect of these characteristics is to make the marginal costs of supplying electricity to rural consumers relatively high compared to those of supplying urban consumers (Pearce & Webb 1987, 330). In its definitive 1975 report the World Bank claimed the average initial 10 year cost of electrifying rural areas to be between 6 to 8 cents per kilowatt-hour, compared with 3 cents per kilowatt-hour for urban areas (World Bank 1975, 5). As electrification programmes proceed this differential increases as smaller and smaller villages in more remote locations are electrified at a consequently greater cost.

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* Load factor expresses the ratio of average to peak power requirement.

1.1.4 Motivation for promotion of rural electrification

Despite the relatively high costs of supplying rural consumers with electricity, governments in the developing world allocate a significant proportion of their energy expenditure to such projects (Pearce & Webb 1987). Rural electrification is well suited to external financing, including development aid, due to the high foreign exchange component and large size of the projects (Fluitman 1983). During the 1960s and '70s major assistance programmes for rural electrification were mounted by multilateral and bilateral funding agencies. Substantial funds have been provided by international funding organisations such as the US Agency for International Development (USAID), the World Bank and the Asian Development Bank in the form of loans, grants and technical assistance. For instance the World Bank reports that prior to 1983 rural electrification accounted for 10 percent of total investment in electric power (World Bank 1983, 56). In the period 1976-1984 total World Bank funding in this sector came to US$ 1,471 million; the largest recipients were India and Brazil with US$ 537 million and US$ 250 million, respectively (Foley 1989, 86).

There are a number of motives for the electrification of rural areas. Ideological motivation spans from early Leninism to the United States "New Deal" policies during the Great Depression, which both specifically incorporated electrification as a key objective (Smith 1980; Foley 1989). Electrification is often seen as a way of unifying countries with different ethnic communities, thereby consolidating political power (Flavin 1986, 34). In addition, individual politicians have found electrification programmes to be very popular with the electorate (Venkataraman 1990).

The provision of an electricity supply is believed to bring sweeping changes to the lives of rural people and the wide range of socioeconomic benefits often cited include:

- stimulation of the rural economy;
- general improvement in the standard of living of rural people;
- reduction of urban migration;
- promotion of literacy due to better conditions for school children to study in the evenings and access to television;
- improvement in health through the provision of refrigeration.

Although there are arguments about these and other alleged benefits, there is no doubt that rural electrification has become integral to the development process in many countries and is now a well-established and accepted feature of many rural development and energy policies (Flavin 1986, 33).

To conclude, three main categories of policy objectives for rural electrification have been identified by the Asian Development Bank (ADB 1983):

(i) **Provision of rural infrastructure** - encompassing most of the socioeconomic objectives of rural electrification;

(ii) **Irrigation** - a central objective in India, Pakistan, Bangladesh and China;

(iii) **Political and security objectives** - including as a part of counter-insurgency measure in sensitive and border areas.

1.1.5 Supply options

Rural electrification is often assumed to be synonymous with grid extension, involving well established technology and design methods for the construction of substations and sub-transmission and distribution networks. However, depending on the characteristics of the area to be electrified, an immediate extension to the grid

network may not offer the optimal technical or economic solution. The alternative to a grid-based supply is off-grid, or decentralised, generation, which often precedes later grid connection (Andersson 1981, 14). Decentralised options include diesel- or petrol-driven generators, small-scale hydro power, solar photovoltaic systems, windmills and various biomass*-based alternatives.

Diesel generation

Diesel generators are by far the most common method of off-grid electricity generation. The technology is well established world-wide and there is a large variety of commercially available diesel generators with outputs ranging from below 5 kW to several megawatts. Small petrol-driven generators cover the lower range from 500 W up to several kilowatts.

An important feature of the diesel option is its flexibility. The output may be controlled by varying the fuel supply and additional units can be installed as demand grows. The maintenance requirement for diesel generators is substantial and, although it is usual for the public utility to provide trained technicians to operate larger power stations serving small towns, there can be problems in finding suitable operators to run village generators (Cheatham 1989). Fuel constitutes the main running expenditure for a diesel generator and fuel transport costs become increasingly significant as the degree of remoteness of the installation and difficulty of access increase.

Small-scale hydropower

In some mountainous parts of the world such as Nepal, there has been a long tradition of harnessing small-scale hydro power, usually for mechanical purposes such as milling. Rural electrification programmes based on micro-hydro technology

* Organic carbon based material, deriving from plants or animals, which reacts with oxygen, in combustion and natural metabolic processes, to produce heat.

have proved to be particularly successful in China and Nepal where it is possible to build upon established practices of using local hydrological resources (Zizhen 1989).

The following small-scale hydro definitions are now widely accepted, although individual countries, such as Malaysia, may employ a different classification: micro hydro is used to refer to plant with output below 100 kW, and the mini hydro range is between 500 kW and 100 kW. Of more technical significance than size is whether the hydro system is, or might be in the future, connected to the grid and whether the scheme incorporates water storage. The larger small hydro schemes may include a dam to provide limited water storage for a few days operation, however, micro hydro schemes are often run-of-river designs, which do not incorporate storage reservoirs.

The choice of turbine depends on the head and volume of water as well as the availability of locally manufactured equipment, which is often substantially less costly. Costs can vary enormously according to the location, type of installation, who carries out the design and construction and the quality of supply required (Whittaker 1988, 40). For example, in all but the most basic supply systems it is necessary to maintain the turbine speed at a constant level in order to protect appliances which are sensitive to variations in frequency and voltage. This can mean the inclusion of a speed governor to vary the amount of water reaching the turbine or an electronic load controller to divert electricity to a ballast load as required. The location of the hydro installation is determined by the hydrology of the area and, if the consumers are more than a couple of kilometres distant from the generating station, it may be necessary to transmit power at a high voltage requiring installation of transformers. In addition, there is a broad consensus that small hydro schemes built by electricity utilities tend to be financially unviable due to overdesign (Foley 1989, 39).

In terms of personnel requirements, basic maintenance and operation procedures must be carried out regularly, but are fairly simple and can often be performed by the

local community. However, repairs and malfunctions must be dealt with by fully trained technicians.

Solar photovoltaic systems

Due to the high cost per unit of installed capacity and low power capability, there has been up to now only a limited role for solar photovoltaic systems in rural electrification. Their use has been established for low power applications such as telecommunications and pumping equipment for remote areas. However, as a source of electricity to provide lighting for remote communities, photovoltaic systems have been shown to be economic only where they displace use of dry-cell batteries (Foley 1989, 70; Jourde, 1989). The capital investment costs are high and almost all the components must be imported, using up precious hard currency. Although daily running costs are minimal, storage batteries are usually necessary if an evening load is to be supplied, and these must be replaced at least every five years. Maintenance requirements are simple but crucial if the system is to operate for more than a few years. A common cause of shortened battery lifetime is failure to top up the battery with clean (preferably distilled) water on a regular basis. A further disadvantage is that it is difficult to adapt a PV system to rapid growth in customer demand at low cost (UN 1989, 162).

Other renewable options

There are few examples of successful long-term rural electrification schemes utilising renewable energy sources other than hydro or solar power. Although windpower is used for pumping water in some parts of the developing world, there are hardly any examples of windmills, or aerogenerators, being used to generate electricity outside Western countries (ESCAP 1988). Limited use is currently made of biomass-based generation technologies. Gasifiers, which burn wood or charcoal to produce gas to drive an internal combustion engine, are to be found in parts of Southeast Asia, although the technology is mostly used in industry and is only at the

demonstration stage as a means of rural electrification (ESCAP 1988; Meunier 1990, 294; Green 1991). There are also examples of factories which burn wood or agricultural waste products, such as rice husk or bagasse, to generate their own electricity requirements using steam-boilers. There has been an attempt in the Philippines to adapt this technology for rural electrification by using wood from special plantations to supply dendrothermal, or wood-fired, rural power stations (ESCAP 1987). However, it is generally agreed that there is still much work to be done in converting these renewable technologies from demonstration or short-term projects to realistic and practical options for long-term rural electrification.

Rechargeable battery systems

The use of lead-acid batteries on an individual basis by rural households is extremely common in areas of the developing world where there is no public electricity supply. In parts of Asia rechargeable battery systems have been introduced as an alternative to grid extension and costly distribution networks for sparsely populated areas (Foley 1989, 49). Batteries are taken to recharging centres which are not necessarily connected to the grid but may generate electricity using diesel, small hydro or photovoltaic systems (Rodriguez 1991; Hettiaratchi & Brown 1991).

Choosing between the options

From a purely technical viewpoint, the grid extension option is far superior to the decentralised alternatives, due to its flexibility in supplying a fluctuating and possibly growing demand, the low local maintenance requirement and because transport and storage of fuel is no longer necessary. However, this option is often too expensive for areas of low demand which are far from the existing grid and decentralised energy technologies may make economic sense (Meunier 1990; Sinha & Kandpal 1991).

Normally, the range of technologies to be considered for a rural electrification programme can be narrowed considerably by broad technical comparisons. Various criteria must be taken into account when examining the alternatives:

- capital costs of each alternative;
- operation and maintenance requirements.
- present distance from the grid and expected expansion of the grid into the area;
- level of demand and its projected growth;
- anticipated load curve†;
- quality of supply required;

Failure to match the characteristics of the proposed supply technology to the local demand pattern and to anticipate correctly the maintenance and repair requirements will result in a truncated project lifetime. However, the choice of a technology which can meet the technical specifications is only one aspect of supply selection. The success of the project ultimately depends upon whether it will be adopted and supported by local users. Bowman and Pintz (1990, 342) have identified the four factors of *dependability*, *maintainability*, *social acceptability* and *cost* which determine the attitude of the local people towards an electrification project. In addition it has been pointed out by Foley (1989, 66) that upon consideration of all associated costs it often becomes apparent that electrification is not yet a feasible proposition for the area under consideration.

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† A load curve is the 24 hour load profile for a typical day.

1.1.6 Institutional arrangements

In its 1983 Regional Rural Electrification Survey the Asian Development Bank identified four types of rural electrification agency structure (ADB 1983):

(i) National agency with RE responsibility;

(ii) Regional/Provincial agency with RE responsibility;

(iii) National agency with unique mandate for RE;

(iv) Local agency with RE responsibility.

More than half of the Developing Member Countries of the Asian Development Bank rely on a national electricity utility to undertake rural electrification as part of its statutory duties and have no specialist RE agency. Some countries employ a combination of more than one agency type, often partitioning responsibility for the tasks of financing, generation, transmission and distribution. In Bangladesh and the Philippines, for instance, a national RE financing agency is closely linked to local cooperatives, which are under central control.

Rural electrification agency functions

The functions of rural electrification agencies include:

- policy and programme formulation;
- central planning;
- project planning;
- construction;
- technical operations;
- commercial operations;
- personnel training and management of contractors and consultants.

The level of centralisation or decentralisation of the functional arrangements varies considerably according to the historical background of the agencies involved and political pressures in each country. In particular, it has been noted that a centralised approach involves a higher demand for information and that the decentralised approach requires greater efforts at coordination (ADB 1983, II.14).

Financial management

Finance for capital investment in rural electrification comes from three main sources (Spencer 1988):

(i), Government subsidies;

(ii), Loans or grants from international organisations, overseas governments, aid agencies, or less commonly from commercial banks at market interest rates;

(iii), RE agencies themselves.

RE agencies aim to recover a certain proportion of their costs from the consumers through setting tariffs which will generate a reasonable rate of return on investment. The level of subsidy available for rural electrification and the tariff structure, including the degree to which a strategy of cross subsidisation between different consumer categories is pursued, are all political concerns.

1.1.7 Development issues

Expenditure on rural electrification absorbs a large proportion of the development budgets of developing nations as well as that of international banks and donor agencies. Since rural electrification is not normally viable on a strictly financial basis, justification is often based on RE as a catalyst for rural development or as a social infrastructural investment (ESCAP 1990). However, since the mid-1970s, there has been a reassessment of the effectiveness of RE programmes and an attitude

of growing criticism and cynicism has resulted (Smith & Kim 1989, 246). In particular, many of the alleged benefits are seen as having failed to materialise as predicted. Consequently, the original justification for many relatively high-cost RE programmes is being re-evaluated.

There are many conflicting views on the most effective strategy for rural electrification, its impact and the significance of its role in development. This section offers a summary of the main arguments.

Impact of electrification

The impact of rural electrification on the rural economy and the lives of rural people is still a subject of some dispute and the evidence is mixed (Desai 1988). This can be partly attributed to problems of measurement and the question of how the impact of rural electrification can be examined separately from the effects of other rural changes. For instance, the type of relationship which exists between RE and increased economic activity is not clear (UNDP/ESCAP 1990). Furthermore, it is generally acknowledged that there has been a tendency to overestimate productivity gains in the industrial and commercial sectors during economic appraisal of RE schemes (Munasinghe 1988, 294).

Numerous studies have been undertaken in an attempt to assess the impact of various RE programmes. Recent and comprehensive surveys of the evidence include those by Fluitman (1983), the Asian Development Bank (1983), Munasinghe (1988) and a joint study by the United Nations Development Programme and the Economic and Social Commission for Asia and the Pacific (UNDP/ESCAP 1990). The findings of this last definitive survey are summarised below:

- Electrification has been shown to correlate with higher household incomes and rural industrial development, but it is thought likely that economic growth precedes electrification and not vice versa.

- The main benefit is improved lighting. In addition, rural households who can afford electrical appliances benefit from improved amenities.
- Many poor households cannot afford connections and appliances. Although electric lighting is cheaper than the equivalent using kerosene, households generally spend more on energy because their consumption increases.
- With the limited exception of China, there has been no substitution of electricity for fuelwoods in cooking.
- Little productive use of electricity by households is observed.
- Community services, such as health clinics, often do not benefit from electrification due to poor coordination in the provision of infrastructure.
- Social benefits previously claimed such as a reduction in rural-urban migration (ECAFE 1963) and lower fertility rates are unproven.
- RE is inherently inequitable, since higher-income households, larger farmers and industries, and richer regions are better able to afford initial connection and use electricity more productively.
- Irrigation pumping associated with electrification programmes has been shown to increase agricultural output and yield. However, grid electricity is often not the lowest-cost choice to electrify dispersed pumpsets, and diesel pumps might be more cost-effective (Cecelski 1982).
- Although most existing businesses and industries adopt electricity as it becomes available, there seems to have been only modest impact on the establishment of new enterprises.
- Electrification alone does not seem to induce economic growth; however, it appears that electricity shortages in rural towns and provincial cities can act as

a constraint to industrial growth.

In conclusion, the UNDP/ESCAP study stated that:

> "the impact of RE on households, businesses, and social services varies tremendously from area to area but it is unlikely to be substantial in the absence of either an already dynamic economy or major complementary investments in rural development." (UNDP/ESCAP 1990)

Policy implications

Consideration of this recent evidence has led to a re-evaluation of the wider policy implications. The main issues and arguments are summarised below.

In particular, the broader issue of rural energy and, within this context, the role of electrification is being examined. It has been noted that rural energy does not necessarily need to be a high quality resource such as electricity. The concept of *energization*, as opposed to electrification, has been introduced by Smith (1980, 90), who argues for a radical re-orientation of approach towards village-centred solutions based on renewable energy and not necessarily geared towards the provision of electricity. The scale of electrification projects and the trade-offs between decentralised and centralised developments have been discussed by Smith and Kim (1989).

It has been asserted that expensive electrification projects do not address the real problems of rural people and constitute a drain on scarce development resources which could be better used to provide improved roads, water supplies and health care (Anderson 1988; PNG 1979, 27-28). Studies of the financial aspects of RE programmes include those by Fluitman (1983) and Pearce (1987) which question the wisdom of providing heavy subsidies for rural electrification and the associated problem of equity.

There is now general agreement that rural electrification should be viewed within the broader context of integrated rural development (ESCAP 1990, 277) and that the

participation of local people in decision-making is essential to improve the effectiveness of RE programmes (Foley 1990). Ownership and responsibility are seen as being as important as technology selection in determining the long-term success of a project. However, as regards the part to be played by New and Renewable Sources of Energy (NRSE) in the electrification of rural areas, opinion is considerably polarised between the sceptics and the enthusiasts. The sceptics claim that renewable technologies are still at an experimental stage and should not be inflicted on the rural poor (Foley 1990), whilst the enthusiasts argue that the decentralised approach, based on renewable energy, is the most sustainable and most lends itself to local control (Smith 1980). Furthermore, a new emerging technological dependency of Third World nations has been identified by Hoffman (1980) as manufacturers and governments of industrialised countries rush to exploit the growing market for alternative energy technologies.

1.1.8 Summary

In this section, the concept of rural electrification has been introduced and its significance in the developmental context of the Third World examined. A brief review was presented of the wide variety of research and opinion devoted to various aspects of RE. This included the central topics of technological choice, cost, political motivation, institutional arrangements and discussion of the controversial evidence for the role of RE in socioeconomic development.

1.2 Analytical framework

The main features of the research framework for the present study of rural electrification in the development of Sarawak are described in the following sections. This includes the justification for the study, its objectives and scope as well as an outline of the methodology and problems encountered during the fieldwork period.

1.2.1 Rationale for the study

The Malaysian Government devotes substantial resources each year to the electrification of rural areas as part of the general effort to improve the standard of living of rural people. The most accessible villages have now been electrified and the high profile rural electrification initiative is becoming increasingly costly as the more distant settlements are progressively targeted. This is particularly the case in the East Malaysian states of Sabah and Sarawak which are infrastructurally and economically less developed and more sparsely populated. However, few modifications have been devised to tailor the rural electrification approach to the special conditions which exist in Sabah and Sarawak. In addition, it has proved extremely difficult to estimate the progress made by the different parts of the programme since, as yet, little work has been carried out to evaluate the appropriateness and effectiveness of the programme or to identify any problems which may be hindering progress.

Since 1947, when a preliminary socioeconomic survey commissioned by the British Government identified subjects for potential studies (Leach 1950), research attention has mostly focussed on social and anthropological aspects of life in traditional rural Sarawak. A paucity of development research in Borneo has been noted by Osborn (1978, 107), who also remarks upon the general disinterest shown by the Malaysian universities and central government in the Borneo states. In particular, Osborn has identified a need for research focusing on policy-derived change and the impact of

development activities. However, as a result of the lack of basic data and previous groundwork upon which to base rural development research projects, the majority of development research carried out in Malaysia is geographically confined to Peninsular Malaysia, which further perpetuates the problem.

As yet, little rural development research has been undertaken in Sarawak, and there has been no assessment or evaluation of the various electrification initiatives. The scope for such a study and the main issues and problems were identified following a preliminary study tour which included both Peninsular Malaysia and the East Malaysian states of Sabah and Sarawak. As an initial investigation of rural electrification in Sarawak and the wider implications for development, this present study has a deliberately broad field of reference. It is anticipated that it will have prepared the ground for a more detailed and quantitative assessment of the options for, and the effects of, rural electrification.

1.2.2 Research objectives

The study objectives were discussed and agreed upon with the Institute of Strategic and International Studies (ISIS) in Kuala Lumpur and the State Planning Unit of the State Department of Sarawak. Given the exploratory nature of the study, the research objectives were defined as follows:

(i) to investigate the extent and form of rural electrification in Sarawak;

(ii) to assess the progress of the various programmes;

(iii) to identify the constraints and problems facing implementers and consumers;

(iv) to examine the priorities and perceptions associated with rural electrification in the villages and at each level of administration;

(v) to consider the effects of the rural electrification initiative on selected communities;

(vi) to make recommendations with reference to the policy issues associated with rural electrification.

1.2.3 Scope of research

This study is concerned with rural electrification in the context of overall rural development. Because there is little existing information for Sarawak, the work is by nature exploratory and wide-ranging. It deals with the development administration at each level of hierarchy and necessarily incorporates inputs from policy makers, programme planners and administrators as well as the project implementers and members of rural communities. Initially, research focussed on the relevant Federal and State Ministries, the Sarawak Electricity Supply Corporation (SESCo) and Government and Semi-Government Offices, and subsequently moved to the level of District Offices and local SESCo Offices.

Although, ideally, the geographical scope of the study would have covered Sarawak in its entirety, this was not a realistic target for an individual researcher. However, an attempt was made to compare and contrast the different circumstances and difficulties facing the electrification of various parts of rural Sarawak rather than limit the study to one village or one administrative district. After consultation with local experts, six of the then 27† Administrative Districts were chosen to reflect the wide range of geographical conditions and socioeconomic pressures which exist in rural Sarawak. The six selected Districts of Lundu, Serian, Lubok Antu, Sarikei, Belaga and Lawas are indicated on the map in *Figure 2*.

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†In 1991 the new District of Matu was created bringing the total number of Administrative Districts in Sarawak to 28.

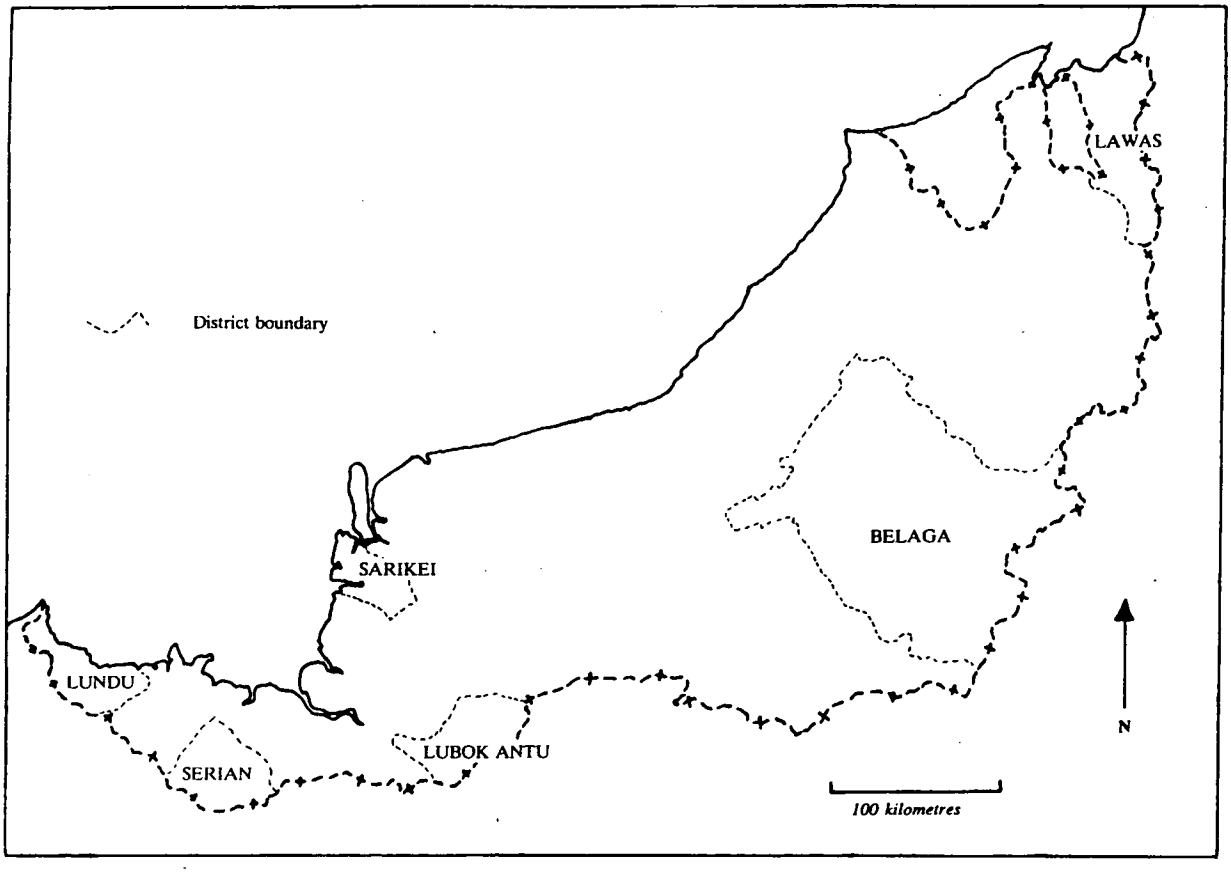

Fig. 2. *Map of Sarawak showing the six Administrative Districts focussed upon in the study.*

Finally, a wide range of rural communities in the six Districts was selected according to the type of electricity supply available, but necessarily taking into account population, location, level of cash economy involvement and degree of infrastructural development. The type of electricity supply in the villages studied can be divided into seven main categories:

(i) SESCo supply.

(ii) Government-provided diesel generator - still working.

(iii) Government-provided generator - broken down.

(iv) Government-provided generator subsequently replaced by SESCo supply.

(v) Some households with private generators.

(vi) Some households with supply from nearby shop.

(vii) No electricity supply.

It should be noted that the categories of supply listed above are not necessarily mutually exclusive. Full explanations of the above supply categories are given in Chapter 4.

1.2.4 Research methodology

The background and basis for the research methodology adopted in the study are explained in this section. In addition, details of the types of agency and main areas of inquiry included in the study are summarised and an outline of the final form of the results is given.

Basic approach

As an initial study into the implications of the electrification initiatives for the development of Sarawak, a broadly-based multidisciplinary approach was required. Socioeconomic and political factors may play as crucial a role in rural electrification programmes as technical and organisational aspects. Although this is primarily a policy study, both "top-down" and "bottom-up" methods were used in examining the priorities and perceptions associated with rural electrification at each level of administration and in the rural communities. This approach is in line with the views of Barnett et al. (1982) who state:

> "It is important to stress that what we discuss as 'social science research' is not something that can only be carried out by social science specialists who are out of contact with technological realities. Rather, it can and should be done by almost anybody: by natural scientists and engineers as well as economists, sociologists and political scientists, all of whom need to work in close contact with those who will be most immediately responsible for dealing with rural energy problems - rural people themselves."

The methods of data collection and analysis adopted for the fieldwork in Sarawak are based on techniques associated with an approach which has come to be known as Rapid Rural Appraisal (RRA) after Chambers (Chambers 1983, 199-201; Longhurst 1981). The approach was considered to be more appropriate for this initial study

than traditional large-scale surveys which rely on the use of highly structured and often inflexible questionnaires. RRA lays great emphasis on the use of existing sources of information, key informants, guided interviews, qualitative data and observation techniques (Chambers 1988). These methods are particularly effective for identifying key problems and issues without resorting to time-consuming and unwieldy quantitative techniques which produce large amounts of irrelevant data. Furthermore, there is more flexibility to explore unexpected areas of interest since the study is less limited by the initial preconceptions of the researcher.

Research design

Field work took various distinct forms:

- Guided interviews with relevant government officials to determine development concerns and priorities, and from whom assistance was requested in acquiring the relevant official data.

- Review and detailed study of documents and publications held by government departments, SESCo, and the Sarawak Museum Library; consultation of government statistical records.

- Field visits to each of the six selected Districts. In each case the approach was to:

  (i) hold discussions at the District Office to determine:

  - development priorities;
  - special projects;
  - particular problems facing the communities in the District;
  - details of distribution of Government provided generating sets;
  - how many generating sets were still functioning.

(ii) visit the local SESCo Office to determine:

- the extent of RES to date;
- plans for extensions;
- particular problems.

(iii) study a range of villages at different stages of rural electrification, staying with each community for a few days if possible. Informal and group interviews, using a checklist of questions as a flexible guide, were employed in covering the following areas of inquiry:

- basic characteristics of the community;
- degree of involvement in the cash economy;
- level of development, access to facilities and recent changes;
- government inputs and communications;
- organisation/leadership forms;
- energy requirements;
- details of electricity supply;
- views on development projects including electrification and their costs and benefits.

(iv) visits to any special development schemes in the District.

Study Results

Results of the study took the form of :

- notes from interviews at all levels of administration and in the villages;
- responses from a selection of rural communities to a standard checklist of enquiries;

- data obtained from various government and SESCo records;
- notes made from selected publications, research reports and government papers held in the Sarawak Museum Library.

Not all of the information sought after was obtainable and there were discrepancies between data from different sources. However, analysis of the available data has permitted an overall picture to be assembled. Lists of interviewees and their institutions (Appendix B) and the settlements and development projects which were visited (Appendix C) are included in the thesis as appendices.

1.2.5 Research period

The fieldwork for the research project was carried out between July 1989 - April 1990 and June - July 1991. Problems and issues associated with the provision of electricity for rural areas were identified during a ten week preliminary study tour of the three geographical entities of Peninsular Malaysia, Sabah and Sarawak. Research proposals were subsequently submitted to the Socio-Economic Planning Unit of the Prime Minister's Department and the Sarawak Government State Planning Unit (see Appendix A). Fieldwork began following approval of the proposals and selection of the six Administrative Districts which formed the geographical focus of the study. A field report was presented to the Malaysian authorities before returning to the UK in April 1990. Following analysis of the data and information gathered during the fieldwork period, a draft version of the final report was sent to interested parties prior to a return visit to Malaysia. A series of meetings was held with rural development administrators and rural electrification programme managers in the state electric power utility for presentation and discussion of the findings. These meetings proved to be extremely worthwhile and valuable feedback opinions and advice were obtained. In addition, further background data was obtained from the relevant government departments. The

abstract of the final report prepared for the authorities in Sarawak is included in Appendix D (Randell, 1991).

1.2.6 Research problems

This section deals with problems encountered during the study by the researcher:

(i) Difficulties of access and availability of transport are an inevitable part of everyday life in Sarawak. There are few roads and the majority are unsealed, which renders them vulnerable to flooding and erosion during heavy rains. River travel is expensive and can be dangerous due to the risk of flash flooding and overturning in the rapids on the upper reaches of the rivers. In the rainy season the normally fast flowing rivers may become impassable. During the drier season the boats may have to be hauled up the rapids, and upriver towns such as Belaga may often be cut off for several weeks each year. Due to the numerous festivals and public holidays associated with the traditions and religions of the various ethnic groups, there are certain times of year when all forms of public transport are fully booked for weeks at a time as the extended families gather together, *e.g.* at Chinese New Year, Christmas, *Hari Raya*, *Gawai Dayak*.

(ii) It was initially necessary to spend a long period of time establishing and following up contacts for the purpose of obtaining information and data.

(iii) Language turned out not to be such a problem as had been anticipated. A basic level of *Bahasa Malaysia* was attained and proved sufficient for most of the information gathering in villages. However, in the majority of rural communities visited the everyday language in use was the tribal language and *Bahasa Malaysia* was often not understood by everybody. Therefore, it was sometimes necessary to use an interpreter in communities with limited

knowledge of the national language.

(iv) A major problem was the difficulty of accessing consistent historical administrative records even dating back a couple of years. In the case of the small generator programme, this could be attributed to the various and changing sources of funding, which made it hard to track down individual project details. An additional problem was that there are no records of how many of the generators distributed in this manner are still functioning. Since, in many cases, the more remote communities are those which have benefited from the scheme, it is particularly difficult for the District Office staff to continually update such records.

(v) A difficulty when cross-referencing with SESCo figures has been the variety of uses of the term "rural". For instance, the State Government defines "urban" as "all gazetted townlands with a population of 10,000 or over, in 1980", which, therefore, refers only to the city of Kuching and the towns of Sibu, Miri and Sarikei. All other areas of Sarawak are considered to be "rural". However, for billing purposes SESCo regards all residents of Kuching, Sibu, Miri and Bintulu as Class I, or urban, consumers and all others as Class II, or rural. A further complication is that SESCo's "rural power stations" are commonly taken to be all those which have been built since the beginning of the First Malaysia Plan in 1964.

1.3 Thesis organisation

The thesis is structured so that the background material on the socioeconomic development of Sarawak and the Malaysian energy and electricity sectors is contained in the second and third chapters. The findings of the research project are presented in Chapters 4 - 6. Chapter 4 deals with the process of rural electrification in Sarawak, including the government policies and the progress made, and emphasizes the priorities and perceptions of the various administrative levels. The role of electricity in the village is examined in Chapter 5 from the point of view of the rural people and in Chapter 6 the commercial and industrial aspects of rural electrification in Sarawak are investigated. The significance of the findings is discussed in Chapter 7 and the conclusions and recommendations are presented in Chapter 8.

Chapter 2:

THE SOCIOECONOMIC CONTEXT OF DEVELOPMENT IN SARAWAK

Sarawak is the largest state in the Federation of Malaysia. It is located on the north-west coast of the island of Borneo and is separated by a 650 km stretch of the South China Sea from Peninsular Malaysia (also known as West Malaysia), which forms the southern tip of the Asian mainland. The island of Borneo is divided between the Indonesian province of Kalimantan, the tiny oil-rich sultanate of Brunei Darussalam and the East Malaysian states of Sabah and Sarawak, with Indonesian territory accounting for just under two-thirds of the land area.

The purpose of this chapter is to provide a general development background for the state of Sarawak with particular emphasis on the situation in rural areas. This includes an outline of the history, demography and economy of the state together with a brief discussion of several of the most important development issues.

2.1 Historical and political background

A brief background is presented in order for the reader to understand the significance of Sarawak's position within the Federation of Malaysia and the background to the institutions and vehicles for development.

2.1.1 A brief history of the state

Prior to the arrival of the British adventurer, James Brooke, in 1841, the northern regions of Borneo were nominally controlled by the kingdom of Brunei. Brooke was granted territory around the Sarawak River by the Raja of Brunei in return for helping to put down a rebellion in the province. By 1905 successive concessions of further tracts of land to the Brooke family by the sultans of Brunei had resulted in the establishment of Sarawak's present-day boundaries. Following the return of Sarawak to the Brookes after the Japanese occupation, Sarawak became a British Crown Colony in 1946.

In 1961 the plans for a Federation were proposed by the Prime Minister of Malaya, which had gained its independence in 1957. The proposals met with mixed reactions; there was great deal of debate, and there still is plenty of controversy, as to the various merits and demerits of such a federation. Sarawak eventually achieved full independence from Britain in 1963, joining together with the Federated States of Malaya, Sabah (formerly British North Borneo) and initially also Singapore to form the Federation of Malaysia.

The most dramatic features of the post-independence era directly affecting Sarawak have been the period of confrontation with Indonesia until President Sukarno's downfall in 1966, the threat posed by communist guerilla activities in the state, dating back to the Japanese occupation, and the suspension of democracy until 1971, following the 1969 race riots in West Malaysia.

2.1.2 The political system

The Federation of Malaysia is made up of thirteen states and two Federal Territories. The *Yang di-Pertuan Agong* (King), selected for a five year term from amongst the hereditary rulers of nine West Malaysian states, is the Supreme Head of Malaysia. The *Dewan Negara* (Senate), whose members are partly chosen by the State Legislative Assemblies and partly appointed, and the *Dewan Ra'ayat* (House of Representatives), whose members are directly elected by the population, make up the Federal Parliament. The *Agong* appoints the Cabinet on the advice of the Prime Minister. Each state in Malaysia has its own Constitution, Head of State and Legislative Assembly, in Sarawak called the *Council Negri.*

Following the formation of Malaysia, the party system in Sarawak emerged as one in which all the political parties attempted to claim support across the various population groups (see Section 2.2.3). However, they have in general evolved into communal parties representing each major group, rather like the political situation in Peninsular Malaysia. Since no single ethnic group dominates to the extent that would be necessary to achieve and maintain power, a multi-party ruling coalition has been created, along the same lines as the *Barisan Nasional* coalition at the national level.

However, the existence of communal groupings is not sufficient to explain the political machinations in Sarawak. Political power is based upon the control of land, timber and minerals (Leigh 1979, 371) and popular support and participation are generally maintained through vertical, or patron-client, relationships (Roff 1974, 8). Under this system of patronage, whichever party is in power delivers benefits to the local representatives and their supporters in the form of economic allocations for development projects, such as roads (Clapham 1985, 55). Development projects distributed in this manner tend to be centrally planned and of the top-down variety rather than stimulating grassroots participation (see also Leigh 1990, 224). In

Sarawak the *Minor Rural Projects* arrangement for small-scale construction projects (including installation of generators) in villages, constitutes an important demonstration of the effects of government policies (Searle 1983, 70) and is a vehicle well suited to the encouragement of electoral support (Grijpstra 1976, 47; Milne & Ratnam 1974, 282).

2.1.3 Administrative structure

The ministerial responsibilities of the State, the Federation and those that are joint are set down by the Federal Constitution. The Ministry of Energy, Telecommunications and Posts, which oversees the public electricity utilities, and the Ministry of National and Rural Development, which coordinates plans for rural electrification, are important Federal responsibilities. In 1990 the Sarawak State Cabinet included ministerial portfolios for Chief Minister, Agriculture and Community Development, Land Development, Infrastructure Development, Environment and Tourism, Industrial Development, Housing and Welfare (Malaysia, 1990). In addition to the State Ministries and Departments, offices representing Federal responsibilities such as Education, Health and Security have been established in Sarawak.

Various statutory corporations set up by both the Federal and State Governments also operate within the State. Notable examples are Land Development Authorities, Port Authorities, Housing Corporations, the Sarawak Economic Development Corporation (SEDC) and the Sarawak Electricity Supply Corporation (SESCo).

For administrative purposes, Sarawak is divided into nine *Divisions* (see *Figure 3*), each with a *Resident* as the officer in charge.

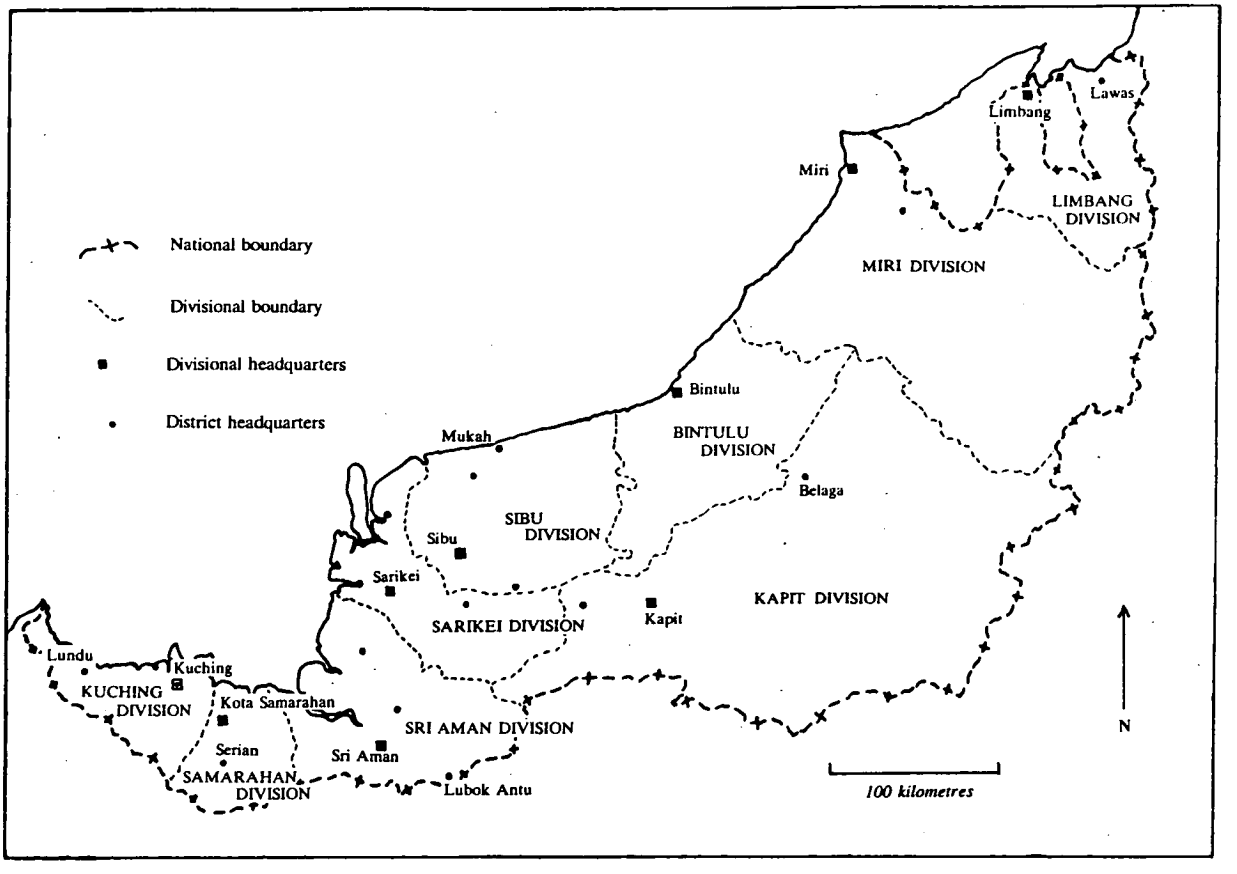

Fig. 3. *Map of Sarawak showing Administrative Divisions and main towns.*

At the next level of administration there are twenty-eight *Districts*, each headed by a *District Officer*, and a similar number of sub-Districts. Technical departments such as Agriculture, Public Works and Health have offices at District level. The role of the District Officer has evolved from being primarily concerned with the preservation of law and order to coordinating development and change activities of the various technical departments within the District, particularly in his capacity as the Chairman of the District Development Committee.

At the village level, development activities are coordinated by the Village Development Committee. This institution was created in 1966 and comprises government appointed members and a chairman, selected from amongst the villagers (Shamsul 1988). The Chairman of the Village Development Committee is the village's link with the District Office and the Sarawak Administrative Officer (SAO) through whom news of future development initiatives and opportunities is transmitted.

The separate system of Native Chiefs, introduced during the time of the Brookes, is a further feature of the administration in Sarawak (Milne & Ratnam 1974). Village headmen are appointed for kampungs and longhouses. Further levels of chief have been created for groups of small villages (*Penghulu*) and at the highest level for the dominant indigenous group in a District or Division (*Temenggong*). Native Chiefs are generally concerned with settling disputes and matters of customary law and are not Government servants, although those at the higher levels (*Penghulu* and above) are paid a small salary. Thus, for example, the Village Development Committee would be involved in decisions concerning the administration of a village generator project, whilst a Native Chief might be called in to assist in resolving land ownership disputes between villages which affect a transmission line project.

2.1.4 International connections

Malaysia is an active member of the Association of South East Asian Nations (ASEAN) which includes Indonesia, the Philippines, Singapore, Thailand and Brunei. ASEAN exists as a framework for regional cooperation in fields such as economics, discussion of regional security problems and, to some extent, industrialisation.

For historical reasons Malaysia has strong links with Britain and, consequently, has developed important relationships with other members of the Commonwealth such as Canada, Australia and New Zealand, as well as the USA. However, financial and business partnerships with Germany and in particular Japan are now of greater significance. These developments in Malaysia's international relations are reflected in loan and business agreements which have been set up in Sarawak. For example in 1989 Japan accounted for 45.7 per cent of total exports from Sarawak, whilst only 40.2 per cent were destined for the other Far Eastern nations of Taiwan, South Korea, the Philippines, Singapore and the rest of Malaysia (Department of Statistics 1990).

As a result of Malaysia's high per capita income there is very little project-related bilateral aid. Most aid comes from Japan and Germany and tends to cover training and short term technical assistance for feasibility studies and master plans.

Immigrant workers from Indonesia and the Philippines are very much in evidence in Sarawak, although to a lesser extent than in Sabah. They are often prepared to labour for lower wages than local Sarawakians and traditionally work in logging camps and, in Sabah, on plantations.

2.2 Demographic profile

2.2.1 Physical geography of the state

An appreciation of the physical geography of Sarawak is useful in understanding the pattern of population settlement. Sarawak has an equatorial tropical climate with high humidity, average temperatures ranging between 25°C and 35°C and recorded annual rainfalls of up to 4500 mm in coastal areas (Ave & King 1986). Sixty percent of the rainfall occurs during the *landas* season between November and March.

The topography of Sarawak is characterised by an extensive river system which drains from the watershed forming the border with Indonesian Kalimantan and flows to the South China Sea in the north (see *Figure 4*).

The terrain can be classified into three principal groups (Niew 1977) :

- alluvial coastal plain
- central belt of undulating country
- mountainous interior

These three zones are indicated in *Figure 5*. The flat alluvial coastal plain extends along most of the shoreline but is particularly extensive in the western part of the state. This region is identified by deep peat soils, poor drainage, tidal inundation and swamp forests (Jackson 1968).

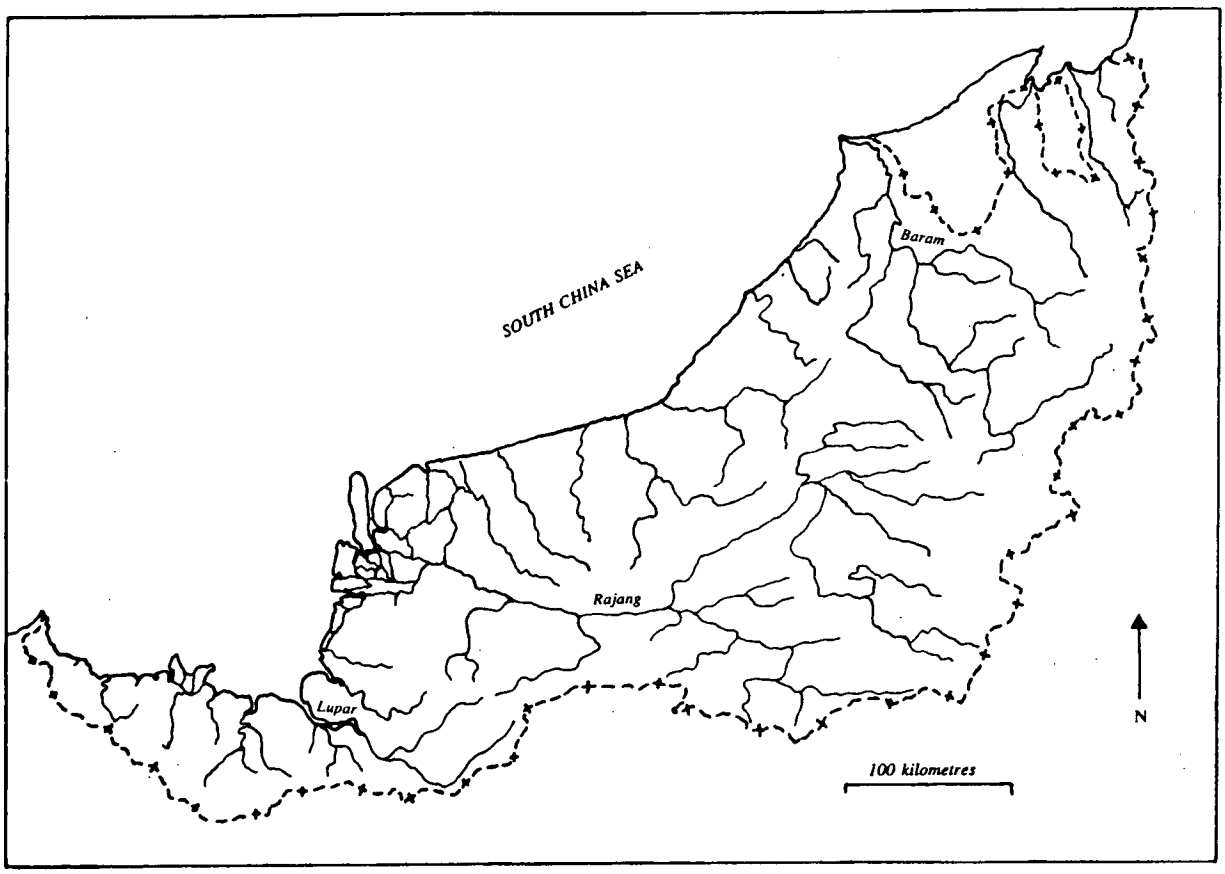

Fig. 4. *Map of Sarawak showing the main river systems.*

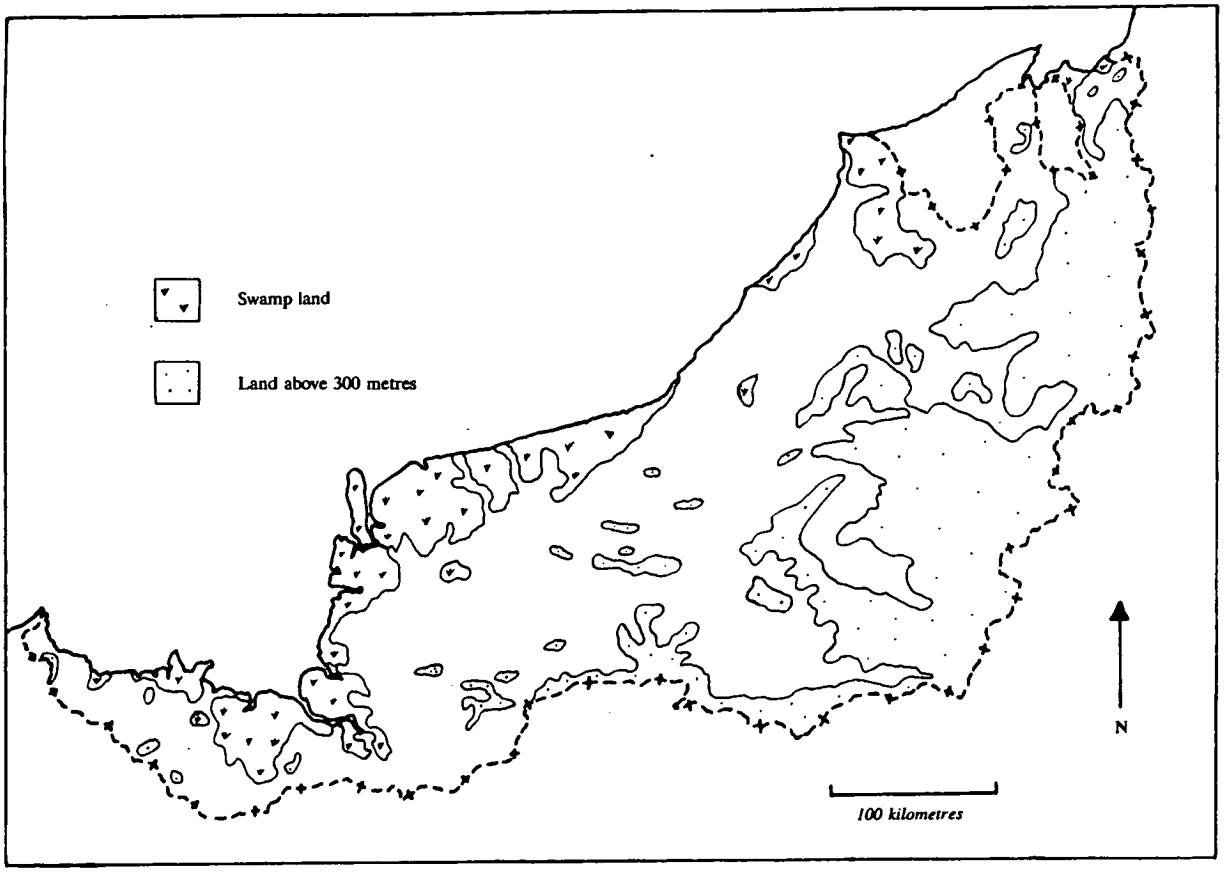

Fig. 5. *Map of Sarawak showing the terrain regions.*

The hilly central belt is the most suitable for agriculture and road construction. Settlements are located beside the rivers, which have always been important in terms of communication and access. However, the likelihood of flooding, especially during high tides, means that agricultural possibilities are limited along the river banks and farms are situated at some distance from the flood danger. Little primary forest remains in this central belt due to the widespread results of agricultural activities and timber extraction.

Most of the mountainous interior is over 300 m and there are substantial areas exceeding 1000 m. There are many fast and turbulent streams with widely fluctuating levels. The land is generally uninhabited and covered with primary jungle except for small pockets of settlements in the upper Baram and Rejang areas.

2.2.2 Population

Sarawak had an estimated population of approximately 1.8 million in 1991, as deduced by the Department of Statistics from a figure of 1.3 million obtained during the 1980 Census. During the eighties the annual growth rate stayed fairly constant at about 2.5 per cent. In 1980 Sarawak accounted for only 9.5 per cent of the total population of Malaysia, whilst the land area of the state comprises roughly 38 per cent of the total land area of the Federation (Department of Statistics 1990).

The overall population density for Sarawak was calculated at 11 persons per square kilometre in 1980. However, this encompassed a range of between 123 persons per sq km in Kuching District to one person per sq km in Belaga District. This is due to the uneven pattern of settlement in Sarawak with concentrations occurring in the Kuching Division and around Sibu, Bintulu and Miri towns (see *Figure 6*).

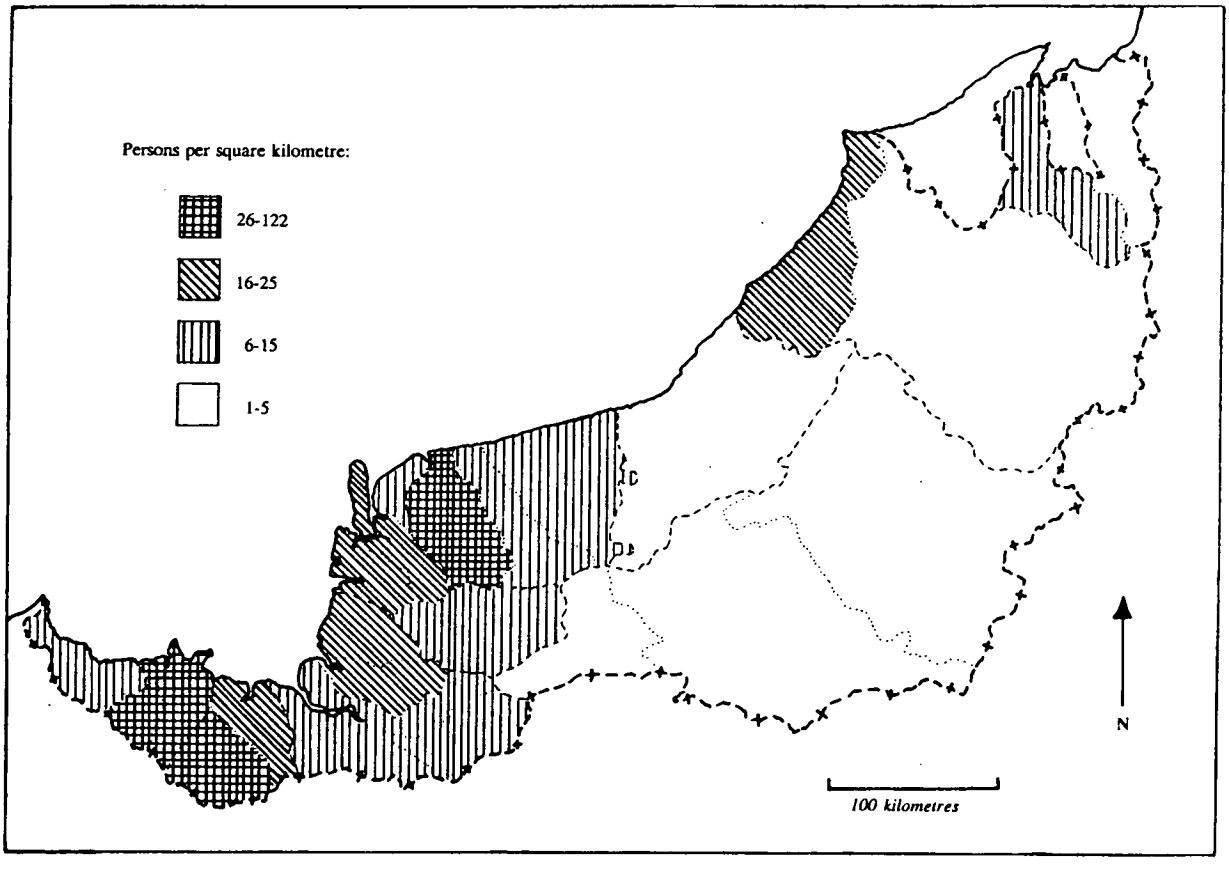

Fig. 6. *Map of Sarawak showing population density in 1980.*

However, the majority of the population still live in rural areas, mostly in coastal villages or along the rivers and tributaries of the interior. The rural population of Sarawak was calculated to be 81 per cent in 1985, compared with 59 per cent of the population of Peninsular Malaysia in the same year.

2.2.3 Ethnic groups

The social structure of Sarawak is characterised by its heterogenity, more than seven major ethnic groups currently being recognised by the authorities. Both the official classification of the population into various groups and the terminology selected to describe the groups have been modified as the administration of the state has evolved (Roff 1974, 20). The choice of categories used by census-takers has reflected political and social pressures as well as bureaucratic confusion.

Administratively, distinctions are drawn between Native (or Indigenous) and Immigrant groups. The indigenous peoples are now referred to as *bumiputra* (or "sons of the soil") whilst the immigrants category is almost solely made up of Chinese. The categories used in the latest census were Chinese, Malay, Melanau, Iban, Bidayuh and Other Indigenous (see *Table 1*).

In order to make some sense of the immense ethnic variety of Sarawak, it is useful to divide the indigenous peoples into two groups: the predominantly Muslim peoples who inhabit the coastal areas (the Malay and Melanau) and the interior peoples or Dayak (such as the Iban, Bidayuh etc.).

Table 1: *Percentage population by ethnic group in Sarawak, 1980.*

Population group	Percentage of the Sarawak population in 1980
Malay	19.7
Melanau	5.7
Iban	30.3
Bidayuh	8.2
Other Indigenous	5.3
Chinese	29.5
Other	1.3

Source: Statistics 1989.

Although the broad Dayak grouping covers a myriad of smaller diverse ethnic groups, these groups do share several features. They traditionally practise the shifting cultivation of hill rice, live in longhouses (see *Figure 7*) near to rivers and follow native customary law (Hong 1987). Dayak groups other than the Iban and Bidayuh are referred to, and refer to themselves, as *Orang Ulu* or "peoples of the interior". According to the 1980 Census, they include, in order of size, the Kenyah, Kayan, Kedayan, Murut, Punan, Bisayah and Kelabit. However there are many more smaller *Orang Ulu* groups.

Fig. 7. *Photograph of typical traditional longhouse (J&L Darmondy).*

2.2.4 Characterisation of the population groups

Although efforts of the Malaysian Government, have been geared towards

> "eliminating the identification of race with economic function" (Malaysia 1986)

in line with the New Economic Policy introduced in 1971, there is still a strong relationship between ethnic identity and social and economic position in Sarawak. In general it is possible to characterise the major ethnic groups by describing the geographical location and style of their settlements and their chief occupations.

The Chinese originally started to settle in Sarawak in the early nineteenth century attracted by deposits of gold in the Bau area. They now dominate commerce in towns and bazaars all over the state. However, in contrast to the situation in most Southeast Asian countries, they are also involved in commercial agriculture which they normally practise close to towns and markets.

The Malays are predominantly rural people involved in small-scale farming and fishing along the coast of western Sarawak. However they have also maintained their high profile in the civil service originating from the early reliance placed upon them in this role during the Brooke era. All the major towns and bazaars now have a significant Malay quarter.

The other indigenous groups are mostly involved in mainly subsistence agriculture. The three major groups are characterised below:

The Iban which are the largest indigenous group, display a relatively homogeneous culture and use one language. Their settlements are to be found throughout the state, although the highest concentration is in the Batang Lupar and Rajang regions. They mostly still live in longhouses and grow both wet paddy in flat areas and hill paddy wherever this is not possible. In addition rubber and pepper are now grown to

provide a source of cash income.

The Bidayuh are to be found exclusively in the interior of the Kuching and Samarahan Divisions and use a number of quite distinct dialects. They originally lived in longhouses but are increasingly adopting a kampung style of settlement involving detached dwellings and reduced size longhouses. They are also moving towards the cultivation of cash crops which is practised along with the traditional planting of paddy. Both Iban and Bidayuh communities tend to have either converted to Christianity or to have maintained their traditional animistic religions depending on the extent of their exposure to outside influences.

The Melanau are mostly fisherman and growers of sago and are to be found in the coastal areas of the Sarikei, Sibu and Bintulu Divisions. Many have become Muslims although others are Christian or follow their own traditional religion.

The *Orang Ulu* are also mainly subsistence agriculturalists, living in the interior of the Kapit, Miri and Limbang Divisions.

2.3 Economy and natural resources

It has been noted that, despite playing a key role in national development as a supplier of valuable export commodities, Sarawak is economically backward in comparison with the developed core areas of Peninsular Malaysia (King 1988, 264). This is reflected in, for instance, the dependence of the economy on a limited number of primary commodities and the undeveloped nature of the infrastructure. Key aspects of the Sarawak economy are examined in this section in order to provide a developmental context for the issue of rural electrification.

2.3.1 Natural resources

In terms of natural resources Sarawak is possibly the richest state in Malaysia. Sarawak's main wealth lies in its huge reserves of petroleum and natural gas (see Section 3.1). In addition to the offshore oil and gas fields, less valuable mineral deposits of gold, antimony, silver and silica sand are to be found in western parts of the state. These are mined on a small-scale, although production of antimony has ceased at present. Sizeable reserves of coal are also known to exist in the state.

Huge tracts of tropical rainforest cover almost three-quarters of Sarawak providing rich reserves of timber as well as countless other jungle products, many of which are extracted on only a small-scale basis. Malaysia is the world's largest exporter of tropical timber and within Malaysia Sarawak is the leading producer. That there is little downstream processing of timber in the state is illustrated by the fact that Sarawak produces over 40 percent of Malaysian sawlogs and only 6 percent of sawn timber (Malaysia 1990). (A discussion of the importance of forestry as a current development issue is included in Section 2.5.5.)

Due to the twin characteristics of high rainfall and rugged terrain, enormous and mostly unexploited hydropower potential exists in Sarawak. This potential is estimated to account for approximately 71 percent of Malaysia's technically exploitable reserves of 123,000 GWh (MICCI 1986).

2.3.2 Economic structure

The economy of Sarawak is heavily dependent on the export of primary commodities and agricultural produce, in particular oil, natural gas, timber, pepper and rubber. Less than 10 percent of raw materials are processed prior to export (Hamid & Hatta 1990), although downstream processing of timber is currently being heavily promoted. Furthermore, economic growth during the last two decades has been

based largely on the export of petroleum, Liquified Natural Gas (LNG) and logs, which together accounted for 77.5 percent of exports in 1989 (Department of Statistics 1990). The dramatic change which took place in the structure of exports between 1963 and 1989 is illustrated in *Figure 8*.

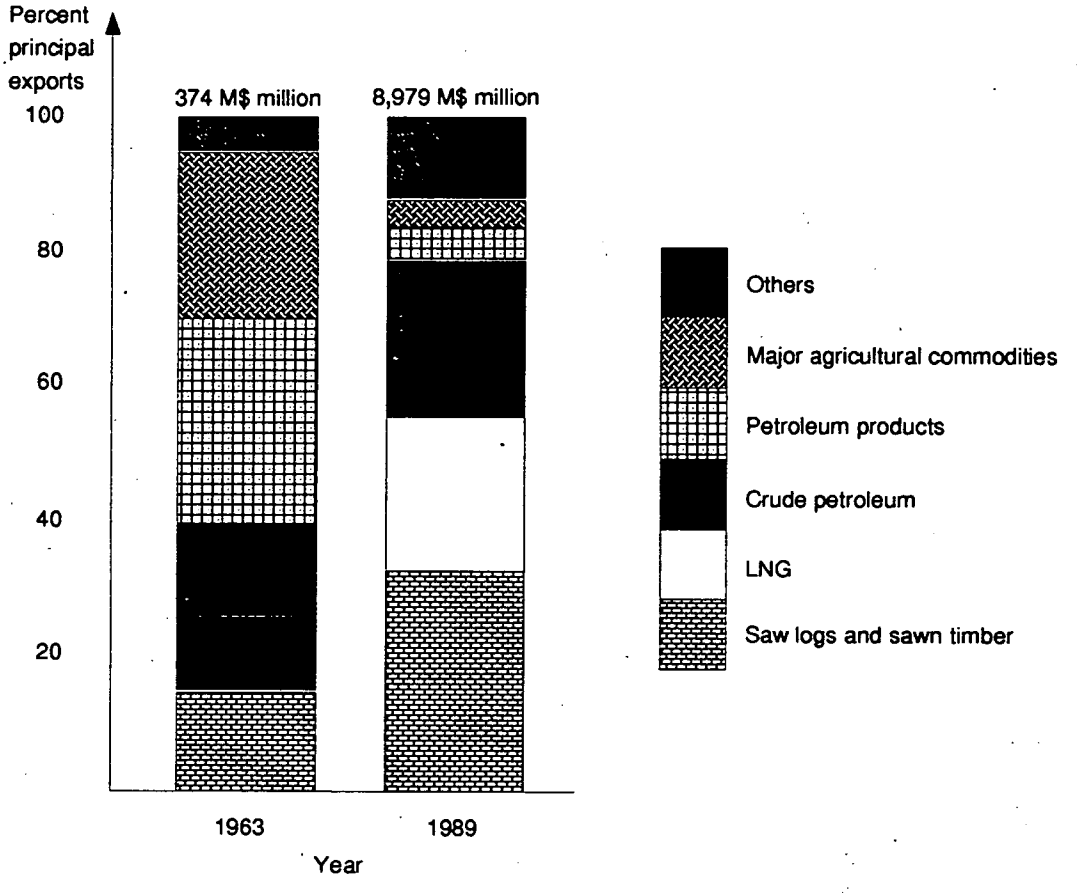

Fig. 8. *Bar chart to show change in structure of exports from Sarawak (Statistics 1990).*

The domestic market in Sarawak is limited due to the small population and the low purchasing power of many of the inhabitants. Consequently, the import substitution strategies adopted by Malaysia in the sixties and seventies to promote the formation of a manufacturing base have had little impact. In contrast, the export-oriented

policies of the late seventies and eighties have seen the development of an enclaved manufacturing sector based on the downstream processing of oil and gas. Key elements have been the LNG and ASEAN ammonia/urea plants at Bintulu.

However, the majority of the population in Sarawak is occupied in agriculture, which is traditionally a small-scale concern. Farming is first and foremost a subsistence activity for the majority of rural households, within which the cultivation of rubber, pepper, coconut, sago and, more recently, cocoa plays an important role as a means of income generation. Malaysia is one of the world's largest pepper producers, 90 percent of which is grown in Sarawak, chiefly by small-holders. The cultivation of oil palm is the only cash cropping activity which is not dominated by smallholders (Cramb 1990). Shops in the bazaars form the basis of the commercial structure of rural Sarawak since the shopowners are also middlemen in the link between cash-crop producers and exporters.

Deteriorating world commodity markets have exposed the vulnerability of the Sarawak economy, and in particular of the smallholders, to falling prices. Despite the large number of people involved in agricultural activities, agricultural commodity exports accounted for only 4 percent of export earnings in 1989 (Department of Statistics 1990).

Sarawak is not self-sufficient in staple foods such as rice and sugar and in 1989 food products comprised 13.3 percent of total imports. The transition of the state away from an economy which is exclusively based on agriculture to one involving some processing of raw products is well illustrated by the changing structure of imports (see *Figure 9*).

The largest category of imports in 1989 was the machinery and transport equipment sector at 46.9 percent whereas in the sixties the major import was mineral fuels at 46 percent.

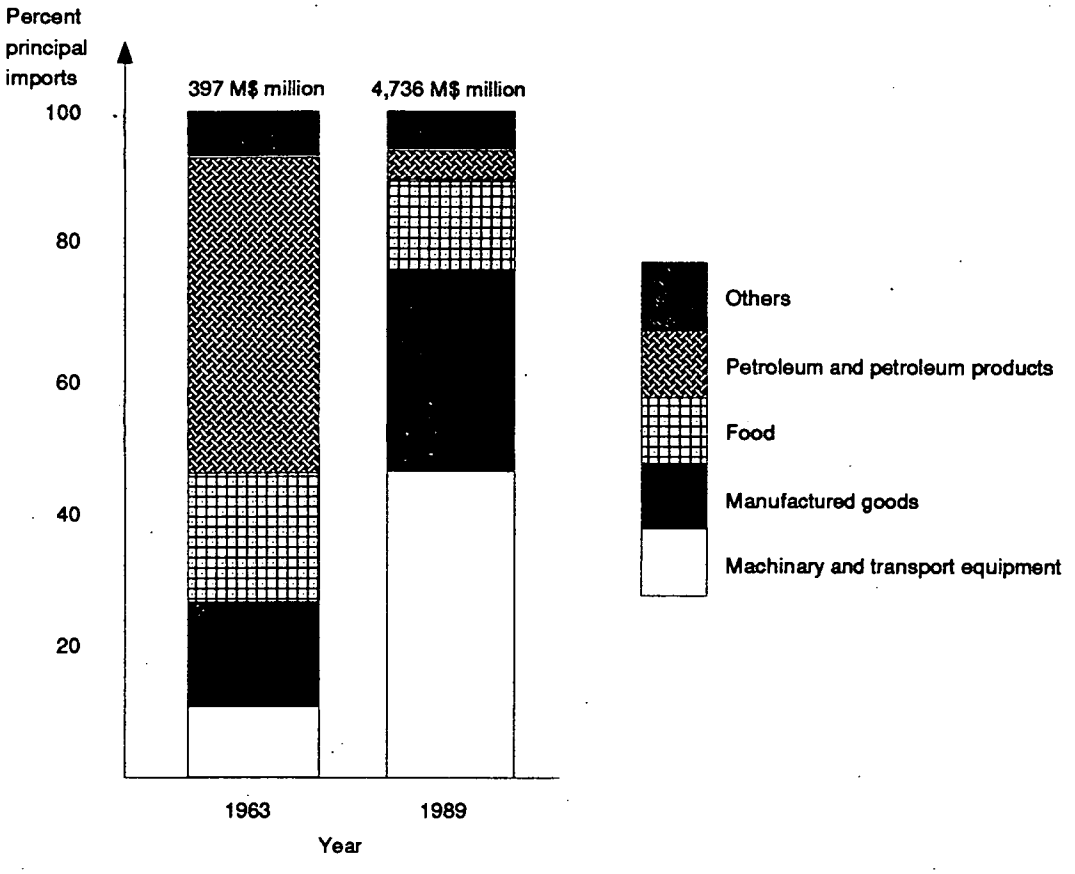

Fig. 9. *Bar chart to show change in structure of imports in Sarawak (Statistics 1990).*

2.3.3 Development planning

The policies governing the planned development of Sarawak are determined by the federal government in Kuala Lumpur. Consequently the Sarawak economy should be viewed in the wider context of the Malaysian economy.

Development of the national economy is steered by a series of five-year economic plans. These development plans state priorities decided upon by the government and set out the measures to be adopted to achieve the declared goals and objectives. In addition the New Economic Policy (NEP), which was launched in 1971, provides a

more long term general guiding philosophy. The main aim is to reduce the dependence of the Malays and other indigenous people on subsistence agriculture and to increase their participation in modern and urban sectors of the economy (Lim 1986). The NEP has as its two central objectives the tasks of reducing the incidence of poverty, and restructuring the economy to eradicate identification of race with economic function.

At a Federal level one of the declared "development thrusts" of the Fifth Malaysia Plan was to "accelerate rural development through rural urbanisation" (Malaysia 1986). This term covers :

- estate-style agricultural development
- promotion of village and small-scale industries
- regrouping of traditional villages into rural growth centres.

In Sarawak the emphasis is also on the modernisation of the rural areas, in particular through promoting the transition of shifting cultivation to more settled forms of agriculture devoted to cash crop production. There has been an assumption that development strategies which have been or are appropriate to the situation in Peninsular Malaysia are also appropriate for Sarawak (Lim 1986). However problems encountered in the implementation of large-scale agricultural schemes modelled on the successful Federal Land Development Authority (FELDA) projects in Peninsular Malaysia have led to suggestions that these assumptions are not valid (King 1988; Puthucheary 1990).

It is currently the policy of the Sarawak Government to emphasise

- the downstream processing of primary products, especially timber, instead of increasing the extraction and export levels of raw products.

- the establishment of plantation-style land development schemes for increased output and efficiency of cash crop cultivation.

2.4 Infrastructure

In comparison with the more developed states of Malaysia, Sarawak is recognised to have inadequate provision of infrastructure and services (King 1988, 264). An essential component of the Sarawak Government's economic policy is the improvement of the infrastructure of the state to enable further economic development and efficient administration in both urban and rural areas.

2.4.1 Transport

Sarawak's low population density and the large distances between centres of habitation have always made communication a problem. The nature of the terrain, characterised by hills, swamps and numerous broad and fast-flowing rivers liable to flooding, mean that road-building is difficult and expensive. In the past marine and riverine communications were of crucial importance. They still play an important role today but are complemented by air and road travel. There is an international airport at Kuching, while the other main towns of Sibu, Bintulu and Miri have busy domestic airports. Fifteen smaller airfields maintained by the Department of Civil Aviation and 24 private airstrips run by the missions have revolutionised access to the interior parts of the state. A rough trunk road now links the main towns of the state (see *Figure 10*) and progress is slowly being made on expanding the limited network of rural roads.

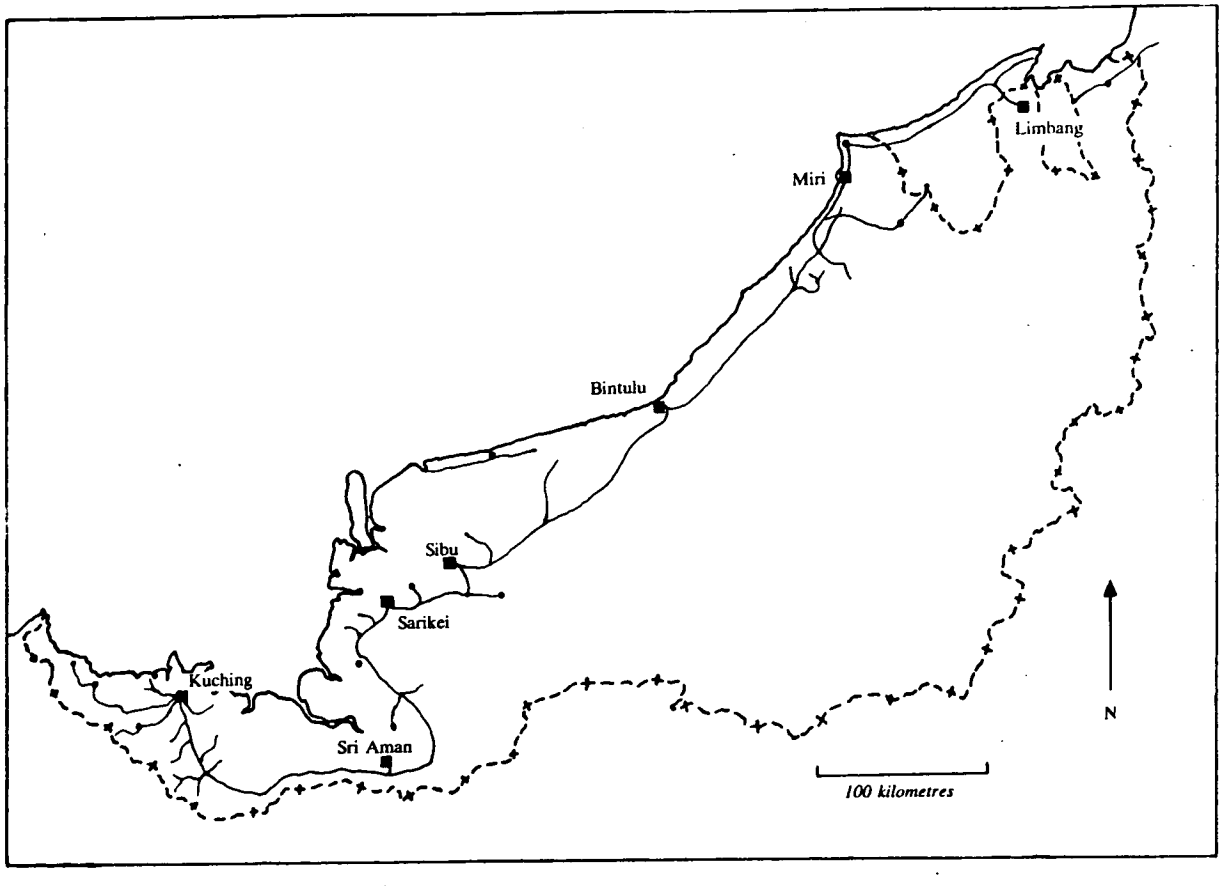

Fig. 10. *Map of Sarawak showing the trunk road.*

Despite these developments, the express boats plying the coastal and big river routes, the speed boats, long-boats with outboard motors and dug-outs with paddles for the shorter routes are still the most common means of transport for ordinary people travelling into the hinterlands on journeys which may take several days. Cargo of freight is also almost totally reliant on river and sea-borne transport.

2.4.2 Public utilities

Water

The control and management of town and rural town water supplies in Sarawak is in the hands of the Department of Public Works (JKR), except for in Kuching and Sibu where it is the responsibility of the Water Boards. Untreated water supplies serving villages are set up by the Health Department (Goh 1990). The type of supply may be a rainwater tank, well, mechanical pump or a gravity-feed supply depending on the location of the village and the availability of a clean source. By the end of 1990 almost 80 percent of the population of Sarawak had access to an approved water supply (Medical Department 1991).

Electricity

The Sarawak Electricity Supply Corporation is under statutory obligation to develop and supply electrical power for the state. With the records showing 134,811 domestic consumers in 1989, it is estimated that almost 45 percent of households in Sarawak were connected to a SESCo supply at that time. The total level of electrification, *i.e* including other sources of supply, was claimed to be at 64 percent at the end of 1990. It has been suggested that a target of 90 percent electrification by the year 2000 can be achieved through the Government's Rural Electrification Programme (Satia 1990). The energy and electricity sectors of the Malaysian economy are discussed in detail in Chapter 3.

2.4.3 Social services

Great advances have been made in the geographical coverage of health care provision in Sarawak. In addition to the town-based divisional and district hospitals, a wide range of clinics, health centres and dispensaries (the majority of which are mobile) exist to serve the needs of the rural population. There is still, however, a shortage of trained health professionals, especially doctors, in the rural areas.

A similar problem exists for the education system. Whilst the number and coverage of the schools is impressive, few trained teachers are willing to endure the hardships of living conditions in remote rural settlements. Consequently classes are large and the turnover of teaching staff high.

2.5 Present-day development issues

A number of topical issues can be regarded as central to a discussion of development in Sarawak and are briefly outlined in the following sections.

2.5.1 Agricultural development

Despite the falling share of the agriculture sector in GDP, it maintains its importance due to the involvement of the majority of the population. In an attempt to boost productivity and efficiency, diversify the limited range of crops grown for export and coordinate production with processing capability, the development of large-scale agricultural schemes has been emphasised by the government (King 1988; Puthucheary 1990). However, in general, the land development projects have suffered from financial problems and low levels of participation by the local farmers.

If a strategy of further expansion into the production of cash crops is followed, the question is whether emphasis should be placed on the development of smallholder agriculture or on the reorganisation of farmers into commercially managed estates (Cramb & Dixon 1988).

This leads on to two further issues: the problem of land rights and the debate about resettlement.

2.5.2 Land rights

The controversial Sarawak Land Code essentially dates back to the Brooke period, although there have been subsequent modifications. Originally designed to protect native land rights through a system of customary tenure, it also causes lengthy delays in, for instance, the implementation of land development schemes and granting of wayleaves, whilst attempts are made to resolve land disputes and determine rights (see King 1986a, 87). Claims have been made that the land code causes increased stress on subsistence farming due to the ban on further felling of primary forest which was traditionally used to establish customary rights to new land. Also restrictions on whether only "natives" of Sarawak or "non-natives" can own a piece of land can lead to illegal leasing agreements (Cramb & Dixon 1988, 10).

2.5.3 Resettlement

A programme of resettlement is sometimes offered as the only realistic long-term solution to the problems of isolated rural communities. This would facilitate administration and provision of infrastructure and health and education services (Masing 1988). In the view of the authorities, it would also assist in the transition from shifting cultivation to settled agriculture (King 1986b, 67). Access to markets would be improved and extension staff would be able to visit on a regular basis.

There has been very limited experience of resettlement initiatives in Sarawak. Relocation of rural communities for security reasons took place in the sixties and early seventies due to the threat of communist insurgency and during the period of confrontation with Indonesia. More recently (1982-1984), 26 longhouses were resettled due to the construction of the Batang Ai hydroelectric scheme. However, there have been various criticisms made of the planning, implementation and follow-up to this resettlement project (King 1986b; Hong 1987; Cramb & Dixon 1988, 13).

2.5.4 Large-scale hydroelectric power development

The issue of resettlement has also played a prominent part in the debate over proposals for a second and much larger hydroelectric power scheme on the Balui tributary of the upper Rajang river. A key feature of the proposed 2400 MW Bakun project was to have been a 650 km high voltage direct current (HVDC) submarine transmission system linking the power station to centres of demand in Peninsular Malaysia (Brauer et al. 1987). It was also expected that power could be supplied to Sabah, Kalimantan and new energy-intensive industries to be sited close to Bintulu.

The original studies carried out by the German Agency for Technical Cooperation (GTZ) for the Malaysian Government pronounced both the hydroelectric project and the associated submarine transmission system to be feasible and economically viable (Ministry of Energy 1986).

Objections to the scheme included the high costs and technical demands, effects upon local communities and the environmental impact of such a large-scale project (Cramb & Dixon 1988, 13). Proposals for the scheme are now being reconsidered due to the high projected costs and level of opposition to the project. Plans for a cascade system of smaller dams in the same general area, which could be implemented sequentially or as the need arises, are now under consideration.

2.5.5 Forestry

Developments in the forestry sector in Sarawak constitute an important and complex issue with a high profile international dimension. Concern has been expressed both within Malaysia and abroad at the rate of depletion of the forest resource.

Timber is of key economic importance as Malaysia's second largest commodity export. Sarawak exported around 14 million cubic metres in 1990 (45 percent to Japan) and about 5 percent of the state's workforce are employed in the timber industry (*Far Eastern Economic Review* 1.8.91). However, there are widespread fears that the rate of extraction is not sustainable. Estimates vary widely; one of the most optimistic is that commercially exploitable reserves will be exhausted by 2006 (Ave & King 1986, 68), and a statement made at the recent International Tropical Timber Organisation (ITTO)'s meeting in Quito, Ecuador, estimated that, at present rates of extraction, all primary forest will be logged within 11 years (*Independent* 10.8.91).

As a result of the large-scale logging operations the way of life of many rural people has been disrupted. Logging has been blamed for increased flooding in down-river settlements, water pollution, soil erosion and long-term forest destruction (Ave & King 1986, 68).

The notion of using timber concessions and the associated commercial contracts as a financial basis for the establishment of political power is not a new one. The present situation has emerged as a result of the departing British authorities' attempts to secure an ethnically balanced political future for the East Malaysian states by granting licences for the extraction of timber to carefully selected local leaders (Roff 1974, p8). Efforts to enforce timber extraction regulations are thus compromised due to the complexity of vested interests. In addition, the practice of shifting cultivation is often blamed for destruction of primary forest by the Sarawak Government (*Singapore Business* 10.91).

The high proportion of round (*i.e.* unprocessed) logs amongst exported timber has been noted and blamed for increased extraction rates as timber prices plummet and producers are forced to raise production levels (Lian 1990). The unrealised export earning potential of downstream processing has now been targeted by the government as an area for immediate further development.

2.6 Summary

Although part of the Federation of Malaysia, the state of Sarawak in Borneo has its own distinctive identity. It is rich in natural resources but, mainly due to historical reasons, is economically less developed than the rest of Malaysia,

The economy of Sarawak is based on the extraction of natural resources, which are mainly exported in the raw state. A high proportion of the ethnically varied and predominantly rural population are agriculturalists, with minimal involvement in the cash economy. Attempts to develop more modern systems of agricultural production, along the same lines as land development schemes in Peninsular Malaysia, have met with only limited success.

Major industrial development has been confined to the establishment of enclave capital-intensive industries based on the production and utilisation of oil and gas. In addition, the characteristically mountainous and swampy terrain has restricted infrastructural development and the road and electricity supply networks are still at a very early stage.

Development issues currently under discussion include appropriate forms of agricultural development and production for the rural areas, the resettlement of remote communities into rural growth centres and the construction of a large-scale hydroelectric project in the Rajang river basin.

Chapter 3:

ENERGY AND ELECTRICITY IN MALAYSIA

According to the World Bank's energy classification of developing countries into oil importers and exporters, Malaysia is a **middle-income oil exporter**† with substantial energy resources (World Bank 1983). However, this convenient label presents an incomplete picture of a complex energy situation. Key characteristics of the Malaysian energy sector include the export of Liquified Natural Gas (LNG) under long-term contract to Japan, the import of crude petroleum to satisfy domestic demand for oil and plans to harness the vast reserves of unexploited hydropotential located far from demand centres. In this chapter the energy resources, policies and the role of electricity within the overall Malaysian energy scenario, with particular reference to Sarawak, are examined.

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† Oil exporters are countries whose official earnings from oil exports exceeded 10 percent of their total export earnings in 1980-1981.

3.1 Energy resources

Malaysia boasts an impressive variety of energy resources and is a net exporter of petroleum and natural gas. The geographical location of energy resources and the energy export and import flows are shown in *Figure 11*.

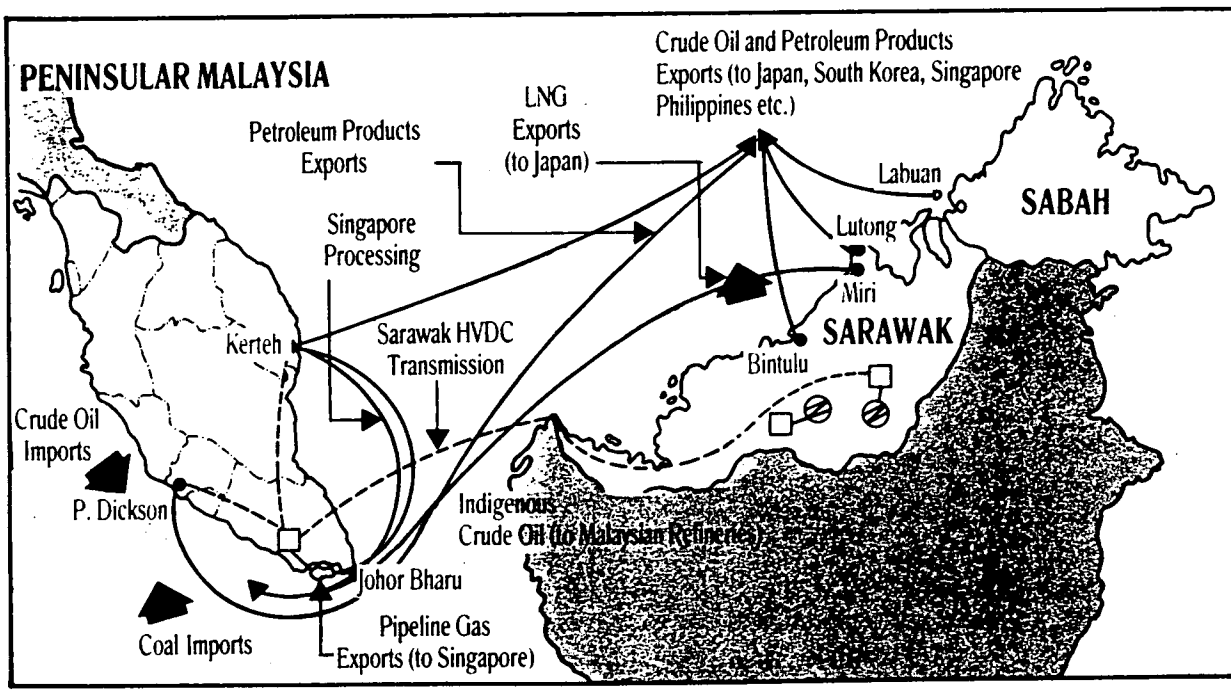

Fig. 11. *Malaysian energy movements (MICCI 1986).*

It has been assessed that Malaysia's energy resource base amounts to approximately 110 EJ*, which is just under 8 percent of total ASEAN energy resources (Rozali 1986a, 3). To put this figure into context, approximately 5 percent of the region's population live in Malaysia and they account for 13.5 percent of the total ASEAN

energy demand. The extent and significance of indigenous oil, gas, coal and hydro resources is outlined in the following sections.

3.1.1 Oil

Malaysia is one of three oil exporters in Southeast Asia, the others being neighbouring Brunei and Indonesia. The Malaysian oil industry has its origins in Sarawak, where the first oil well was drilled in 1910. The large offshore fields were discovered in the 1970s. Petroleum was the most valuable export commodity until 1987, when the electrical and electronics sector took over. In 1989 oil was the second largest export earner, accounting for 11 percent of Malaysia's total exports by value (Malaysia 1990).

Malaysian oil resources are located offshore in three main groups of fields, one of which is off the north coast of Sarawak. Known oil reserves currently stand at 3.1 billion barrels. In 1989 oil production was at a level of 562,000 barrels per day (Malaysia 1990). Of the thirty producing oilfields, the eighteen East Malaysian fields (fifteen are off Sarawak) produced 45 percent of the total output.

Malaysian crude oil is light and has a low sulphur content and therefore fetches a high price on the world market. In 1988, 76.5 percent of domestic output was exported whilst heavier crudes were imported to supply almost 80 percent of domestic demand for petroleum products (Ministry of Energy 1989).

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* 1 Exajoule (EJ) = 10^{18} Joules (J)

3.1.2 Gas

Natural gas supplied 17 percent of Malaysia's energy needs in 1985 (MICCI 1986). Gas reserves, estimated to be three times as large as the oil reserves, are located offshore in the same general areas as the oil fields. It has been calculated that East Malaysian gas reserves (proven and estimated) account for almost half of the estimated total resource in Malaysia of 63 trillion cubic feet* (MICCI 1986).

Almost 70 percent of gas produced is exported to Japan under long term contract, in the form of LNG (UN 1990, 224). The domestic market for gas is growing as the distribution network expands. A trans-peninsular pipeline is under construction to transport gas to the industrial and population centres on the west coast of Peninsular Malaysia, and gas developments now supply the power generation and heavy industry sectors.

3.1.3 Coal

Most of Malaysia's known coal resources, estimated to amount to approximately 700 million tonnes, are to be found in Sarawak (Ministry of Energy 1989). Low grade lignitic and sub-bituminous coal deposits thought to be of commercial significance are known to exist in the vicinity of Mukah and Bintulu, however only limited extraction has taken place to date. Although these coal deposits are referred to in Government energy resource assessments the economic viability of large-scale extraction is unknown. Coal is currently imported to satisfy the demands of cement producers in Peninsular Malaysia, who account for the majority of national consumption.

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* In S.I. units this is approximately equivalent to 1.8×10^{12} cubic metres.

3.1.4 Hydropower

In 1985 hydropower supplied about 7 percent of Malaysia's total primary energy supply (MICCI 1986). The substantial hydro resource is due to a high annual rainfall, averaging 2500 mm, and the rugged terrain, especially in East Malaysia. It is estimated that Malaysia has a technically exploitable hydropower resource of 123,000 GWh (MICCI 1986). However, only 13 percent of the total exists in Peninsular Malaysia, although it is in this region of Malaysia that the majority (82 percent) of the population lives. Furthermore, the development of unexploited sites in Peninsular Malaysia raises problems such as the loss of large areas of valuable forest and farmland through flooding, and transmission costs are likely to be high due to the distance of remaining sites from load centres.

Increasingly, attention has been focussed on the enormous hydropotential which exists in Sarawak, with a view to transmitting power across the South China Sea to centres of demand in West Malaysia (Rozali 1986b). It is estimated that the share of hydro in total primary energy supply will rise to 12 percent by the year 2005, if the proposed hydro power projects in Sarawak are implemented (MICCI 1986).

3.1.5 Other energy resources

Non-conventional energy resources do not, as yet, contribute significantly to national commercial energy supply. An outline of the estimated biomass, solar, geothermal and wind resource and their possible applications follows.

Malaysia has a plentiful biomass resource, primarily comprising fuelwood and to a lesser extent animal and vegetable wastes. The importance of biomass can be seen in that it accounts for almost 17 percent of total energy consumption in Malaysia and 66 percent of household energy consumption (UN 1990, 224). However, use is mostly confined to domestic applications. On an industrial scale, palm oil wastes are burnt

to provide self-sufficient power generation in palm oil mills and the potential for a similar use of rice husk is being explored by a number of Malaysian research institutes (Rahim et al. 1981).

The mean solar energy per day has been calculated to range between 14.7 to 16.1 MJ/sq. metre for Peninsular Malaysia, and probably slightly lower figures are true for Sabah and Sarawak. However, it has been suggested that the figures disguise hourly and seasonal variations in solar radiation due to cloud cover, which may affect the suitability of various solar technologies. Consequently it has been recommended that coastal areas in Sabah, Sarawak and northern parts of Peninsular Malaysia are most favourable for the utilisation of solar energy due to reduced cloud cover (Corvinas 1987). Pilot projects are underway using solar energy for crop drying, heating water and to generate electricity by application of photovoltaic technology.

Although there is no present use of geothermal energy, two potential geothermal resource areas have been identified in Sabah. The extent and capacity of the sites are unknown as, so far, only basic preliminary investigations have been carried out. In addition, the high cost of drilling geothermal wells and the low demand for power in the surrounding area are disincentives to proceed (Corvinas 1987).

Finally, it has been suggested that favourable conditions for the utilisation of wind energy exist in some coastal areas, although the feasibility has not yet been fully evaluated due to the lack of data*.

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* Private communication Dr Mohd Noh Dalimin, Dept of Physics, UKM

3.2 Malaysian energy policy and planning

The energy situation in Malaysia has shifted from from one in which energy needs were largely satisfied by non-commercial sources such as fuelwood, to limited commercial utilisation of indigenous coal, and then a growing dependence on oil. In order to reduce the vulnerability of the Malaysian economy to the increasingly unpredictable global oil markets, government attention was turned to the development of an energy diversification plan. This resulted in the introduction of a national **four-fuel diversification strategy** in 1981. This is an ongoing initiative which aims to increase the use of indigenous hydro and gas resources as well as imported coal, in an attempt to reduce over reliance on oil. By 1985, the heavy dependency on oil had been reduced to 62 percent of primary commercial energy supply, from 93 percent in 1981 (MICCI 1986). Although there is interest in exploring the potential of renewable resources, especially solar and biomass, and several pilot projects are underway, energy planners foresee little prospect of large scale implementation taking place in the near future (Leong 1983; Rozali 1986b).

There is no separate department or agency solely responsible for decision making on energy matters. For instance, the Ministry of Energy, Telecommunications and Posts oversees the power utilities, the Ministry of Science, Technology and Environment is responsible for research programmes into alternative energy sources, whilst the various aspects of regulation and development of the extractive industries (for petroleum, natural gas and coal) are dealt with by separate departments and agencies. Furthermore, energy planning is carried out at the Federal level, and no separate department exists with responsibility for energy matters in Sabah and Sarawak. However, the Cabinet Committee on Energy, chaired by the Prime Minister, has been set up to coordinate energy planning and work is underway to formulate an integrated national energy policy (Ministry of Energy 1982, 18).

Major policy considerations include the importance of oil and gas as foreign exchange earners and the role played by a secure and reliable supply of energy in promoting economic growth. According to stated development objectives the broad Government line on energy matters is perceived to be to (MICCI 1986, 14):

- ensure security and continuity of supply;
- ensure optimum energy costs based on economic considerations;
- encourage industrialisation;
- maximise foreign exchange opportunities;
- promote regional cooperation;
- ensure utilisation of local technology;
- encourage energy conservation;
- meet environmental standards.

Within the national energy supply scenario, the electric power generation sector is regarded as of key importance to industry as a reliable, cost competitive and secure source of energy (MICCI 1986, 27) as well as an essential element in the overall socioeconomic development of the nation. The following section deals with the electricity supply sector in Malaysia as a whole. The supply and demand structure of the sector in Peninsular Malaysia naturally dominate this overall picture due to the higher levels of industrialisation and demand in this region. This dominance is reflected in the national energy planning priorities and projects, which are primarily geared towards servicing the growing demands of industry in Peninsular Malaysia. The electricity supply sector in Sarawak is treated separately and in further detail in Section 3.4 due to the very different constraints on its supply and demand structure.

3.3 Malaysia's electricity profile

The Malaysian Government recognises that the electric power sector occupies a central position in the energy economy and believes that electricity inputs are strongly related to economic growth (Ministry of Energy 1982).

According to the statutes, the National Electricity Board (LLN)* in Peninsular Malaysia and the Sarawak Electricity Supply Corporation (SESCo) and Sabah Electricity Board (SEB) in the East Malaysian states are responsible for the generation and supply of electricity with a view to the economic development of Malaysia. Coordination of the three utilities at the national level is carried out by the Ministry of Energy, Telecommunications and Posts.

The importance of the role played by the electric power sector is expected to increase further due to:

- increasing per capita usage of electricity in all consumption sectors;
- increasing coverage, mainly due to advances in rural electrification;
- further industrial development. (Rozali 1986)

3.3.1 Fuel mix

In 1988, the electricity supply sector was by far the largest energy consuming sector accounting for 28.2 percent of the total primary energy supply (excluding non-commercial sources such as firewood) (Ministry of Energy 1989). It was a major consumer of oil prior to the adoption of the four-fuel diversification strategy and consequently the utilities were selected as easily identifiable initial targets for the new measures and incentives (Rozali 1984).

* Privatised in September 1990 and renamed Tenaga Nasional Berhad (TNB)

Trends in fuel consumption for the electric power generation sector are in line with the government's four-fuel diversification strategy. Changes in the mix of fuel consumed by the Malaysian power generation sector from 1978 to 1988 are shown in Figure 12.

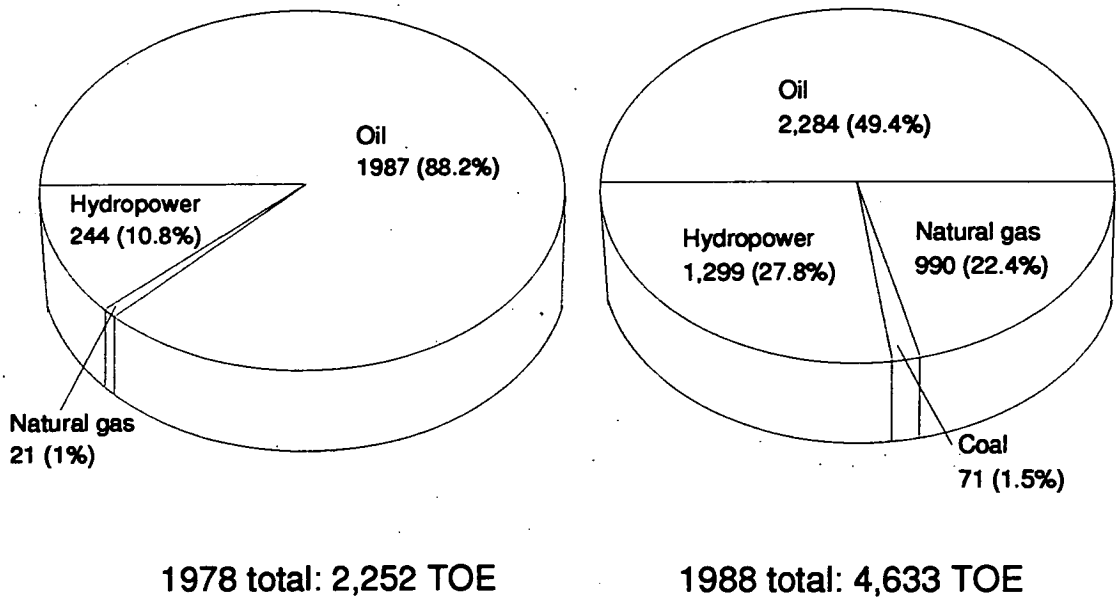

Fig. 12. *Fuel mix for electricity generation, 1978-1988 (Ministry of Energy 1989).*

The share of oil in the fuel mix for power generation declined significantly from 88.2 percent in 1978 to 49.3 percent in 1988. The availability of hydropower is subject to seasonal variations in hydrological flows. This accounts for the fact that although there was no increase in installed capacity in 1988, the proportion of hydropower in the fuel mix increased due to favourable rainfall and river flow conditions. The advent of natural gas as a generation fuel was heralded by the commissioning in

1984 of Paka power station, on the East coast of Peninsular Malaysia. By 1988, Paka was responsible for almost 90 percent of gas-based electricity generation. In addition imported coal now accounted for a 1.5 percent share in the power sector fuel mix.

3.3.2 Generation mix

In accordance with the four-fuel diversification strategy, the electric power sector is reducing its heavy dependence on oil and increasing utilisation of local natural gas reserves. Table 2 shows the installed generation capacity in Peninsular Malaysia for years 1980 and 1988.

Table 2: *Changes in LLN installed generating capacity, 1980-1988.*

Plant type	LLN installed capacity			
	1980		1988	
	MW	%	MW	%
Steam turbines	1210	*59.3*	1930	*40.0*
Hydro	613	*30.0*	1250	*25.9*
Diesel*	118	*5.8*	169	*3.5*
Gas turbines	100	*4.9*	280	*5.8*
Combined cycle	-	-	900	*18.6*
Coal	-	-	300	*6.2*
Total	**2041**	**100**	**4829**	**100**

* Excludes 12 hr supply rural stations

Source: LLN 1989.

Proposals have been put forward to increase further the share of hydro in the Malaysian generation mix, chiefly through the development of large scale projects in Sarawak coupled with the construction of a submarine transmission system linking the scheme with load centres in Peninsular Malaysia. In the early eighties, energy planners included the development of the Rajang river basin in Sarawak as a key element in possible future energy scenarios (LLN 1988a, 4; Leong 1983; MICCI 1986). However, although feasibilty studies have been completed, a decision on the proposals is being held off, mainly due to financial reasons.

Meanwhile, the share of natural gas in the generation mix is set to increase further, following the completion of the Trans-Peninsular Pipeline project. This will deliver gas from processing terminals on the east coast to industrialised areas on the west coast, where there are plans for the construction of new gas-fuelled thermal stations and conversion of existing oil-fired plant.

3.3.3 Malaysian generation and demand

Demand for electricity more than doubled in the period 1978-1988, with increases in both the "residential and commercial" and "industrial" sectors (see Figure 13) through

(i) expansion of the commercial sector, primarily air-conditioning, lighting and electrical equipment

and

(ii) increase in the number of electrified households, as well as wider ownership of appliances.

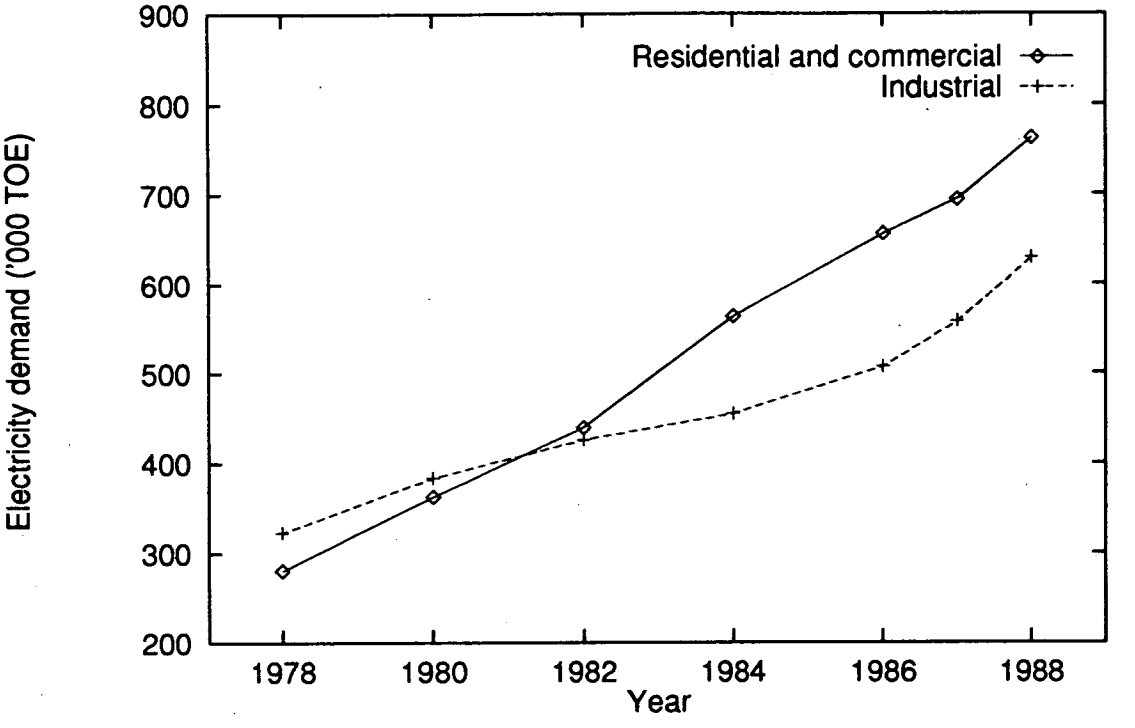

Fig. 13. *Rise in electricity demand over the ten year period 1978-1988 (Ministry of Energy 1989).*

Increases in the consumption of electricity by industry are due to a general increase in the activity of the manufacturing sector. Demand in the industrial sector has also been stimulated by low tariffs and discounts, in particular those aimed at electricity intensive industries such as cement, iron and steel manufacturers (Kamal & Chua 1990, 14).

In 1985, 89 percent of Malaysia's electricity demand was accounted for by Peninsular Malaysia, reflecting the lower level of industrialisation in the East Malaysian states. Predictions released by the Ministry of Energy, Telecommunications and Posts for the growth of electricity demand and the required generation capacity to meet this demand are presented in *Table 3*.

Table 3: *Electricity generation and demand forecasts for Malaysia, 1985-2000.*

	1985*	1990†	1995†	2000†
Sarawak				
Generation (GWh)	760	1,470	2,590	3,640
Peak Demand (MW)	150	280	480	670
Generation Capacity (MW)	180	340	580	800
Sabah				
Generation (GWh)	700	1,200	2,000	3,090
Peak Demand (MW)	140	230	390	600
Generation Capacity (MW)	170	280	470	720
Peninsular Malaysia				
Generation (GWh)	12,200	18,100	26,000	35,900
Peak Demand (MW)	2,120	3,130	4,560	6,310
Generation Capacity (MW)	2,540	3,750	5,470	7,570
Total Malaysia				
Generation (GWh)	13,660	20,770	30,590	42,630
Peak Demand (MW)	2,410	3,640	5,430	7,580
Generation Capacity (MW)	2,890	4,370	6,520	9,090

* Actual installed capacity

† Forecast required capacity

Source: Ministry of Energy 1986.

3.3.4 LLN load profile and growth

As can be seen from *Table 3* the figures for national electricity demand are dominated by levels of consumption in Peninsular Malaysia. The LLN load profile for Peninsular Malaysia is analysed in this section whilst the SESCo demand structure in Sarawak is discussed in Section 3.4.4.

In 1988 LLN had a total of 2,576,814 consumers of whom 87 percent were domestic consumers. However, industrial consumption accounted for 43 percent of electricity sold and, due to the tariff structure which favours industrial customers, the commercial sector provided over 40 percent of sales revenue (see *Table 4*).

Table 4: *LLN consumer profile 1987/88.*

Consumer class	No. of consumers		Units sold		Value	
		%	(GWh)	%	(M$ million)	%
Domestic	2,242,831	*87.1*	2857.8	*20.9*	609.1	*24.1*
Commercial	322,812	*12.5*	4,429.6	*32.4*	1,025.5	*40.6*
Industrial	5,745	*0.2*	5,867.8	*43.0*	820.5	*32.4*
Mining	227	-	380.5	*2.8*	46.2	*1.8*
Public lighting	5,199	*0.2*	121.5	*0.9*	26.5	*1.1*
Total	**2,576,814**	**100.0**	**13,657.2**	**100.0**	**2,527.8**	**100.0**

Source: LLN 1989.

Because of the high proportion of electricity consumption in the residential and commercial sector (55 percent in 1988), large daily peaks occur around midday and in the evenings. Demand management initiatives involving special tariff rates and discounts for industrial users fulfilling certain criteria are now in operation in

Peninsular Malaysia. There is a small seasonal variation in the national energy load curve, which is highest during the slightly hotter months from March to August, probably due to increased use of air-conditioning.

3.3.5 Transmission and distribution

The LLN National Grid now covers the whole of Peninsular Malaysia, whereas SEB and SESCo in the East Malaysian states of Sabah and Sarawak are at the earlier stage of interconnecting autonomous generating facilities to form basic networks. In Peninsular Malaysia a programme of expansion and reinforcement of the existing 132/275 kV transmission network has resulted in the completion of a 275 kV ring linking demand centres on the industrialised west coast with gas facilities on the east coast and northern and central regions (see *Figure 14*).

Work has been undertaken to standardise voltages and equipment used in the LLN grid system (see *Table 5*). The most important voltages for transmission are now 275/132 kV. High voltage (HV) distribution is carried out principally at 33/11 kV, although for historical reasons 22 kV is used in Johor Bahru and Perak. In heavily built up urban areas the distribution system is underground, whereas in rural areas the 33 kV lines are mostly overhead.

The low voltage (LV) distribution system is standardised at 240/440 volts. Bare aluminium conductors are used for LV distribution, although there is now increasing use of insulated aerial bundled conductors in rural areas. This is advantageous in areas where there would otherwise need to be excessive cutting of trees, especially of revenue earning fruit trees belonging to the local population.

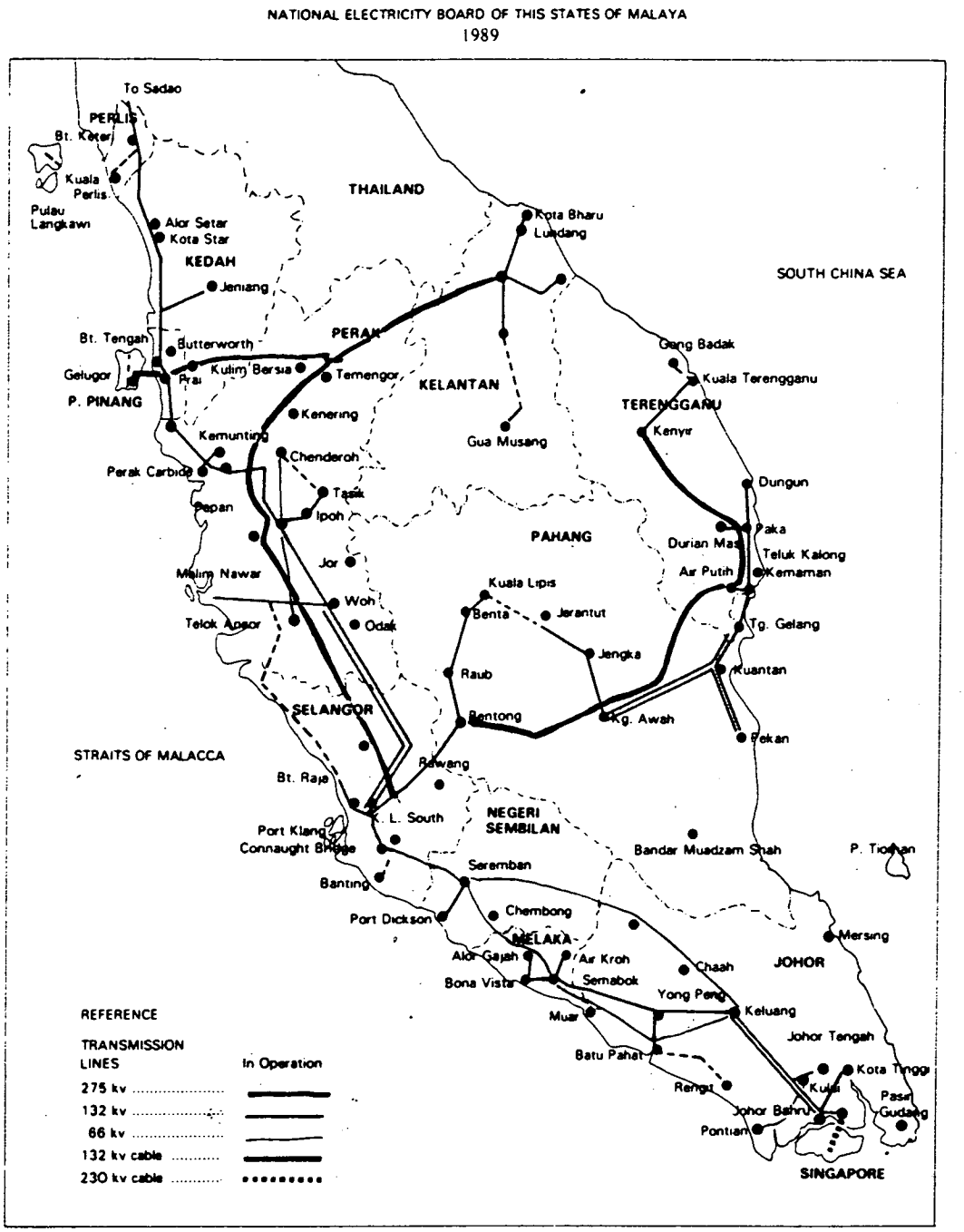

Fig. 14. *Map of Peninsular Malaysia showing the high voltage transmission system (Malaysia 1991).*

Table 5: *LLN transmission and distribution line lengths.*

Voltage (kV)	Line lengths (cct-km)			
	1985	**1986**	**1987**	**1988**
275 o/h	2,322	2,788	3,100	3,100
132 o/h	3,825	4,060	4,401	5,754
132 u/g	66	113	113	117
66 o/h	987	1,009	1,009	911
66 u/g	3	3	3	3
33 o/h	1,229	1,569	1,573	1,757
33 u/g	216	251	326	341
22 o/h	1,192	1174	1,164	1,170
22 u/g	366	443	488	585
11 o/h	477	638	712	802
11 u/g	13,004	14,107	16,064	17,437
TOTAL	**23,687**	**26,155**	**28,953**	**31,977**

o/h - overhead; u/g - underground

Source: LLN 1989.

3.3.6 The ASEAN power grid

A 132 kV link (maximum transmission capacity of 50 MW) connecting the LLN system with the Electricity Generating Authority of Thailand (EGAT) transmission system was commissioned in 1981 as the first step in ASEAN regional cooperation on power system interconnection. A 22 kV link with Singapore was upgraded to 132 kV with a 200 MW firm capacity in 1985. These links are intended to enhance

system security and operation. Attention is now being turned to interconnection for the purpose of energy export (Rozali 1986a). This is principally seen as a way to improve the economic viability of large-scale hydroelectric development in locations far from load centres. There have been, for example, proposals to build submarine transmission links between Sumatra and Peninsular Malaysia across the Straits of Malacca, and between Sarawak and Peninsular Malaysia across the South China Sea, in association with the proposed hydro projects.

3.3.7 Rural electrification

Before independence, rural electrification in Malaya was conceived as a means of improving the security of rural communities, through the installation of lights along the perimeter fencing in an effort to reduce the likelihood of terrorist attacks (LLN 1988b). However, by the launch of the First Malaysia Plan in 1966, the electrification of rural areas was firmly established on the agenda as part of the overall development strategy to introduce basic amenities to the rural areas. Along with piped water and improved communications facilities, the introduction of electricity was expected by the authorities to lead to significant improvements in health, security and educational performance.

Rural electrification is currently regarded as an integral part of the Government's strategy "to improve the socioeconomic conditions of rural areas" (Malaysia 1986). Almost as importantly, it is also a means of allowing the rural people to share in benefitting from the fruits of Malaysia's overall economic development.

The process by which electricity supply is introduced into rural areas, can take several forms. In earlier times small rural power stations were built to supply electricity for 12 hours (or less) per day. Since 1988, all rural stations in East and West Malaysia have been upgraded to provide a 24 hour service. As the national grid in Peninsular Malaysia expands, the majority of rural electrification projects

comprise extensions to existing systems rather than new generating facilities. The total installed capacity of the small LLN diesel stations operating independently of the grid system is approximately 45 MW. In Sabah and Sarawak many villages are far from the existing supply networks and line extensions are economically unattractive, especially since demand is typically very low. Autonomous rural power stations may be built to serve small towns and surrounding villages, but the only option for many of the more isolated villages is a community-run generator.

Mini hydroelectric projects add a further dimension to the rural electrification programme. By 1989, twenty-two of the 82 projects identified under the Fifth Malaysia Plan for Peninsular Malaysia had been commissioned and 16 further projects were at various stages of implementation. In the East Malaysian states 12 mini hydro projects have been implemented to supply small towns and nearby villages.

The rural electrification programme is fully funded by the government, except for in Peninsular Malaysia where, since 1989, LLN has been required to contribute 50 percent of the costs. The three power utilities, LLN, SESCo and LLS, are responsible for implementation of the projects. Allocations of funds for electrification of traditional villages are approved by the Ministry of National and Rural Development. Installation of electricity for the the new housing associated with FELDA land development schemes and funds for mini hydroelectric projects are approved by the Ministry of Energy, Telecommunications and Posts and the Prime Minister's Department, respectively.

The success of the rural electrification initiative is generally regarded as being synonymous with the rate of progress of the programme. In this sense, progress is normally gauged by:

- the amount of funds approved;

- whether all the funds allocated for that year were utilised;
- the number of additional households connected to a supply.

During the course of the Fourth and Fifth Malaysian Plans it is estimated that, with a budget allocation of over M$1,180 million, electricity supply was extended to approximately 710,500 additional households. However, despite the huge sums of money devoted to rural electrification, no comprehensive study has been undertaken to assess the results of the programme and it is not known whether the anticipated socio-economic benefits of rural electrification have been realised (Gill 1987, 13).

As the electricity utilities do not keep separate records for rural and urban consumers it is impossible to obtain an accurate figure for the number of rural households connected to an electricity supply. However, estimates obtained from the Ministry of National and Rural Development in 1990 suggest that approximately 80 percent of the rural population in Peninsular Malaysia had electricity, compared with 52 percent in Sarawak.

3.4 Electric power development in Sarawak

3.4.1 History of public electricity supply in Sarawak

The first electric lighting system to be established in Sarawak was installed in Kuching in 1924 by the Electric Department of the Public Works Department, during the time of Vyner Brooke. The generating plant comprised two 250 kW DC generators powered by high-speed steam engines with boilers fired by locally produced coal.

To begin with there were 84 consumers and the peak load was 45 kW, but by the following year this had increased to 364 consumers and, together with the street lighting for Kuching, the total installed load came to approximately 350 kW (Masing 1984). Small power stations were later constructed in the towns of Sibu and Mukah.

In 1932 the Sarawak Electricity Supply Company was formed as a joint venture between the State Government and United Engineers Ltd in order to raise the necessary capital for further power stations in other towns. During the war years the existing small power stations were either dismantled by the Japanese or suffered severe deterioration due to neglect. The necessary restoration, upgrading and conversion to AC which followed, delayed the construction of additional power stations.

In 1952 the Supply Ordinance was drawn up to give the Sarawak Government sole authority to control and regulate generation, transmission, uses and charges (Tan 1988). Subsequently United Engineers withdrew and the Government became the sole owner of the company.

By 1963, when the Sarawak Electricity Supply Company became a Corporation (also known as SESCo), there were 15 power station supplying 16,906 consumers and the

total maximum demand was more than 7,700 kW (Masing 1984).

3.4.2 Generation plant

The total installed capacity of SESCo in 1989 was over 360 MW. The generation plant is divided into four categories:

(i) **Batang Ai hydroelectric plant** - installed generating capacity 108 MW, commissioned in 1985.

(ii) **Major power stations** - in the major towns of Kuching, Sibu, Miri and Bintulu running on gas, diesel or light fuel oil (<100 MW).

(iii) **Urban power stations** - medium-sized diesel stations supplying urban towns (<10 MW).

(iv) **Rural power stations** - diesel and mini hydro plant supplying rural towns and villages in more remote areas (<1 MW).

In 1989 the Batang Ai-Kuching system, Sibu, Bintulu and Miri power stations accounted for 93 percent of electricity generated.

There are eight urban and approximately 40 rural diesel stations operating autonomously to supply small towns and villages within the state. However, this number will gradually be reduced further as the transmission network is progressively extended. Since 1986, following an instruction given by the Federal Government, all rural stations providing a restricted 6 or 12 hour supply have been upgraded to run for 24 hours.

Seven mini hydroelectric projects with a total capacity of 2.35 MW have been completed since 1984. Three of the schemes supply previously unelectrified rural areas and four supply substantial and well-established load centres, thus displacing

existing diesel generating capacity.

3.4.3 Transmission system development

Until 1985 there was little interconnection between the various generating facilities supplying the widely scattered towns. The distribution network (HV) at each station is mostly at 11 kV although 33 kV distribution is used in the wider coverage provided by the major power stations.

The first 275 kV transmission line to be built in Sarawak came into operation in 1985 linking the newly commissioned Batang Ai hydroelectric power station with Kuching. The new generating capacity was able to meet the bulk of the electricity requirement of the Kuching system (98 percent in 1987) relegating the existing diesel plant to standby and peaking functions only. The 275 kV system has been extended to Sibu and Bintulu (see *Figure 15*), and substations have been built to supply the largest towns *en route* allowing their generation facilities to be shut down and maintained for standby purposes only. However, Sibu station is still used for peaking functions and the new 90 MW gas-fired Bintulu combined cycle power station will be a key element in the State Grid.

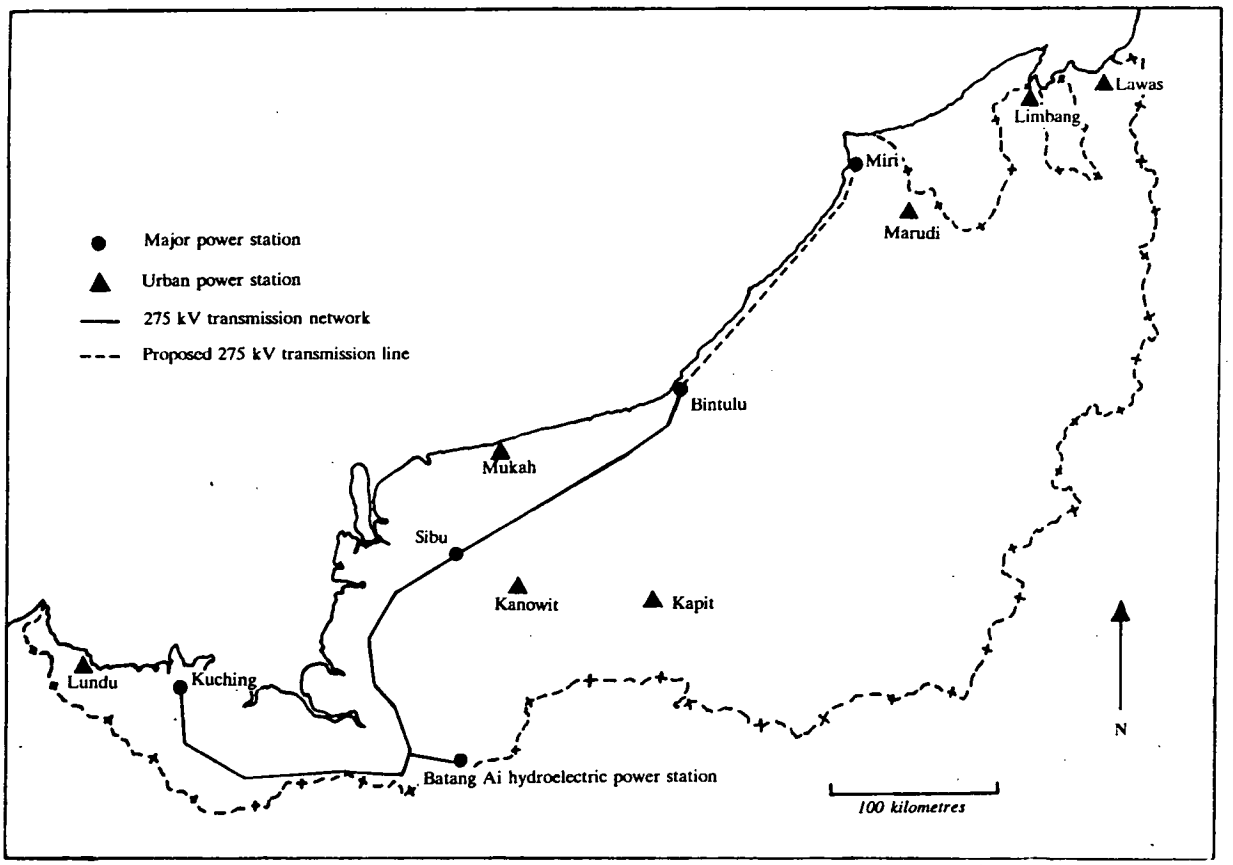

Fig. 15. *Map of Sarawak showing major power stations and the 275 kV transmission system.*

3.4.4 Load profile

In 1989 there were 164,621 consumers throughout the state, of which 82 percent were classed as domestic and fewer than 1 percent as industrial (see *Table 6*). The number of consumers grew at an average yearly rate of 8.5 percent over the ten year period 1979-89, mostly as a result of progress made in the rural electrification programme.

Although the commercial and industrial sectors comprise only 17.3 percent of total consumers, they account for 68 percent of electricity consumed. Unlike the LLN load profile for Peninsular Malaysia where the industrial sector is the largest consumption category, in Sarawak the commercial sector predominates. In both Peninsular Malaysia and Sarawak the tariffs are set such that industrial consumers pay special low rates. Consequently the commercial sector contributes a larger share of total sales revenue relative to its level of consumption.

Table 6: *SESCo consumer profile 1989.*

Category	No. of consumers		Units sold		Value	
		%	*(kWh'000)*	*%*	*(M$'000)*	*%*
Domestic	134,811	*81.9*	225,756	*31.4*	67,820	*34.2*
Commercial	28,109	*17.0*	352,380	*49.0*	101,264	*51.1*
Industrial	456	*0.3*	130,514	*18.2*	24,753	*12.5*
Street lighting	1,245	*0.8*	10,094	*1.4*	4,387	*2.2*
TOTAL	**164,621**	**100.0**	**718,744**	**100.0**	**198,224**	**100.0**

Source: SESCO 1990a.

For billing purposes SESCo regards all residents of Kuching, Sibu, Bintulu and Miri as Class I or "urban" consumers, and all others as belonging to the Class II or "rural"

category. This was originally devised as a measure to reflect the higher operating costs of the smaller power stations, and rural consumers are charged M$ 0.03 more per unit as a result. With the expansion of the State Grid this means of differentiation becomes less relevant and suggestions have been put forward to restructure the tariff rates accordingly.

In 1989 consumers supplied by the Class I stations accounted for almost 88 percent of electricity consumption. In the same year maximum demand was 170.5 MW compared with an installed capacity of approximately 360 MW. The average growth rate of maximum demand for the previous ten years was 8.8 percent.

The system load factor improved gradually over the decade to reach 60.4 percent. Demand management measures such as those adopted by LLN have not yet been introduced.

3.5 Summary

Malaysia is rich in energy resources, possessing substantial offshore reserves of oil and gas as well as significant hydro potential, especially in the state of Sarawak. The oil and natural gas reserves are of prime importance as export earners and play a key role in supplying growing domestic demand for fuel. In an effort to reduce the nation's heavy dependence on oil, the government has instituted the four-fuel diversification strategy. This has had notable results in the power sector, which has expanded its use of indigenous natural gas, imported coal and hydroelectric power. In addition, there has been great interest in developing large-scale hydroelectric projects in Sarawak with a view to supplying electricity to Peninsular Malaysia, where few economically feasible or environmentally acceptable large-scale sites remain to be exploited.

However, there are great differences between the pattern of supply and demand in Sarawak and that of Peninsular Malaysia. Due to the small and scattered population and the low level of industrialisation in Sarawak, demand for electricity is low and the cost of supply is therefore high. Although over 80 percent of consumers in both East and West Malaysia are accounted for by the domestic consumer category, the pattern of consumption differs such that, in 1988, industry consumed 43 percent of electricity sold in Peninsular Malaysia, whereas industrial consumption accounted for only 16 percent in Sarawak.

A basic transmission system to serve the main towns is under construction in Sarawak. However, many of the smaller towns are still supplied by autonomous diesel generation plant and it is estimated that 48 percent of the rural population are without electricity supply. The rural electrification initiative in Sarawak is therefore an important element in the government's strategy for promoting development of the rural areas.

Chapter 4:

RURAL ELECTRIFICATION IN SARAWAK

Progress made in the electrification of the rural areas of Sarawak is examined in this chapter. Problems affecting the various programmes and the extent of coverage achieved in each case are considered. In addition, the priority accorded to RE by those involved in the process, including policy-makers, programme planners, implementers and administrators, is assessed and the perceptions at each level of the administrative hierarchy are investigated.

4.1 Forms of supply

In Sarawak there are currently two categories of rural electricity supply:

Public supply : installed, operated and maintained by SESCo. The supply may be provided by the main transmission system or by a rural power station with installed capacity ranging from 40 to 2000 kW.

Private supply : which can be further subdivided into the following three categories:

(i) **government-provided** diesel generator set for a remote village which is unlikely to be connected to a public supply in the near future. The rated capacity of such a set, comprising a diesel engine and an alternator, can range from 600 W to 33 kW and depends on the size of community for which it was originally intended. The generator usually becomes the property of the community, which is expected to assume full responsibility for operation, maintenance and repair.

(ii) **commercial** generator (typically supplying up to 3 kW) owned and operated by a private business which sells electricity to some of the residents in a nearby village. Such small suppliers usually operate without a licence, as is officially required of all private commercial supply operators.

(iii) **private-use** diesel (or petrol) generator set, purchased by a household or group of households to supply their own requirement for electricity (usually not more than 1 kW).

4.2 Goals and objectives of the rural electrification initiative

The official rural electrification programmes currently underway in Sarawak are targeted towards:

(i) increasing the coverage of the public electricity supply, and

(ii) providing small diesel generators for more remote villages, where the above approach is not economically feasible.

This rural electrification initiative is one of the strategies which has been adopted by the Government "to improve and uplift the socioeconomic standing of the rural population" (Kong 1988). The economic aim, as interpreted by the Sarawak Electricity Supply Corporation (SESCo), is "to raise the standard of living and productivity in rural areas by providing electricity", and the social aim is "to extend service to areas of low income and productivity" (SESCo 1989).

There are widely varying estimates of the current level of coverage of electrification (see Section 4.7). Official figures for 1990 compiled by the Ministry of National and Rural Development suggest that approximately 52 percent of the rural population of Sarawak has access to an electricity supply. SESCo has stated its aim to provide electricity to 90 percent of the population by the year 2000 (Satia 1990).

4.3 Government programmes

There are three different Government programmes, with separate funding arrangements, for rural electrification projects in Sarawak:

4.3.1 Rural Electrification Scheme (RES)

A Malaysia-wide programme for the extension of supply to rural areas was initiated under the First Malaysia Plan with the commencement of what is known as the Rural Electrification Scheme (RES). SESCo implements RES with funds from the Federal Ministry of National and Rural Development to supply electricity to rural areas of Sarawak.

Applications for connection to an electricity supply made by individual villages, or groups of ten or more houses, are channelled to SESCo. A survey is carried out by engineers from the local SESCo Regional Office to obtain an estimate of the costs involved and the number of households expected to benefit. Subsequently, a prioritised list of projects is compiled in consultation with the State Development Office. Highest priority is awarded to the electrification of areas earmarked for development by the Government or with high economic potential. This is followed by areas with natural resources which can be readily exploited for power generation and those areas which already lie close to a power line (Kong 1988). Projects from the list are approved by the Ministry on a yearly basis, in accordance with budget guidelines set by the current Malaysia Plan.

Rural electrification projects comprise the construction of extensions to existing transmission line systems or, where this is deemed to be uneconomic, new rural power stations may be built to serve the more isolated centres of population. Each Regional SESCo office is responsible for the planning and implementation of RES projects in its area.

Table 7 shows the resources allocated to RES and the number of households electrified, over the five Malaysia Plan periods. The source of funding has evolved to rely exclusively upon Federal grants whilst the Sarawak State Government and SESCo are no longer required to contribute. However, operation and maintenance costs which, it must be noted, inevitably exceed revenues in the rural areas of any country, are borne by SESCo. RES applicants can also make use of a loan, repayable over a three year period and provided under the Assisted Wiring Scheme (AWS), to cover internal wiring costs.

It is likely that the cost per household was particularly low during the Second Malaysia Plan period since the process of rural electrification was in its very early stages. Consequently, the majority of electrification projects involved installing a

Table 7: *Resources allocated to RES.*

Malaysia Plan	Funds (Million Ringgit)		Households supplied	Cost per household (Ringgit)
	Federal	State		
1st (1966-70)	-	1.5	650	2,293.00
2nd (1971-75)	1.2	2.4	3,615	995.00
3rd (1976-80)	10.4	5.2	13,950	1,118.00
4th (1981-85)	72	-	21,316	3,377.00
5th (1986-90)	65.95	-	15,000	4,396.00

Source : SESCO 1990c.

supply for those small towns which were relatively accessible. As rural electrification has progressed the cost of electrification per household during each Plan period has risen. This is due to the high cost of extending supply to increasingly remote and scattered settlements inhabited by fewer prospective consumers.

4.3.2 Mini hydro programme

As a further effort in the overall drive to electrify rural areas, the Federal Government actively promotes the development of mini hydroelectric power generation projects. SESCo receives grants from the Economic Planning Unit of the

Prime Minister's Department to cover the capital costs of the mini hydro programme. The grants are made available as a result of international loan agreements with organisations such as the Asian Development Bank or World Bank. It is often a condition of the loans that foreign consultants should be engaged to carry out both the feasibility studies and detailed design. Whilst those schemes which will supply established load centres often prove to be the most economic, strong consideration is also afforded to projects which will supply the more remote areas.

Details of the cost of the seven mini hydro schemes completed to date and the number of households subsequently electrified are shown in *Table 8*.

Table 8: *Mini hydro schemes in Sarawak.*

Scheme	Online from year	Capacity (kW)	Cost (Million Ringgit)	No. of households supplied
Kalamuku	1984	1000	7.6	266
Sebako	1985	300	5.4	534
Lundu	1985	300	4.5	532
Semadang	1988	200	6.71	415
Batu Lintang	1988	100	3.104	550
Saliban	1988	150	5.566	482
Penindin	1990	300	3.0	-

Source : SESCO 1990b.

4.3.3 Small generator sets for individual villages

The programme of allocating funds for the provision of small generator sets was started by the Ministry of Energy, Telecommunications and Posts in the early 1980's

when it was recognised that, at least in the foreseeable future, SESCo would not be in a position to supply the many very isolated kampungs and longhouses in the State. Since 1986 small generators have been included in the lists of projects for rural areas approved for State funding, as part of the Minor Rural Projects programme. Other projects include the construction of rural roads, bridges, places of worship, community halls and allocations to cover the cost of building materials.

A grant to cover the cost of a generating set, associated wiring and installation varies according to the number of households, the proximity of the living quarters and the power capability required. During 1988, allocations ranged from M$ 40,000 for a 30 kW set (102 households) to M$ 15,000 for 8.5 kW set (10 households).

Currently there are four separate funds which may be used to finance the provision of generating sets for rural communities in Sarawak. Federal sources include the **Member of Parliament** and **Generator Funds**. The **Minor Projects** and **Special Development Assistance Funds** are allocated by the Sarawak State Government.

(i) **Member of Parliament (MP) Fund**

Projects allocated from this fund are approved at the discretion of Members of Parliament normally following a request from members of the constituency. Projects include water supplies, bridges and roofing materials as well as generators. During the Fifth Malaysia Plan a total of M$ 4.8 million was available for allocation each year under the MP's Fund.

(ii) **Generator Fund**

- 70 percent is allocated by the Implementation and Coordination Unit (ICU) of the Prime Minister's Department, for distribution by the State Development Office.
- 30 percent is approved by the Minister for Energy, Telecommunications and Posts,

Official figures are available for Generator Fund allocations made under the Fifth Malaysia Plan from 1986-1990 and are presented in *Table 9*, together with the number of projects for which the funds were approved.

Table 9: *Generator fund allocations, 1986-1990.*

Year	No. of projects	Total cost of approved projects under the Generator Fund (Ringgit)
1986	146	3,500,000
1987	-	1,500,000
1988	25	1,090,120
1989	29	592,650
1990	20	437,400

Source: SDO 1990.

Following the creation of the Generator Fund in 1981, an allocation of three million Ringgit was made for village generators each year under the Fourth Malaysia Plan. However, after a pre-election general upsurge in development activity in 1986, fewer generator projects are being approved every year. This can partly be attributed to the relatively high cost per project compared to small construction projects or grants for building materials which are therefore more popular amongst political representatives since they can be distributed amongst a greater number of villages.

(iii) **Minor Projects Fund at State Level**

This fund is approved by Council Negri Members in a similar manner to the MP Fund.

(iv) Special Development Assistance Fund

The State Development Office can approve Special Assistance Funds to supplement (iii), as necessary.

Figures for 1986-1989, compiled by the State Development Office from reports of completed generator projects financed using State funds (iii and iv above), are given in *Table 10*.

Table 10: *State funded generator projects, 1986-1989.*

Year	Cost of generator projects (Ringgit)
1986	469,800.00
1987	5,343,165.00
1988	477,300.00
1989	549,000.00

Source : SDO 1990.

The high level of funds approved for generator projects in 1987 is explained by the fact that elections for Sarawak State Assembly were held during that year. Allocating funds for a small development project under the Minor Rural Projects Scheme is a fairly standard method by which political candidates with government influence can attempt to attract support.

The State Development Office ensures that all four funds are administered correctly, as part of the overall Minor Rural Projects programme which is implemented at District level by the District Office. The authorities estimate the size of generator required by a village using a guide of 120 W (three 40-W bulbs) per household and normally only one power point, to be located outside the headman's door. However,

for kampungs nearer to town, this would not be sufficient. The District Office tenders out the contract to a local supplier who is also required to carry out the installation and wiring and to demonstrate to the villagers how to operate and maintain the generator.

4.4 Other generation projects for remote villages

In addition to the diesel generator programme, electrification of remote villages using alternative renewable sources of generation is being considered by the Sarawak Government. To date, two solar photovoltaic projects have been completed and details are given below.

4.4.1 Solar power projects

(i) A remote 35-door Penan longhouse, at Lusong Laku, in Belaga has recently been supplied with a BP solar power system by the State Planning Unit. The 12-V system comprises 10 roof-mounted High Power Solar modules, an electronic control unit, a DC-AC inverter and a bank of six photovoltaic batteries. It is designed to provide a peak load of 264 W for a maximum period of four hours nightly, and the batteries have a storage capacity of 6-7 days to allow for overcast or rainy weather. The capital cost of the project came to M$ 24,000. However, this does not take into account transport costs for which records are unavailable. Given the remoteness of the settlement these will have been substantial. Due to its low power capability the system provides lighting for only the common verandah, although this is due to be upgraded to include the family apartments.

(ii) The implementation by SESCo of solar systems for two longhouses financed by Belgian aid, was completed in 1990. The longhouses concerned are Rumah Saong Block A (18 doors) at 52 Mile and Rumah Saong Block B (14 doors) at 51 Mile, Sungei Engkabang adjacent to the Kuching-Sri Aman road. Assuming three lighting points and one power point, for a television or fan, per door the estimated peak loads are 4.3 kW and 3.75 kW for the two longhouses. 216 modules for Block A give a total peak installed capacity of 18.36 kW and 200 modules for Block B a total peak installed capacity of 17 kW. Assemblies of eight roof mounted photovoltaic modules are arranged to give peak power at 110 V D.C. The estimated total cost of equipment supplied by the Belgian consultant was approximately M$ 1 million, which suggests an approximate cost per household of M$ 31,000. The consumers are billed by SESCo just as if they were receiving connection to a conventional supply and are not required to carry out maintenance tasks.

4.4.2 Micro hydro projects

There are currently no government initiated micro hydro projects in the state. However, there are two independently conceived and constructed schemes operating in Sarawak.

(i) The first is the hydro scheme at Long San on the Baram River. This scheme was installed by the mission priest to supply the mission buildings with electricity over ten years ago. The hydro plant is reportedly still functioning well, although the scheme was not visited as part of the study.

(ii) A second independently-initiated micro hydro project was recently constructed by villagers from Buduk Nur in the Bakelalan area in Lawas District, also without any government financial assistance. This project was visited on two occasions and is reportedly still running well. Further details of the hydro

project at Bakelalan are given in Section 5.11.

4.4.3 Further development of alternative generation options

Solar and micro hydro initiatives in Sarawak remain very much the exception and organisation has been ad-hoc, on an individual project basis. Furthermore, there has been little opportunity for a full evaluation of the strengths and weaknesses of either solar or micro hydro power as a means of supplying remote villages in Sarawak with electricity as part of a state-wide programme. However, the experience drawn from these projects is worth noting, as there is currently great interest, amongst those familiar with development problems in the rural areas, in finding an alternative to the diesel generator programme. In particular the possibility of developing autonomous micro hydro projects to serve very isolated communities has been discussed for some time (Masing 1984). The State Development Office, being aware of the limitations of the diesel generator programme, are interested in undertaking a pilot micro hydro project to determine the feasibility of such a scheme.

4.5 Importance of rural electrification

In this section, the priority accorded to rural electrification at each level of development administration is examined. All the material presented is based on interviews carried out with individuals from both Federal and State Government offices, SESCo and the six District Offices included in the study. The relative importance attached by rural consumers to the provision of an electricity supply has been dealt with separately and is included in Section 5.13.

While it was widely acknowledged within SESCo that the pursuit of rural electrification could not be justified on purely economic grounds, RES was afforded

relatively high priority in line with Government requirements and expectations. However, targets set for increases in electrification are largely determined by the project proposal and planning process. Applications for individual projects are received by SESCo and site surveys are carried out to determine approximate costs. The list of proposed projects is prioritised in consultation with the State Development Office and the Ministry of Infrastructural Development. Federal approval is subsequently sought from the Ministry of National and Rural Development. The Economic Planning Unit of the Prime Minister's Department allocates a share of the available resources according to their estimation of the number of proposed projects which SESCo would be able to complete.

Amongst the range of programmes to serve the needs of the more isolated villages, the small generator distribution programme is not regarded by the State Development Office as deserving highest priority. An electricity supply is still considered to be a luxury as compared to the supply of clean water, which is very much a basic need. Therefore, the most immediate concern is for the provision of gravity-feed water supplies to the small percentage of rural communities still without a safe piped water supply. Otherwise, the main preoccupation is with the construction of rural roads to increase communication and access to markets. The development of a network of roads is also seen as essential for the economic development of rural areas by organisations such as the Sarawak Economic Development Corporation (SEDC).

As an indication of the relative significance of generator projects within the Minor Rural Project (MRP) framework, a comparison with the percentage allocation of federal funds for rural roads and rural water supplies is presented in *Table 11*. At the District Office level the importance of road building, where this is possible, was also stressed. Drainage to prevent the roads from being washed away was also cited as a priority. However the most common projects approved under the Minor Rural Projects umbrella were allocations for building materials, community halls and places of worship.

Table 11:

Allocation of Federal funds for Minor Rural Projects, 1983-1988.

Year	Total Federal MRP allocations (Ringgit)	Percentage share of funding		
		Generators	Rural water supply[a]	Rural roads[b]
1983	20,459,178	14.7	48.9	-
1984	15,211,002	19.7	32.8	14.1
1985	18,257,979	16.4	5.8	21.5
1986	29,505,957	11.9	17.4	24.9
1987	16,172,889	9.3	29.1	13.5
1988	21,614,463	5.0	13.4	19.3

Source : SD0 1990.

[a] - includes rural roads construction projects under the Public Works Department and kampung roads

[b] - includes both rural water supplies under the Public Works Department and village supplies under the Health Department

4.6 Progress made by the rural electrification initiative

In this section the progress made by SESCo and the State Development Office in the implementation of the rural electrification programmes is examined. Progress is conventionally assessed in terms of numbers of power stations constructed, generators installed and additional numbers of households connected to an electricity supply. Official figures are therefore presented for each of the official programmes. The question of the overall extent of electrification, or the percentage coverage, is addressed in Section 4.7.

4.6.1 RES

Since 1966, 62 rural power stations have been constructed in Sarawak under RES. The majority have a capacity of approximately 300 kW, although there are three with an installed capacity of under 100 kW. Many of the stations supply small towns, together with any of the more accessible nearby villages. A number of the autonomous power stations have been closed following the construction of transmission line extensions from larger existing systems. Currently, approximately forty rural power stations operate independently (see *Figure 16*), although this number is decreasing as work on the 275 kV transmission network linking Kuching with Batang Ai, Sibu and Bintulu progresses.

In 1986, a directive from the Federal Government required all electricity supplies to be upgraded to provide power on a 24 hour basis. This led to an increase in capital, operating and maintenance costs due to the necessity of employing additional power station staff and investing in additional standby equipment.

Table 12 shows the number of projects completed and the number of households supplied under RES during each Malaysia Plan period. As can be seen from the table, the RES efforts of SESCo have recently been concentrated upon extension of existing systems and fewer new stations are being built. In fact between 1977 and 1990 twenty-five rural power stations running on diesel were shut down, following the extension of High Tension (HT) lines to centres of demand previously served by local autonomous generation systems. This reflects a SESCo policy of consolidating and interlinking existing systems through the expansion of the network, relying on power from the major urban stations and the Batang Ai hydroelectric scheme.

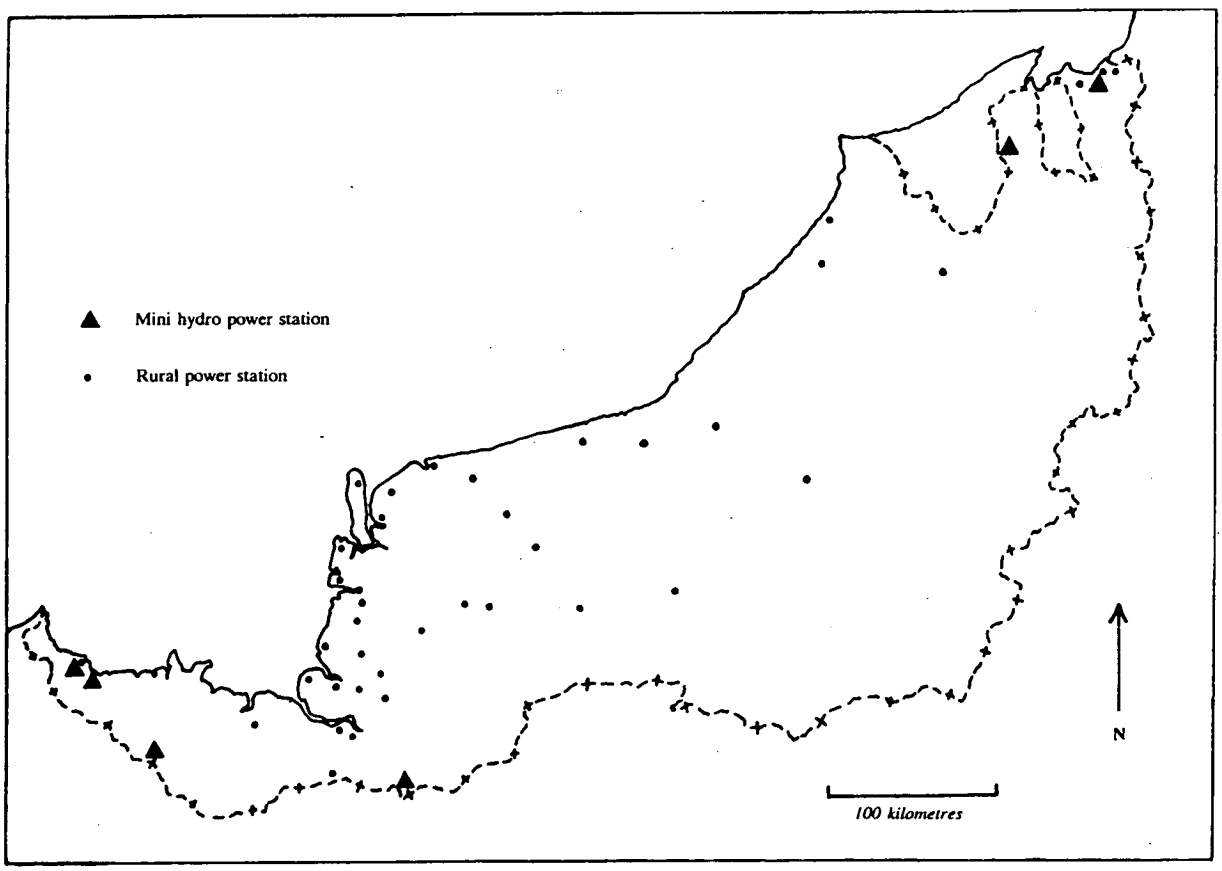

Fig. 16. *Map of Sarawak showing rural power stations and mini hydroelectric installations.*

Table 12: *Progress of RES.*

Malaysia Plan	New stations	Systems extensions	No. of households supplied
1st (1966-70)	4	23	650
2nd (1971-75)	11	64	3,615
3rd (1976-80)	27	94	13,950
4th (1981-85)	18	196	21,316
5th (1986-90)	2	134	15,000
TOTAL	62	511	54,535

Source : First to Fifth Malaysia Plans.

4.6.2 Mini hydro

The majority of rural stations supply power from small diesel generating sets. SESCo, however, is also involved in the the development of mini hydro power as part of the Government's Rural Electrification Programme. By early 1990, six mini hydro power projects with a total installed capacity of 2.05 MW had been commissioned, and a seventh has since followed. Three of the completed schemes supply previously unelectrified areas and three supply substantial and well-established load centres, thus displacing existing diesel generating capacity. Further

potential sites for small and mini hydro schemes have been identified and pre-feasibility and feasibility studies carried out. More detailed design will commence once the funding has been made available. It is reported that 2,779 additional households have been connected to an electricity supply as a result of progress made in the mini hydro programme (SESCO 1990b).

4.6.3 Small generator programme

Under the Government's small generator programme administered by the State Development Office, several hundred generators have been distributed to longhouses and kampungs throughout Sarawak. Although the programme was officially underway by 1982, due to changes in funding structures, reliable figures are not available until 1987. According to statistics obtained from the State Development Office, 251 villages and rural schools were provided with generators over the three year period from 1987 to 1989. However, it is not known how many of those generators are still operational, or how many of the villages have since been connected to a SESCo supply. It should be noted that in the same period only ten allocations were made to cover the cost of major repairs to generators.

4.7 Extent of electrification

The problem of obtaining estimates for the current extent of coverage generates much interest amongst top-level development administrators. This is an area for which there is little reliable information, and the data which do exist are still a subject of discussion. Many of the figures conflict and it is difficult to say which are likely to be more accurate. The salient details are itemised below:

- The 1980 population census established that 41.6 percent of all "occupied housing units" used electricity for lighting purposes (Statistics 1990). Of these, 80 percent were connected to a public supply and the remainder were recorded as using a "private generator". No separate figures are offered for urban and rural consumers, which would anyway be of limited relevance due to the static and rigid nature of the official definition of rural (see Section 1.2.6).

- Dr Joseph Ko of the Department of Statistics, Sarawak Branch, has estimated that the percentage of housing units connected to a public supply rose from 33.1 percent in 1980 to 48.1 percent in 1988 (Ko 1989).

- It is estimated that approximately 54,000 households have benefited from RES since the commencement of the First Malaysia Plan in 1966 (SESCo 1990b). In line with SESCo's practice of taking the average size of a household in Sarawak to be 5.5 persons, this suggests that approximately 16.5 percent of the total number of households have been connected to an electricity supply under RES.

Unfortunately, this last piece of information is of limited value as an indication of the level of electrification in rural areas, since RES refers to the funding mechanism for the capital costs involved, rather than to any clearly defined category of consumer. Some successful RES applicants actually live on the fringes of town and some rural consumers have paid for extension of the system according to normal connection procedures. Once connected, Class II consumers are differentiated only according to the "domestic", "commercial" and "industrial" categories. Furthermore, it is often an impossible task to keep track of all consumers who have been connected under a single RES project, since there are invariably many additional late applicants.

- SESCo estimate that the overall level of electrification in the state rose from 57 percent of the population in 1988 to 64 percent in 1990. These estimates take into account progress made in the small generator programme but ignore the fact that a significant proportion of the generators are likely to be out of order.

- The State Development Office has provided figures for both Federal and State funding allocations for the small generator programme from 1981 to 1989 (see Section 4.3.3). However, unlike SESCo projects, which can safely be assumed to be operating successfully ten years after commissioning, the small generator projects cannot be regarded as long term, as there is no structure to ensure that repairs are carried out or that old and irreparable machines are replaced. This means that the number of small generators paid for through the scheme since its inception is not a reliable indication of the number of villages currently enjoying an electricity supply.

- The Chief Electrical Inspector (Public Works Department) maintains a record of those private generator operators who possess a licence. However, it is generally only the larger commercial concerns such as timber companies who apply for licences in the first place. It is acknowledged that the majority of the smaller generators remain unregistered.

All of these points are of relevance when estimating the approximate level of rural electrification in the state. However, the conflicting and imprecise information makes speculation on a precise figure difficult. In this context, the most reliable indication of electricity supply coverage is likely to be provided by the results of the 1991 Census.

4.8 Implementation problems

The implementation problems of the various programmes are dealt with in two sections. The first section outlines problems encountered by SESCo in implementing RES and the Mini Hydro Programme, and the second covers problems experienced by development officials in attempting effective implementation of the small generator programme.

4.8.1 Problems encountered by SESCo

Problems faced by SESCo, in the course of extending its operations to reach the rural areas of Sarawak through RES and the Mini Hydro Programme are well-documented (Kong 1988; Tham 1984). The difficulties encountered have been loosely grouped into four categories :

(i) **Problems associated with the implementation of the majority of large-scale rural development programmes in Sarawak.**

(ii) **Other implementation problems encountered by SESCo.**

(iii) **Operation difficulties faced by SESCo in the rural areas.**

(iv) **Problems associated with the low cash income of consumers.**

The main problems are briefly outlined below :

(i) In common with many large scale development initiatives in the rural areas of Sarawak, problems experienced during the implementation of RES projects or mini hydro projects include those associated with the difficult terrain, heavy rainfall and the extremely scattered pattern of settlement.

- The hilly and swampy terrain and the many rivers make road construction and the erection of transmission and distribution lines difficult and expensive.

- Poor roads and unpredictable, or even dangerous, river travel conditions increase the cost of access and transportation of construction materials, equipment, fuel and spare parts.

- The small size of many communities and the large distances between villages, together with the low load factor due to the negligible daytime requirement for electricity, are all factors contributing to the extremely high cost of rural electrification in the state.

- As with all development projects which involve the use of land, the progress of electrification is further hindered by the complicated and time-consuming procedures for obtaining planning permission and arranging for the acquisition of land. In addition a large number of requests for compensation are received from landowners who have had fruit trees cut down to make way for overhead lines. Lengthy disputes often result from claims which cannot be met, due to the limited resources available.

(ii) Implementation problems specific to the SESCo programmes include:

- The late approval of Federal grants for RES is a major cause of delay in the implementation of RES projects and, in addition, can lead to inflationary cost increases.

- High costs are also incurred due to the lack of sufficient local manufacturing capability for materials and equipment. This leads to the need to purchase many items from overseas (Peninsular Malaysia and abroad).

- Changes in priority due to the inclusion of new projects at short notice at each year-end, often as a result of political pressures, can necessitate the delay of long-planned projects.

(iii) Once the electrification project has been completed operational difficulties include:

- The lack of suitably educated potential employees living in remote areas who could be trained to run the rural stations. In case of breakdown it is

consequently often necessary to send town-based technicians to first assess the problem and identify which equipment is needed, before a repair can be attempted.

- Communications facilities are frequently either absent or of poor quality.
- In remote areas the collection of bills by the travelling clerk can be expensive. Costs sometimes exceed the total revenue collected in poorer areas where most consumers incur only the minimum monthly charge. During seasons of high agricultural activity the villagers are often away on distant farms and cannot easily be contacted.

(iv) In addition to these problems, which are discussed at length in SESCo reports and publications, staff at the local SESCo offices, concerned with the day-to-day implementation of RES as well as the consumer side of operations, mentioned the poverty of many rural consumers as constituting a problem. The proportion of consumers who are unable to pay their bills was generally estimated to be similar to that in town areas, although the debt incurred tends to be much lower. Indeed, the majority of rural consumers use only enough electricity to incur the minimum monthly bill, which together with AWS payments is, in itself, barely affordable. However, payment of the collateral deposit, which is currently required before connection will be carried out, was more problematic. Many of the villagers save hard and eventually find the money from somewhere. However, in a few areas with low average cash incomes, despite the levy of an especially low collateral deposit, connection rates had dropped to as low as two-thirds.

4.8.2 Problems facing the small generator programme

The primary constraint on the number of small generators issued is the limited funding available. However, constraints on the *effectiveness* of the programme, as

expressed by the implementers, are outlined below:

(i) no technical experience on the part of the villagers who have responsibility for managing the generators.

(ii) in some communities lack of an established organisational structure leads to problems with collection of payments for fuel or repairs.

(iii) high cost of transport for diesel and repairs in the case of breakdown.

(iv) limited power capability of generators, in particular for the slightly better off communities.

(v) frequent but often avoidable breakdowns due, in the most part, to overloading and lack of proper maintenance.

(vi) villagers often unable to pay for major repairs to the generators.

(vii) no provision within the framework of the programme for maintenance or repair of generators.

(viii) a correspondingly reduced life-span for many generators.

(ix) subsequent short term nature of each project.

4.9 Perceptions of officials towards the rural electrification initiative

This section is based on material obtained from interviews conducted by the author with staff in the State Development Office, State Planning Unit and District Offices. It is by its very nature anecdotal and names of informants have been intentionally excluded.

4.9.1 RES

Development administrators and planners indicated that they viewed the RES activities of SESCo as successful, if proceeding at a slightly slower rate than they would have hoped for. There was a general expectation that SESCo would eventually be able to supply the majority of villages in the state. There was also an appreciation that connection to a SESCo system was the mode of electrification preferred by most rural people. However, there was also a realisation that interim measures would be required to provide remote villages with a temporary substitute electricity supply until extension of the existing system could be completed.

4.9.2 Small generator programme

There were, however, mixed feelings about the value of the small generator programme.

At the planning level the limitations of the programme were recognised and whilst some interest was shown in the development of alternatives, *e.g.* micro hydro power installations, little progress has been made to this end. In particular, a continuous stream of requests for village generators arriving from political representatives and community leaders means that the programme can not easily be terminated without finding a substitute.

On the other hand, the attitude of District office staff depended very much upon the specific geographical, demographic and developmental characteristics of their particular District, as well as on the experience they had gained whilst at previous posts in other Districts.

A few District Officers claimed that the programme worked well and that it served the purpose of improving living standards in the rural areas. They called attention to

the benefits brought by the introduction of electric lighting and television sets to remote villages which had been made possible by the installation of generating sets.

Conversely, many District Office staff were of the opinion that once problems of maintenance and repair were encountered the generator could too often become a burden to the recipient community, rather then an asset.

In the more accessible Districts the programme was often not regarded as being worthwhile. The projects were of short term duration by their very nature and this was made worse by the problems of maintenance and repair. One of those interviewed stated that by the time that every village in the District had been provided with a generator, fewer than half of those distributed would still be functioning. It was felt that the money available could be more effectively used on other rural development programmes such as the construction of rural roads.

In addition, a number of the District Office staff expressed worries about their ability to implement the projects, without any relevant technical knowledge or experience to assist them in making choices of equipment, contractors or in dealing with problems.

The following recommendations were offered by those interviewed:

- the programme should be taken over by SESCo who would have the expertise to deal with maintenance and repair problems;
- it should be removed from the Minor Rural Projects structure;
- for the villages that can eventually be reached by SESCo, it does not matter that the projects are of short term value only. For the villages that are too far away from any future system extensions, resettlement might, in any case, be the only option. However, this view was not supported by other top officials who felt that, from their experience, resettlement was far too unpopular to be feasible.

4.10 Summary

There are both public and private electricity supplies operating in the rural areas of Sarawak. Public electricity supply is provided by the state electric power utility, SESCo. Private supplies generally take the form of small diesel generators, either for the private use of the owner, or operating on an informal commercial basis to serve a limited number of nearby consumers. The present extent of coverage of electricity supply is a subject of much debate due to conflicting evidence. However, it is has been estimated by the Ministry of National and Rural Development that 52 percent of the rural population have access to an electricity supply. The rural electrification initiative aims to increase this coverage in order to improve socioeconomic conditions of the rural areas.

SESCo is responsible for the federally funded rural electrification programmes. These programmes allow for the construction of small diesel power stations, mini hydro schemes, and extensions to the existing networks to provide electricity supply to small towns and villages. A separate programme exists to provide small generator sets to remote villages which are unlikely to receive connection to a SESCo supply in the foreseeable future. Two villages in the state have been electrified using solar photovoltaic systems and there is some interest in exploring the potential for a similar use of micro hydro power.

Rural electrification is accorded high priority in line with Government requirements and expectations. Emphasis is laid on the expansion of the public electricity supply provided by SESCo, the progress of which is conventionally judged in terms of the number of additional households supplied. It is not known how many village generator sets have been provided under the Minor Rural Projects programme nor how many are still operational; neither is it known how many private generator sets operate commercially in the state.

A wide range of problems are encountered by SESCo in implementing RES projects resulting in higher costs and long lead times. Many of these problems are due to the particular geographical characteristics of Sarawak and others are to do with administrative procedures. The small generator programme is beset by many difficulties due to the short-term nature of each project and is regarded by many development officials as ineffective and wasteful.

The next chapter goes on to address the issue of rural electrification from the point of view of the rural consumers.

Chapter 5:

ELECTRICITY IN THE VILLAGE

The "bottom-up" approach to the study of rural electrification centres on the villages and their resident communities. In an effort to assess the significance and effectiveness of the RE programmes undertaken in Sarawak, detailed studies were carried out in twenty-two villages in the six selected Districts of Lubok Antu, Lundu, Serian, Sarikei, Lawas and Belaga. Shorter visits were made to additional villages, including those forming part of resettlement schemes or in other Districts.

A broad range of villages was chosen to reflect the wide variety of circumstances in rural areas. Important characteristics of the villages studied are outlined in the first section in order to give an indication of the range covered.

In order to assess the significance of an electricity supply for a rural community, it is necessary to consider it within the overall developmental context of the village. Matters of direct relevance are:

- the extent to which the community as a whole, as well as its constituent households, are involved in the cash economy;
- the form, scale and success of other development initiatives in the village;
- the predominant organisation and leadership forms present in the community.

These subjects are dealt with in the first three sections of this chapter and are followed by an analysis of the status of energy and electricity in the villages.

5.1 Important characteristics of the villages studied

One of the most significant characteristics of each village is its location, especially relative to the nearest town and market. Also of major importance is the difficulty of access. The villages visited ranged from some of the most isolated settlements to be found in Sarawak to roadside longhouses or kampungs on the fringes of small towns. A summary is presented in *Table 13*.

Most of the isolated longhouses in Belaga District are accessible only by boat, river conditions permitting, and villages at Bakelalan in Lawas District are reached either by air or after five days walk from Lawas town. Fishing villages in the Rajang delta, such as Daro and Matu, are also only accessible by boat and travel is often dangerous or impossible in stormy weather. In contrast other villages included in the study are located adjacent to the main road from Kuching to Serian, or in close proximity to a market town such as Lundu.

Forms of settlement vary from a longhouse or cluster of smaller longhouses to that of a kampung comprising more scattered separate family houses (see *Figure 17*). If the ground is swampy or a nearby river is liable to flood then the houses are often built on stilts.

Table 13: *Location of villages selected for study.*

District	Village	Location and access
Lubok Antu	Rh. Sunok, Nanga Stamang	3 hrs by boat (20 h.p.) up Engkari tributary from Batang Ai reservoir, depending on river conditions.
	Rh. Nisau, Panjai Ruai	½ hr drive along rough track from the road.
	Rh. Rabong, Sebangki Panjai	Next to main road.
	Tinting Lalang	Near to road from Lubok Antu.
Serian	Rh. Saong	Sungei Engkabang, 53rd Mile Kuching-Serian Road.
	Kg. Jerok	67th Mile Kuching-Serian Road.
	Kg. Talagus	65th Mile Kuching-Serian Road.
	Kg. Tangga	Close to Tebakang Road.
	Kg. Munjau	5 miles down track at 21st Mile Kuching-Serian Rd.
Lundu	Kg. Stunggang Melayu	On river next to Lundu town.
	Kg. Pueh	Near to Sematan, reached by rough unsealed road from Lundu.
Lawas	Buduk Nur	Twin Otter plane (or 5 day walk) from Lawas to Bakelalan.
	Buduk Bui	2½ hr walk from Buduk Nur.
	Long Langgai	½ hr walk from Buduk Nur.
Sarikei	Kim San Road	Main road from Sarikei.
	Rh. Jimbai	Track from Kim San Road.
	Rh. Pak	Gravel track off main road.
	Rh. Tutang	12 miles from Bintangor.
Belaga	Uma Kulit, Long Jawe	1-2 day river travel, at normal water level.
	Uma Lesong, Batu Keling	8 hrs by boat, "
	Uma Ukit, Long Ayak	1 day by boat, "
	Uma Lahanan, Long Pangai	8 hrs by boat, "

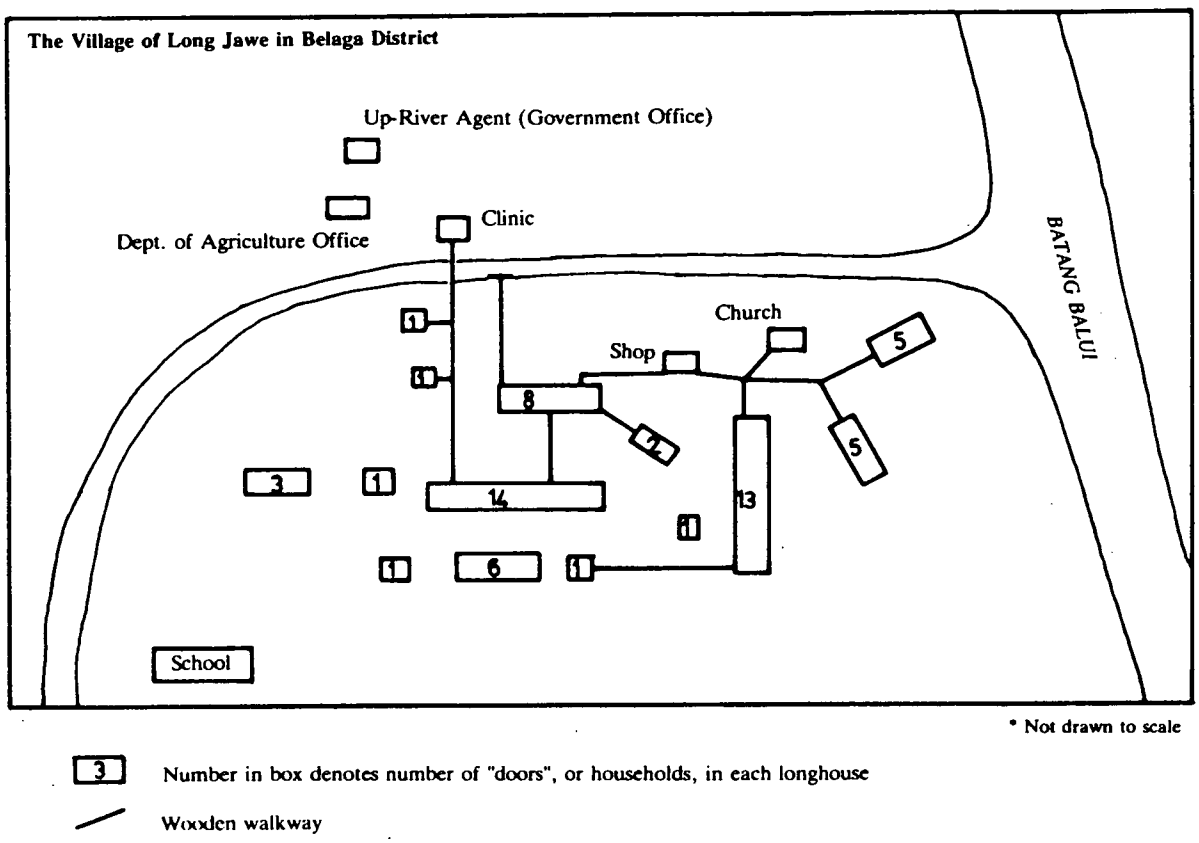

Fig. 17. *Layout of the village of Long Jawe on the Balui river in Belaga District.*

The size and arrangement of villages in Sarawak are fairly dynamic. For instance, it is not uncommon for villages to split up and move apart following a division amongst members of the community, often due to political or religious differences. An enquiry into the history of a village occasionally revealed that the whole community has moved in order to be nearer to the main road. In some villages there

was a lot of rebuilding in progress at the time of the fieldwork. This was particularly noticeable in a number of Bidayuh villages in Serian District where there appeared to be a move away from longhouse style dwellings to separate houses, also remarked upon by Grijpstra (1976). The size of the community or number of households in the villages included in the study ranged from an eleven-*door* Iban longhouse in Sarikei to a 170-*door* Bidayuh village in Serian District.

Changes were also noted in population, a number of villages having experienced a flow of inhabitants to towns to find work. However, despite this shift the majority of villages reported that the population remained fairly stable.

5.2 Degree of involvement in the cash economy

The predominant economic activities practised in the villages which were included in the study are farming and, near to the coast, fishing. By far the most important crop is rice. On flatter land and near to the coast the cultivation of wet paddy is common, although in most places the yield is insufficient for commercial production to be viable. However, in the highlands of Lawas, wet paddy is grown commercially due to its superior quality and consequently higher market value, which renders it economically viable despite high transport costs. In inland areas the most important agricultural activity is the shifting cultivation of hill paddy, which is generally grown solely for domestic consumption, although it does possess some value as a bartering item.

Some form of barter trade is practised in the majority of households, either between households or with local businesses who exchange cash crop or jungle produce for necessary food staples such as sugar, salt or tea. Labour can also be offered in exchange for goods.

A small number of the communities visited are almost exclusively dependent upon subsistence agriculture, based upon the cultivation of rice, for their livelihoods. However, in many areas the majority of communities are involved, to a limited extent, in the cash economy. This is due to the increasingly important role of cash crops as a supplementary source of income to small-scale subsistence farmers, and to the general rise in opportunities for wage labour.

Rubber is the longest established cash crop in Sarawak and the cultivation of pepper is now also fairly wide-spread. In areas closer to town many rural households have taken advantage of government subsidies to start small plots of cocoa.

A major limiting factor on the potential for increased involvement in the cultivation of cash crops is the inaccessibility of markets for many of the more remote communities. This is particularly a problem in upriver areas such as Belaga District. Furthermore, cultivation of cash crops is by no means a guaranteed source of steady income because of the vagaries of the primary commodity export markets. In addition, cultivation of fruit and vegetables for selling is rarely deemed to be economic and then only in the few villages with ready access to guaranteed markets.

Water buffalo are calculated to be the most valuable potential sources of income for many families in the Bakelalan area. The buffalo are brought over the border from Indonesian Borneo and play an important role in the cultivation of wet paddy. Regular expeditions are made to walk the buffalo down to Lawas where they can fetch between M$ 1,100 and M$ 1,800 a head.

A number of communities in the interior areas such as Belaga District derive the largest proportion of their income from the sale of wild meat, such as deer and wild boar, and fish. The game is stored in electric freezers owned by a travelling merchant from which it is collected at regular intervals.

Established markets also exist for certain valued jungle products, such as rattan and illipe nuts, and to a lesser extent for hand-crafted items, such as mats and bags, derived from jungle produce. A number of varieties of wild fruit, *e.g.* durian, provide a short-lived and seasonal, but sometimes lucrative, income for those communities with the necessary access to markets.

Fishing and farming communities alike are both accustomed to large seasonal variations in their cash income. Casual or short-term contract wage labour, where this is available, plays an important role in providing an alternative source of income at such times. The most common sources of employment are to be found in timber camps, on government agriculture schemes or on larger more commercially oriented farms, as in Sarikei District.

5.3 Organisation and leadership forms

Each community exhibits a leadership structure peculiar to the culture and traditions associated with their particular ethnic group. The communities of the villages studied ranged from those with a hierarchical social structure to relatively egalitarian societies. However, in many villages the authority of the traditional village head has to some extent been superseded by that of the politically appointed Chairman of the Village Development Committee. In some communities the Chairman is chiefly concerned with coordinating development projects and changes taking place in the village, whilst the headman is still responsible for the cultural life of the community and for such matters as settling disputes. Ultimately the actual roles adopted, the balance of power and the effectiveness of the resulting leadership are largely determined by the personalities of the individuals involved.

The extent of exposure of a community to outside influences has some bearing on its organisation and leadership. The distance of a village from a town is again a factor

and visits from outsiders such as District office staff, agricultural extension workers or politicians do play a role. Over a period of time the fact that the children go away to boarding school, especially if there are many going on to secondary school, alters the priorities and expectations within the community. School pupils are often instrumental in transmitting religious influences to the more remote communities.

The Malay tradition of *gotong royong* (loosely translated as "working together") has been adopted by the authorities to describe development initiatives in which the community involved takes responsibility for providing the labour and possibly some of the organisation. However, in reality there is a high level of government involvement in almost all development initiatives. In the more accessible villages it was rare to find development projects which had been undertaken solely on the initiative of the community and using their own resources. In such villages only the occasional group effort to, for instance, clear an irrigation channel or build a plank-walk was reported. However, the more distant villages were obliged to rely more upon their own resources and were consequently judged to be more self-reliant both in their own eyes and the opinions of local development officials. Some of these communities still adhere very strongly to traditions of cooperation and assistance founded on tribal customs, whereas in the less remote communities such traditions are often losing prominence in the interests of modern technological innovation and individual progress.

5.4 Development initiatives

Village development initiatives take a number of different forms. Many of the individual projects are initiated by external agents, although this often follows a formal request made by the Chairman of the Village Development Committee to the District Office or a visiting dignitary. The majority of such development initiatives

are construction projects. These range from the building of small churches, mosques or community halls through to bridges, jetties and even badminton courts. Village access roads, paddy threshers, small generating sets and building materials are also included under the Minor Rural Projects umbrella, as administered by the State Development Office.

One of the furthest-reaching development programmes is the Medical Department's drive to ensure that every village has a clean water supply. The Department has worked together with the community in each case, and as a result simply constructed gravity-feed water supplies are to be found in even the most remote villages. All of the villages that were visited during the study had a piped water supply of some description, with only one out of order requiring major repairs.

Apart from construction projects, the other main field of development initiative is concerned with agriculture. Most of the farming communities reported that members were involved in schemes run by the Agriculture Department. Cocoa and pepper schemes facilitated the distribution of seedlings and fertilizer at subsidised prices. There were also several projects to replace existing rubber trees with the new higher yielding variety.

Comprehensive networks of primary schools and health clinics cover rural Sarawak and are run and maintained by the Education and Medical Departments respectively.

5.5 Energy needs in villages

The predominant cooking fuel is firewood, and few of the communities reported any difficulty in acquiring sufficient quantities to meet their needs. Gas and kerosene stoves are used in some of the more accessible villages, by those who can afford them. However, although users of such stoves often referred to the increased

convenience of commercial fuels, a majority also pointed out the superior taste associated with food cooked on a wood fire.

For those without electricity, lighting needs are met in general by kerosene lamps and occasionally by pressure lamp. The poorer households use fewer lamps but many households, including those in villages with generators, leave a single lamp burning as a night light. In all the villages there is extensive use of small dry batteries for torchlights and to power radios and combined cassette players.

Motive power is generally provided by diesel engines for pumping (irrigation or crop spraying), circular saws and rice mills. They are also used as prime movers for alternators to supply electricity for a limited number of hours in the evening. Sometimes the same diesel engine is connected up via a drive belt, to operate an alternator, circular saw or rice mill. Smaller motors (petrol or diesel) are very much in evidence to drive chain saws or as outboard motors, in villages located on a navigable river.

5.6 Electricity supply

A summary of the type of electricity supply, if any, available in each village in the study is presented in *Table 14*. Included in the information presented is the year in which the the supply was installed or became non-operational.

To summarise, of the twenty-two villages included in the study:

- 7 villages were supplied with electricity by SESCo;
- 5 villages had functioning generator sets which had been provided by the Government, although at the time of the visit three were not operating since the diesel had run out;

Table 14: *Type of electricity supply in the selected villages.*

District	Village	Type of electricity supply
Lubok Antu	Rh. Sunok, Nanga Stamang	SDO generator (1981*)
	Rh. Nisau, Panjai Ruai	SESCo (1987*), preceded by SDO generator (1983*)
	Rh. Rabong, Sebangki Panjai	SDO generator (1979*), broke down (1985†), some households with commercial supply.
	Tinting Lalang	SESCo (1986*), preceded by SDO generator (1984*)
Serian	Rh. Saong, Sg Enkabang	Some households with commercial supply/private generators
	Kg. Jerok	" "
	Kg. Talagus	" "
	Kg. Tangga	SESCo (1985*)
	Kg. Munjau	Some private generators
Lundu	Kg. Stunggang Melayu	SESCo (1980* and 1982* for each side of the river)
	Kg. Pueh	SESCo (1988*)
Lawas	Buduk Nur	Micro hydro (1990*) using alternator from SDO generator (1985*)
	Buduk Bui	SDO generator (1987*) - no fuel
	Long Langgai	SDO generator (1987*) - no fuel
Sarikei	Kim San Road	SESCo (1987*)
	Rh. Jimbai	One household with SESCo supply (1989*)
	Rh. Pak	SDO generator (1989*)
	Rh. Tutang	SESCo (1989*)
Belaga	Uma Kulit, Long Jawe	A few households with supply from Church generator
	Uma Lesong, Batu Keling	SDO generator (1980*), broke down (1985†)
	Uma Ukit, Long Ayak	4 households with own generators
	Uma Lahanan, Long Pangai	SDO generator (1980*), broke down (1987†)

Note: Shown in brackets is the year of either installation (*) or of breakdown (†).

- 3 villages had non-functional generator sets provided by the Government;
- 7 villages had no official electricity supply, *i.e.* neither SESCo connection nor a Government-provided generator set.

Altogether ten villages were without electricity supply and another three had no fuel for their generators. However, in all of these villages at least one household operated a private generator or paid a nearby shop-owner for an evening supply from a diesel generator. The various types of electricity supply available in the villages, their establishment, management, costs and associated problems are described in more detail in the following three sections.

5.7 Public electricity supply

Those villages served by a SESCo public electricity supply tend to be reasonably easily accessible *i.e.* located near to roads or towns. Of the 22 villages included in the study, seven were supplied by SESCo. In these villages almost all occupied living quarters had been connected except in the cases where new houses were in the process of being built, such as in four of the villages in Serian District.

5.7.1 Connection to a SESCo supply

In all of the villages without electricity, those members of the community who were interviewed wanted a SESCo supply to be installed as soon as possible. Requests had often been made through the District Office, political representatives or even direct to SESCo. However, it was generally recognised that applications could take a long time and that those far from transmission lines or substations could expect a very long wait. Once funding had been approved and the project was underway, a

sense of anticipation prevailed.

In contrast to a diesel generating set project, communal contributions of money or labour are not normally required. Occasionally villagers may be engaged by the contractors to clear land, but they are often paid for their labour.

The usual wiring arrangement covered by the Assisted Wiring Scheme (AWS) loan is for three lighting points and two or three power points. Few villagers elect to exceed this configuration, as the cost of any further points is charged immediately. A meter is installed outside the front door of the living quarters of all the households taking part in the scheme, and connection is carried out once a collateral deposit has been paid.

5.7.2 Costs

The vast majority of rural SESCo consumers reported bills amounting to the minimum charge of M$ 4 plus the monthly AWS payment (typically M$ 10.00), for the first three years. A few of the more affluent consumers were paying up to M$ 30 per month.

Before each household can be connected to the newly installed supply, payment of a collateral deposit is required. The level of deposit is related to the average expected monthly bill. This will vary between districts and in the poorest areas a charge of M$ 60.00 is levied.

A number of people had experienced difficulties in paying even the minimum charge at times of low cash income. Some consumers, surprised by the relatively large initial bills, had eventually responded by cutting back on their electricity use.

5.8 Government-provided village generators

Generators provided by the State Development Office had been installed in ten of the 22 villages included in the study. Two of these villages had since been connected to the SESCo public supply and their generators were no longer in use. Three of the generators had suffered major breakdowns and were considered to be beyond repair and five were still operational. However, at the time of visiting, diesel stocks had been exhausted in three of the villages and there was consequently no evening supply.

5.8.1 The diesel generator as a development project

After requests made by village leaders to the District Office, local political representatives or even Government Ministers, funds may be made available for a village generating set. Funds are granted according to the size of the community, which determines the necessary maximum capacity of the generator and also according to the amount of wiring required. A longhouse settlement will involve the least wiring, whereas the cost of wiring the more scattered housing arrangement in a kampung becomes progressively more costly as the distance between living quarters increases.

By the time that the necessary funding allocation has been approved, the declared number of participating households is liable to have changed (and normally increased). Consequently it is sometimes necessary to find extra money to cover the discrepancy between the supplier's final estimate and the original allocation. This can cause disappointment and result in an even longer delay but often, if the villagers have the financial resources and are motivated enough, each household will contribute towards making up the shortfall.

An adequate construction to house the generator constitutes an additional expense. Sometimes the cost of building materials can be met by the government but usually the work is carried out by the villagers. The supplier who installs the generator and carries out the wiring is required, as part of the contract, to demonstrate operation and maintenance procedures to the villagers, who often have had no previous experience of engines or generators.

5.8.2 Management of the diesel generator

In many villages, as is usually the case for any "development projects", a special village committee is set up to oversee the management of the generator. A member of the community who has some technical experience or aptitude and who is willing to take on the job may be appointed as an attendant and paid a small salary. However, the majority of villages instead arrange a rota of duty amongst the households, usually for a week at a time. Frequently the operator has no real experience or training.

Responsibility is usually limited to first-line maintenance, *i.e.* topping up the oil and water, starting the engine up at the beginning of the evening and turning it off at the end. The hours of operation are typically from six or seven o'clock in the evening until nine or ten. However, on special occasions, or if important visitors are present, the times are often extended. A common innovation is to attach a long piece of wire or string, leading back to the longhouse, to the fuel supply valve on the diesel engine. This allows the operator to shut down the generator without the inconvenience of having to find his way back from the powerhouse in the dark.

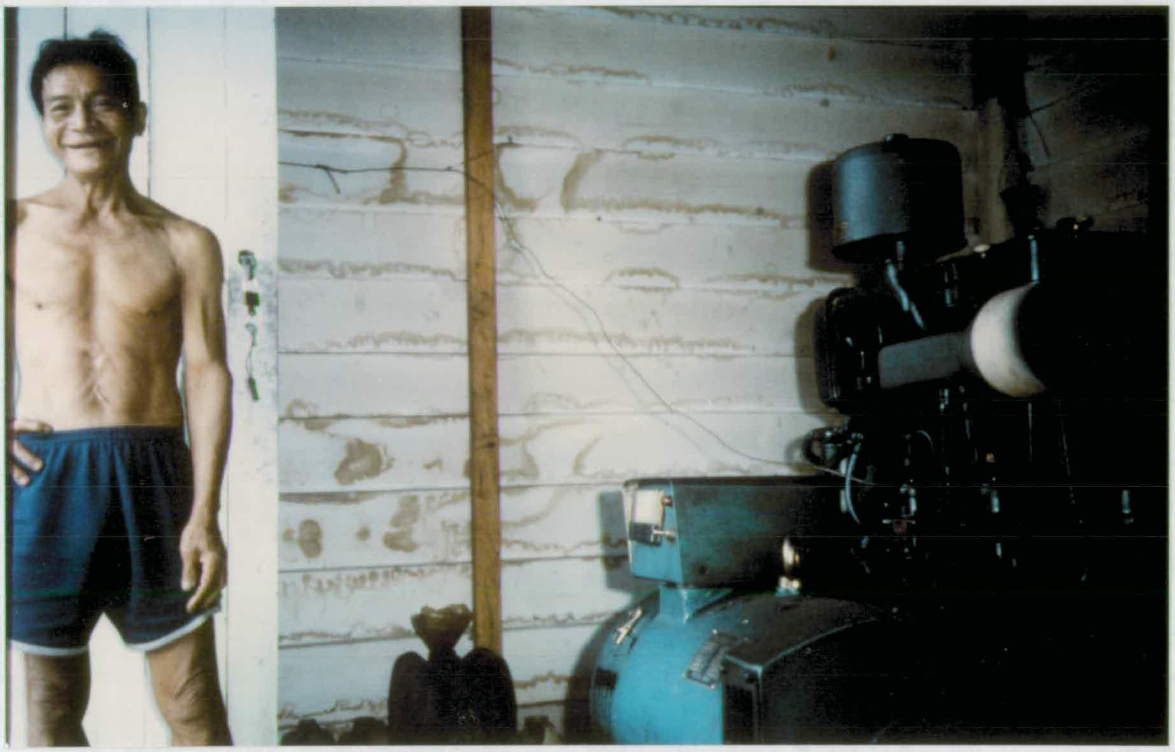

Fig. 18. *Photograph of the village generator (7.5 kW Petter) at Rumah Pak, Bintangor.*

Payments are made monthly, or as necessary, to the committee. In at least one of the longhouses visited, the children had been made responsible for collecting the money from each household, or *door*, as it is commonly known. Someone travelling to town is then delegated by the committee to collect the diesel. Often there is a flat charge per door, although in a couple of villages this has been changed to a charge per functioning bulb, after a number of bulbs had blown and since people could not always afford to replace them.

5.8.3 Problems encountered by the villagers

There have been reports of sub-standard or faulty wiring carried out by careless contractors and of repainted second-hand generators sold as new. However, the majority of problems are caused by lack of technical expertise and limited financial resources to cover the inevitable but often unanticipated costs of repairs. Overloading over a period of time leads to a steady deterioration in the performance of a generator and ultimately to a shortened lifetime.

Breakdowns have also been reported due to severe overheating when cooling water was allowed to run out and, on more than one occasion, when the power house was flooded. If there are repeated breakdowns requiring even minor repairs the generating set soon becomes a financial burden to the community. After being asked to contribute to the cost of repairs once or twice, the villagers lose enthusiasm and confidence in the reliability of their electricity supply. Long periods of disuse due to undealt with breakdowns or lack of fuel lead to a further deterioration in the condition of the generator.

5.8.4 Costs

In theory the capital costs associated with installing a Government-provided generating set are borne by the Government, although occasionally a community can be asked to find additional funds to cover an unexpected shortfall. The principal financial commitment of the community consists of paying for fuel, possibly for maintenance and almost certainly for repairs following a breakdown.

Flat rate monthly payments to cover the cost of fuel typically ranged from M$ 3 to M$ 5 per household. In the cases where instead a charge was made per lighting point the range was from M$ 1 to M$ 4. In one longhouse these monthly payments also covered the wage for an operator and the charge was M$ 10 per household.

Diesel costs vary considerably according to the distance of the village from the supplier, the difficulty of access and also distance from the nearest large town. In Bakelalan, diesel is transported by a plane chartered by the cooperative to deliver rice for sale and to bring back goods for the store. This adds substantially to the cost of the fuel.

In the event of breakdown the cost of repair is split between the households. If the amount of money needed is so great that not everyone is prepared or able to contribute, representations may be made to the authorities for assistance.

5.9 Commercial generators

A common characteristic of the longhouse and kampung communities visited in the Serian and Lubok Antu Districts was that a number of them had moved their village to be nearer to a road. Subsequently, a number of small general stores have started up at the road-side in close proximity to the villages. From there they are in an ideal

position to generate trade both from the nearby community as well as from passers-by. Many of the general stores operated a small diesel generator to supply electricity for the shop itself. Typical applications included lighting, refrigeration and possibly fans and a television set. In a significant number of cases the owner of the shop had subsequently extended distribution lines to the nearby village in response to an obvious demand. In half of the villages visited in the Serian and Lubok Antu Districts a small number of households had been wired up to receive an electricity supply for a few hours each evening.

The charge was normally per lighting point per month and varied from M$ 5 to M$ 6. It was not unusual to see a fluorescent tube protruding from a hole in the front wall of the apartment to provide light for both the verandah and apartment.

5.10 Private electricity supplies

In most villages where there was no official electricity supply, a few of the wealthiest households had acquired their own small generators. These tended to be families who had higher disposable incomes due to their greater level of participation in the cash economy. Privately-owned generators are obtained from a variety of sources and the cost depends very much upon where they were purchased. Small, self-contained, Japanese-made sets running on petrol, suitable for supplying one or two households, were the most common. The purchase price ranged from M$ 850 for a 500 W set in Serian to M$ 1,100 for a 600 W set in Kapit.

The most expensive petrol cost M$ 10 a gallon in Long Jawe. The amount of petrol that is required depends upon the rating and efficiency of the machine as well as the load and the number of hours of operation each day. Most private generating sets were used for a few hours in the evening to supply electricity for lighting and possibly to operate a television set if the television reception was good enough. In

remote areas where petrol might not be easily obtainable or when there is a shortage of cash these small generators lie idle.

It was noted that in a small number of villages, where the inhabitants derived small irregular or seasonal sums of cash from wage labour activities or from the sale of cash crops, there was limited use of 12 V car batteries to provide minimal lighting and to run a television set. This system allows users to make use of cash as it becomes available and at other times does not cause a drain on their limited financial resources.

5.11 Bakelelan micro hydro scheme

In this section, an innovative independent electrification project is described. The village initiated micro hydro scheme at Bakelalan is an unusual example of grass-roots driven development.

Diesel generators are very expensive to run in this remote and mountainous region of Sarawak, due to the high cost of transportation of fuel. Interest in building a hydro scheme developed following a visit by a foreign consultant who was under contract to SESCo to assess the hydro potential of the area. It was not found to be economically viable for SESCo to build a hydroelectric scheme to supply the cluster of villages in the Bakelalan area as originally proposed. Inhabitants of the village of Buduk Nur subsequently took matters into their own hands and sought assistance from an Indonesian technician who had experience of building village-sized hydro schemes in Kalimantan. Although the design was hardly conventional and progress was made largely on a trial-and-error basis, a high level of cooperation was achieved and the result was, ultimately, adequate to meet the electricity needs of the community.

The scheme makes use of the alternator from a 10 kW diesel set provided under the small generator programme five years previously. The Chinese-manufactured cross-flow turbine was purchased from an Indonesian supplier by the technician. Twenty 44-gallon oil drums, which had originally been used to transport diesel fuel from Lawas, were welded together to form the penstock. The casing for the turbine was also crafted from part of an oil drum. The scheme was initially designed to operate under low head (6 m) since a high flow rate was estimated. Subsequently hydrological conditions were found to be more appropriate for a high head scheme (40 m), and the original penstock replaced with 10 cm diameter PVC piping, similar to that used for gravity-feed water supplies.

Due to its low generating capacity of under 3 kW, the scheme presently only supplies power for the lighting needs of the 56 households and church in the village of Buduk Nur, each household having at most three or four fluorescent strip lights rated at 20 W. The entire scheme was initially projected to cost M$21 000, although the subsequent purchase of appropriate transformers has probably increased the cost to some extent. An approximate value for the cost per household can be estimated at M$ 375, bearing in mind that the alternator had been originally provided by the government as part of the diesel generator set.

Fig. 19. *Photograph of the micro hydro plant in operation, Bakelalan.*

Fig. 20. *Photograph of the the first transformer to be installed at the village of Buduk Nur at Bakelalan.*

5.12 Costs of alternatives to electricity for lighting

By far the most universally used lighting fuel was kerosene. Once again prices varied considerably with distance and difficulty of access. Near to the town of Serian, villagers quoted 50 sen per bottle (slightly less than a litre) as being the standard price, whereas in Buduk Nur at Bakelalan the cooperative charged M$1.90 per bottle.

One large and relatively affluent Kayan household reported that they used between 20 and 40 litres per month. However, 10 litres per month was a normal level of consumption and poorer households could make do with even less.

There were not many pressure lamps in use. These were usually only brought out on special occasions for large gatherings of people when a large area of floor space needed to be lit.

5.13 Uses of electricity

By far the most significant use of electricity is for lighting. The number of bulbs in use varies according to the wealth of the respective household. This is often due to the cost of replacing worn out bulbs rather than a difference in the the number of lighting points installed, which tends to be the same for each household except for extremely wealthy exceptions. It was noted that even where switches existed, *e.g* as in the case of SESCo supply, few consumers thought to switch off lights which were not needed.

Television sets are the most common appliance, followed by radio-cassette players, irons and fans. Only a very small number of households possess rice-cookers or refrigerators. The incidence of appliance ownership is related to the wealth of

individual households as well as to the accessibility of the nearest main town. However, it should be noted that the number and variety of appliances in a village are almost always greater where there is a mains supply rather than a village generator set. In some cases this is because the capacity of the generator set is only enough to support lighting, and the wiring arrangements are mainly limited to providing lighting points and very few power points.

Those households possessing their own small generator sets often run a television set. Where there is no generator, television sets are sometimes run off car batteries. Batteries are also used for radio-cassette players and electric torches. The longhouses visited in Belaga District use their power supply exclusively for lighting. Although one incident of television ownership was reported, reception is apparently so poor that this is hardly used.

It should also be noted that mere ownership of a refrigerator or rice cooker does not necessarily mean that it is in regular use. In practice most of the few rural households owning such luxury appliances have been given them by relatives living in town and have discovered that the resulting electricity bills are prohibitive.

Small-scale or cottage industries are currently very undeveloped in Sarawak. Consequently electricity is mainly used for domestic purposes. However, local businesses, which normally take the form of a general shop, as well as acting as middlemen in the sale of agricultural produce, often run deep-freezers and lighting from their own generators if there is no SESCo supply.

A few of the wealthier farmers in the Kim San Road community have found innovative productive uses for electricity following the completion of a "Gotong Royong" project for their area. Electricity is used to power a small home-made pepper threshing machine and also for the incubators used in the more intensive rearing of livestock.

5.14 Perceptions regarding the role of electricity in the village

Views expressed during the interview sessions by members of the communities in the selected villages are summarised in the following sections.

5.14.1 Relative importance accorded to electrification

In general the issue of whether, or when, the village could be electrified assumed low priority compared with other concerns of the community. A major problem for many communities was their low level of cash income. More specifically, low cocoa, pepper and rubber prices, the inaccessibility of markets and the lack of opportunities for paid employment were quoted as matters of great concern. The disappearance of fish or game from the area and poor rice harvests were also mentioned.

The construction of a village access road or the setting up of an agricultural scheme were often cited as development projects which would bring most benefit to the village. However, members of a few communities stressed that the installation of an electricity supply would be their next priority following the construction of an access road.

A number of communities in Serian District were planning to apply to SESCo for installation of supply in the near future. However, since a large number of households were currently occupied with the lengthy operation of constructing new dwellings, electricity supply was not yet high on the agenda.

5.14.2 Advantages and disadvantages of the various supply forms

Generally a great preference was expressed for a SESCo supply over all other forms. Indeed there has been a recent example of a Village Development Committee refusing to accept a generating set project for which the funds had already been

approved, instead insisting that the community wanted a SESCo supply (SDO 1989). The following were viewed as the advantages of a SESCo supply:

- individual control is possible;
- there is no restriction on the type or number of appliances that can be used;
- the supply is in general reliable and available at any time of the day;
- it is never necessary to contribute towards the cost of repairs.

No disadvantages were quoted, although it was mentioned that some families found payment of bills difficult during seasons of low cash income. Some farmers, whose entire households spent periods of peak agricultural activity living in temporary farm huts far from the village in order to be nearer to the fields, expressed resentment that the monthly minimum charge was payable despite negligible electricity consumption.

However, those communities who were operating a Government-provided generator and for whom there was no prospect of connection to a SESCo supply usually felt that their supply was quite adequate, unless there had been a history of breakdowns. In one of the villages where a generating set had been installed, fears were expressed over the risks of fire and electric shock.

5.14.3 On the introduction of electricity to the village

Those interviewed felt that by far the most significant benefit of electrification had been the better quality of lighting available. A small number of communities with village street lighting cited improved confidence and security as a beneficial side effect.

The next identified benefit of electricity was in providing the power to run a television set. Increased knowledge and awareness of Malaysia and the rest of the world were often quoted as important changes within the community. It was also claimed that the unprecedented exposure to *Bahasa Malaysia* had significantly improved the standard of the national language, especially amongst the young people.

However, it was felt that television sets reduced the level of socialising on the verandah in the evenings. Mention was made in a few villages of the fact that children now watched television instead of studying.

Few other changes were noted. Instead it was frequently claimed that not much could change since the villagers had no money for appliances and would only use the electricity for lighting anyway. However, when asked why the community wanted electricity, a significant number of responses were to the effect that rural communities would like to benefit from the advantages of electricity in the the same way that they knew town-dwellers were able to.

5.15 Summary

A number of socioeconomic factors are of great significance in determining the role of electricity in the village. Of key relevance are the location and accessibility of the village, the size and form of settlement and any changes which may be taking place in the local population profile. The extent of involvement in the cash economy dictates, in the case of a SESCo supply, initially whether connection is possible and, subsequently, the level of use affordable. In the case of supply from a village generator, availability of cash also effects the ability of a community to cope with fuel, maintenance and repair costs. In particular, the effectiveness of organisation and leadership forms and the previous exposure of a community to development programmes determine its preparedness to take an active, or even initiating, role in

development projects. These factors have great bearing on the success or failure of a village autogenerator project. By contrast, minimal involvement of the community is required for connection to a SESCo supply, although cooperation is essential in resolving associated disputes over land or crop compensation.

An assessment of the energy needs of rural communities in Sarawak reveals that they are mostly limited to: firewood for cooking, kerosene or electricity for lighting and batteries for torchlights and radio-cassette players. Diesel is widely used to fuel small combustion engines which drive pumps, rice mills, circular saws and power small boats.

Existing electricity supply arrangements in the villages studied included SESCo supply, government-provided village generator sets, private generators operated by individual households, commercial supply provided by a nearby shopkeeper and a micro hydro scheme which had been installed at the initiative of the villagers of Buduk Nur. Use of electricity was mostly confined to lighting of living quarters and running of television sets, radios, fans and irons. Consumption was limited by both the cost of appliances and also by the expense of running them.

Generally there were more problems and most dissatisfaction with the government-provided generator sets, for which there was little technical or financial backup. Running costs for a generator set varied considerably according to the degree of remoteness and accessibility of the village. Monthly tariffs for a commercial supply and SESCo connection were both considered to be expensive, however there were no maintenance or repair worries or costs associated with this form of supply. It was noted that although dry cell batteries were the most expensive option, consumption could be most conveniently matched to the availability of cash.

Chapter 6:

COMMERCIAL AND INDUSTRIAL USE OF ELECTRICITY IN RURAL SARAWAK

The commercial and industrial applications of electricity in Sarawak are relatively undeveloped, especially in the rural areas. However, the experiences of other countries has shown rural electrification programmes to be most economic in a productive context (World Bank 1975, 3), since domestic consumption is generally very low.

In this chapter the state of rural industry in Sarawak is reviewed and assessed in relation to the level of infrastructural development, in particular public electricity supply. The prospects for a wider use of electricity in rural areas, where the consumer structure is currently dominated by the household sector, are examined. Data and examples pertaining to the Districts of Lundu, Serian, Lubok Antu, Sarikei, Belaga and Lawas have been used in the chapter. These six Districts have been chosen to reflect the broad range of rural circumstances existing in Sarawak. An outline of the main demographic and geographical differences between the Districts is given in Section 6.1.

6.1 District Profiles

The six Districts featured in the study display a wide range of geographical characteristics, examples of which are: geographical location, size and distribution of population, key economic activities, significance of physical and economic linkages and the extent to which the District can be described as "rural". This section presents a short summary of the distinctive characteristics of each District.

6.1.1 Population

The population profiles of the selected Districts for 1989, together with the relevant figures for the whole of Sarawak, are contained in *Table 15*. The relatively large size and low population density of Belaga District are immediately apparent. The Districts of Sarikei and Serian have the greatest number of inhabitants and are the most densely populated.

Table 15: *Population characteristics of the six Districts in the study.*

District	Population ('000)	Land area (sq km)	Population density (Persons per sq km)
Lubok Antu	26	2,338	11
Serian	83	2,040	41
Lundu	27	1,812	15
Lawas	25	3,812	7
Sarikei	55	1,716	32
Belaga	15	19,403	1
Total Sarawak	**1,626**	**124,450**	**13**

Source: Statistics 1989

6.1.2 Communications

Figure 21 shows the location of each District and the corresponding administrative town as well as other main towns in the State. Not only the proximity to large towns but also the quality and existence of roads between towns and within the District are of economic and political significance.

The towns of Serian, Lubok Antu and Lundu can all be reached from Kuching within a day, on roads of varying quality. The port of Sarikei is easily reached by road from Sibu or by express boat from Kuching. The town of Lawas lies in isolation in the far east of Sarawak, close to the borders both with Sabah and Brunei, and Belaga town is usually approached by river from Sibu, although unmaintained logging roads can be used outside the rainy season.

However, the population of Sarawak is essentially rurally based and in all Districts there are many villages which cannot be reached by road, necessitating travel by boat or, in the absence of navigable rivers, a long walk. This is particularly the case in Belaga District where there is no road network and the longhouses are situated at great distances from each other. Villages in the highlands of Lawas, longhouses upstream of the Batang Ai hydro scheme and coastal kampungs in Sarikei District are also far from the limited road system.

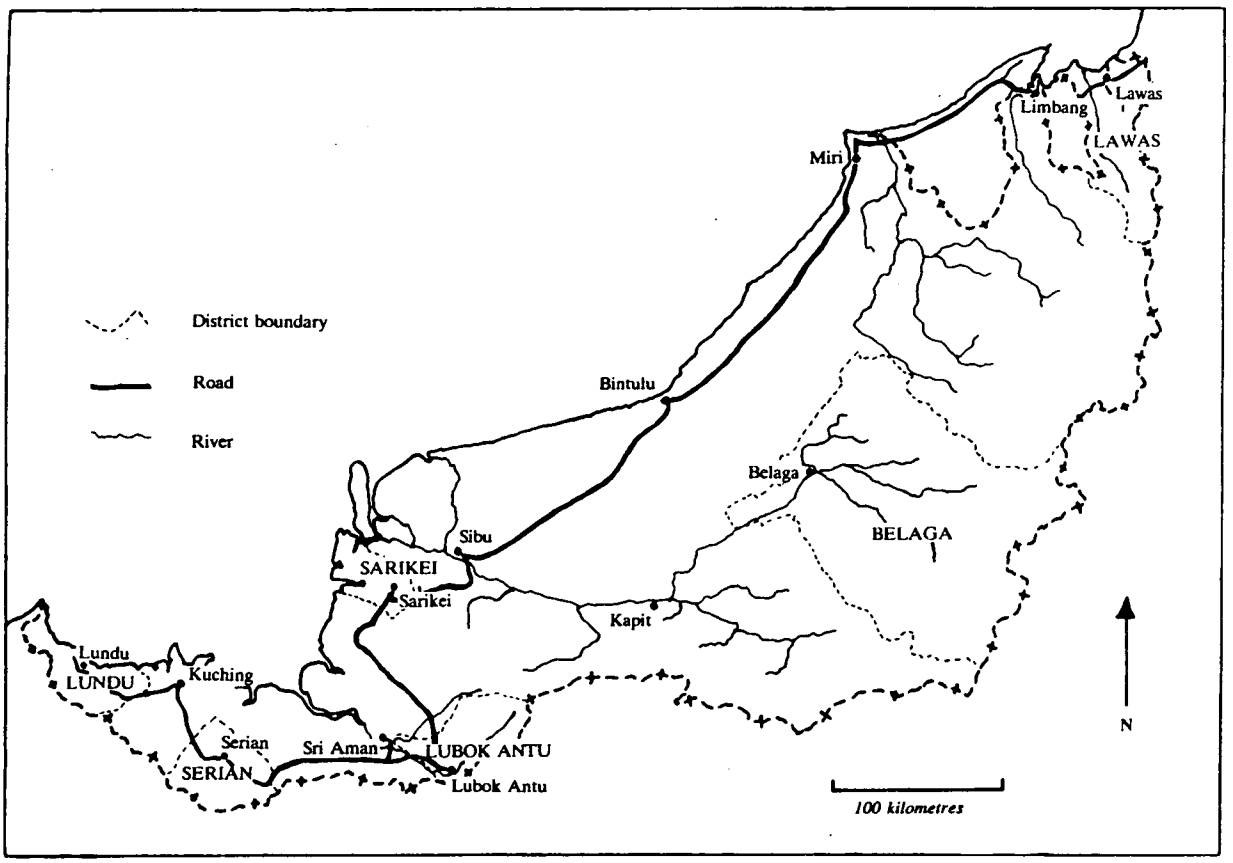

Fig. 21. *Map to show important towns and lines of communication in relation to the six selected Districts.*

6.1.3 Rural nature of the Districts

A comparison of the degree of rurality exhibited by the six Districts is shown in *Table 16*. This is a fairly rough representation, given that it relies on the latest available census figures to indicate the proportion of the local population residing outside the official boundaries of towns and bazaars. In addition, a further indication of rurality is given by the proportion of the population involved in agriculture (see Vu 1960), and here again the latest available figures derive from the 1980 Census.

Table 16: *Rural characteristics of the six Districts in the study.*

District	Out-of-town population* (%)	Population involved in agricultural industry** (%)
Lubok Antu	89	86
Serian	94	84
Lundu	87	77
Lawas	96	71
Sarikei	58	62
Belaga	94	89
Total Sarawak	**70**	**63**

* Population living outside the boundaries of towns and bazaars.

** Includes hunting, fishing and forestry

Source: Statistics 1987.

The table shows that only a small minority of the population lives in towns or bazaars and a high percentage of the working population is involved in agriculture.

Only in the District of Sarikei, where there is more involvement in trade and commerce, do both these figures dip below the State averages.

6.2 Industrial Development of the Rural Areas

The state of commerce and industry in the rural areas of Sarawak is examined in this section.

A short account is given of the basic agricultural processing which currently takes place in villages across Sarawak. Larger scale industrial enterprises are normally located in towns or on main roads and examples of specific developments are taken from the six Districts focussed upon in the study.

6.2.1 Village-based commercial activities

In Sarawak the most important village-based cottage industry has traditionally been the manufacture of a wide variety of handicrafts, for example weaving of mats and baskets from rattan, beadwork, wood carving and weaving of textiles. The raw materials used are normally gathered from the forest and may require drying, cutting, dyeing and heating on a small scale before work can start on the weaving and carving. The finished products may be kept for their cultural significance but, traditionally, there has always been trade between different cultural groups, many of which have developed their own specialisations in a particular craft. These craft products are also highly valued by town-dwellers and, in addition, are becoming popular tourist items.

Following the introduction of cash cropping to the subsistence way of life, basic processing of agricultural produce is also carried out in the villages, prior to selling

to the dealer. After tapping, the rubber latex is rolled into sheets through a mangle and then hung out to dry in the sun. Smoking was often carried out by the local dealer in the nearest town or bazaar. However, it is becoming increasingly common for farmers to collect and coagulate the latex in plastic bags supplied by the dealer, who sells the unprocessed latex directly to the factory. This measure has been introduced by the rubber manufacturing companies in an attempt to improve and control the quality of the rubber produced by the many smallholders involved in the industry.

Both pepper and cocoa crops require some basic processing before they are sold on to the dealer. The cocoa beans are fermented in sacks before being dried in the sun. Pepper is also dried in the sun, although in order to make white pepper the outer layer must first be removed by soaking the seed in water. Crops such as coffee and tobacco, which are produced primarily for the consumption of the villagers are also dried. Crop-drying is normally carried out by spreading the produce out on a large rattan mat in the sun, regularly raking it over and quickly bringing it inside in the event of rain. The task is normally carried out by older people who are no longer able to work in the fields.

Most rice-growing communities in rural Sarawak now have access to a padi mill. This mill may be operated by a nearby shop owner, privately owned by a member of the community or the results of a Minor Rural Project. Systems of payment depend on the availability of cash or goods for barter. In some villages a share of the rice is given to the miller and in many cases the bran can be used as part-payment.

Fig. 22. *Photograph of family padi mill operating at Bakelalan.*

Fig. 22. *Photograph of family padi mill operating at Bakelalan.*

6.2.2 Small and medium-sized industries

Existing industrial ventures in rural areas can be classified into four categories, as follows:

(i) large-scale processing of agricultural produce;

(ii) saw mills for the processing of logged timber;

(iii) small enterprises connected with the processing and packaging of food products;

(iv) one-off projects making use of a particular occurrence of a natural resource.

Falling into the first category are the oil palm mill and SALCRA cocoa scheme processing centre in Lubok Antu District and the rubber mill at Meradong, near to Sarikei. These three examples are all associated with State-run agricultural development schemes which it was expected could supply the mills with sufficient and regular quantities of the harvested crop for processing to be economic.

Large-scale private enterprises which are independent of agricultural schemes are normally situated close to town and obtain their supplies of raw produce via middle-men. In the case of the rubber mills, they are often able to offer higher prices to the small-holders and consequently the mills run by the State land agencies have sometimes been unable to secure adequate supplies of the crop.

There were 58 saw mills in the State of Sarawak in 1988 (Department of Statistics, 1990). Since the rivers provide the main routes for the transportation of timber from the logging areas, many of the saw mills are situated on the banks of major rivers and close to ports for easy access to export facilities, as in Sarikei District.

Examples of small businesses involved in the processing and packaging of food products include ice factories, which are of prime importance to the fishing industry;

seafood exporting businesses, as are to be found in Sarikei town, and coconut drying factories producing copra for export. A modern sago processing factory owned by the Sarawak Economic Development Corporation (SEDC) operates in the Mukah area where the manufacture of sago products has long been an important cottage industry.

Unusual industrial development projects include the SEDC silkworm project in Lundu District which incorporates a mulberry bush plantation and aims to eventually involve the local farming community in the rearing of silk worms. The State's only tea plantation and factory is run by a subsidiary of the SALCRA land development agency in the District of Serian.

Mining and quarrying operations are dependent on the existence of exploitable deposits of minerals and generally require good communications and infrastructure to be viable. A silica sand mining concern is currently being set up in Lundu District and elsewhere in the State gold and coal are also mined.

6.2.3 The commercial and service sector

Shops selling almost identical ranges of basic foods and consumer items proliferate in the many bazaars and small towns scattered throughout Sarawak. They are also the business headquarters for the traders and dealers who provide the first link between the cash crop farmers and the export markets. As well as food staples these stores often also sell fertilizers, pesticides, farm equipment and tools.

Local offices of the various government departments such as Agriculture and Public Works as well as SESCo and the District Office are present in the administrative towns. In the larger towns there are often small hotels, the better class of which, increasingly, are able to offer air-conditioned rooms.

6.3 Energy Requirements of Industry

The energy requirements of the various industrial activities which take place in rural Sarawak are described in turn. Examples are drawn from the six Districts featured in the study and specific details of typical electricity requirements are presented for a range of industrial ventures.

6.3.1 Cottage industry

The energy requirements of village-based commercial activities are limited to:

- sun for crop drying
- fuelwood for fires used in the processing of some natural craft materials
- diesel or petrol for small combustion engines used to power padi mills, circular saws and occasionally crop-sprayers.

However, the availability of transport ultimately determines the level of participation of many rural communities in the cash economy. Depending on the location of the village in relation to the market or the existence of travelling traders, the requirement for transport fuel varies. In the highlands of Lawas District sacks of rice are transported to market by small airplane and the only means of communication between the markets and the upriver settlements of Belaga District is by longboat using an outboard motor. In both these cases the availability and cost of fuel have crucial implications for the economy of remote villages. In the Districts of Serian and Sarikei, villagers residing close to the main road are able to make use of the local bus service to reach the nearest market or may even share the cost of a journey in a truck or van owned by a member of the community.

6.3.2 Oil palm mills

Oil palm mills are generally self-sufficient in fulfilling their own energy requirements through the utilisation of waste products of the milling process. At present fibre and shell are burnt to provide high pressure steam for process heating and to generate electricity. It has been suggested that greater use could be made of the energy resources available in the mills (Corvinas 1987, 15). In particular the palm oil mill effluent could be used to produce biogas for electricity generation, simultaneously reducing pollution, and use could be made of the heat produced when bunch is burnt to obtain ash fertilizer. However, there is currently little incentive to further utilise these waste products since the mills are already capable of supplying their own energy and electricity needs (Ministry of Energy 1991, 12).

The SALCRA oil palm mill in Lubok Antu District can process 30 tonnes of fresh bunch an hour and is able to supply its own electricity demand of 400 kW. This is sufficient to power the whole mill operation and provide lighting for offices and the compound. There are no living quarters associated with the plant since the workforce all come from nearby longhouses. The total installed capacity is 1 MW, comprising two 500 kW steam turbines which are interchanged to keep running times even.

6.3.3 Saw mills

Electricity is used to operate the cutting machinery in saw mills. This level of consumption is proportional to the scale of the mill and machinery. Many of the larger saw mills in Malaysia use woodwaste and sawdust to generate electricity for their own use. However, some operate their own diesel generators and those which are conveniently located may obtain their supply from the power utility.

There are two saw mills in Lundu District, one of which generates its own electricity requirement and the other, at Sematan, receives its supply from SESCo. The saw mill at Sematan presents a fairly constant daytime demand of 50 kW, although the connecting of the saw mill into the mini grid has had its price, since an over current of 100 A is now observed by the local SESCo operators when the saw mill starts up. This surge can normally be absorbed by the system which is reinforced by a hydro scheme. However, if the hydro is for any reason off-load, the whole system can trip due to its reduced voltage stability.

6.3.4 Crop processing

On a small scale most of the processing of agricultural produce grown in Sarawak requires only the energy of the sun for drying. However, on a larger scale this becomes impractical as the drying process can only take place when it is not raining (a frequent occurrence in Sarawak) and it is difficult to maintain consistent levels of quality.

At the SALCRA cocoa scheme in Lubok Antu District the cocoa beans are dried for 24 hours at 70°C after fermentation. A 7 kW diesel generator is used to supply electricity to the drying machinery as well as for lights and fans in the offices. A 5 kW generator is kept on standby in case of breakdown and for use during maintenance periods.

Rubber factories are normally located close to the larger towns and ports. Coagulated latex from producers over a fairly wide geographical area is sent to be processed. As well as electricity to drive the machinery, fuelwood is needed for the smoking process. Rubberwood from old plantations is the principal source of fuel.

The Mayang tea factory in Serian District began operation in 1985, three years after planting had begun on the tea estate. Diesel generators were initially used to supply

electricity to the machinery which dries and sorts the leaves. The maximum electricity demand of the factory is approximately 200 kW. In 1989 SESCo was able to extend supply to the factory as well as the surrounding villages.

Other industrial users of electricity include ice-making factories and food processing establishments such as the seafood exporting company visited in Sarikei. The silkworm farm in Lundu District is eventually expected to require up to 400 kW.

6.3.5 Commercial sector

Shops and businesses in the small towns and bazaars of rural Sarawak use electricity primarily for refrigeration, lighting and fans. However, their consumption is negligible compared with those offices or hotels which have had air-conditioning systems installed. The most significant increase in consumption levels for Lawas power station have occurred since 1986 when three new hotels were connected into the distribution network. The three hotels, which all operate air-conditioning systems, now constitute the largest single consumption category.

6.4 Electric Power Supply Infrastructure

The 275/132 kV transmission system now links the Batang Ai hydroelectric power station with the city of Kuching and the town of Sibu; eventually it will also connect up with the new gas-fired combined cycle generating plant at Bintulu. As the transmission system is gradually extended, a number of the smaller existing power stations are being closed down. There are, however, many rural SESCo power stations supplying limited loads that are too distant from the limited grid system for connection to be considered feasible. The status of electricity supply in each of the six Districts is summarised below:

Lubok Antu

The 108 MW Batang Ai hydroelectric power scheme, located in the District of Lubok Antu, was commissioned in 1981. The small town of Lubok Antu was subsequently connected to the scheme in 1983 and the original diesel station was closed down. A rural power station (172 kW) supplied the town of Engkilili from 1982 until 1988, during which year it too received supply from the Batang Ai scheme.

Serian

Serian town and Tebakang bazaar were connected into the Kuching system in 1979 and the original power stations were closed down. All SESCo consumers are now supplied from the grid system.

Lundu

A mini grid has been established in the District of Lundu following the commissioning of the Lundu and Sebako mini hydro schemes, each of which has an installed capacity of 300 kW. The original diesel power stations in the towns of Lundu and Sematan are required to supplement supply during periods of peak demand or if either of the hydro schemes are off-load. A third mini hydro scheme (Penindin, 300 kW) was brought on line and connected into the grid in 1991 and this has further reduced fuel costs.

Lawas

Four diesel power stations and the Kalamuku mini hydro station (1 MW) operate in the District of Lawas. Under normal operation the mini hydro scheme supplies the town of Lawas via an 11 kV transmission system. The Lawas diesel power station is brought on-line in case of system failure. Lightning strikes and fallen trees affecting the transmission system have proved to be a major cause of such failure in the past. The rural power stations in the small towns of Sundar (installed capacity 352 kW), Merapok (161 kW) and Kuala Lawas (212 kW) are operated autonomously.

Sarikei

The Kuching-Batang Ai system was extended up to Sibu and the town of Sarikei in 1988. However, elsewhere in the District rural power stations operate at Paloh, Belawai and Selalang. The station at Belawai has an installed capacity of 487 kW and HT lines now connect it to the coastal settlements of Rejang and Jerijeh which were previously served by small unconnected power stations. The stations at Paloh (73 kW) and Belawai are unlikely to be connected to the Kuching system due to their inaccessibility and the swampy, deltaic nature of the terrain. The rural power station at Paloh commenced operation in 1983, currently has an installed capacity of 73 kW and supplies only 63 consumers.

Belaga

Since 1981, SESCo has operated a small rural power station serving the town of Belaga with an installed capacity of 236 kW. There are no other SESCo supplies in the District.

The levels of public electricity supply coverage, as they stood at 31st December 1990 for each District, are presented in *Table 17*.

Table 17: *Public electricity supply coverage by District.*

District	Percentage coverage
Lubok Antu	26
Serian	43
Lundu	49
Lawas	44
Sarikei	65
Belaga	7
Total Sarawak	**57**

Source: SESCo 1991.

6.5 Commercial and industrial consumption of electricity

A breakdown of consumer structure and consumption trends for the six Districts is presented in this section. The significance of the role played by the commercial and industrial categories and possible areas for future growth are highlighted in Section 6.7.

6.5.1 Number of consumers

The total number of SESCo consumers in Sarawak increased by a factor of 2.7 in the ten years from 1976 to 1986. *Figure 23* shows the relative increases in consumer numbers in the six Districts focussed upon in the study.

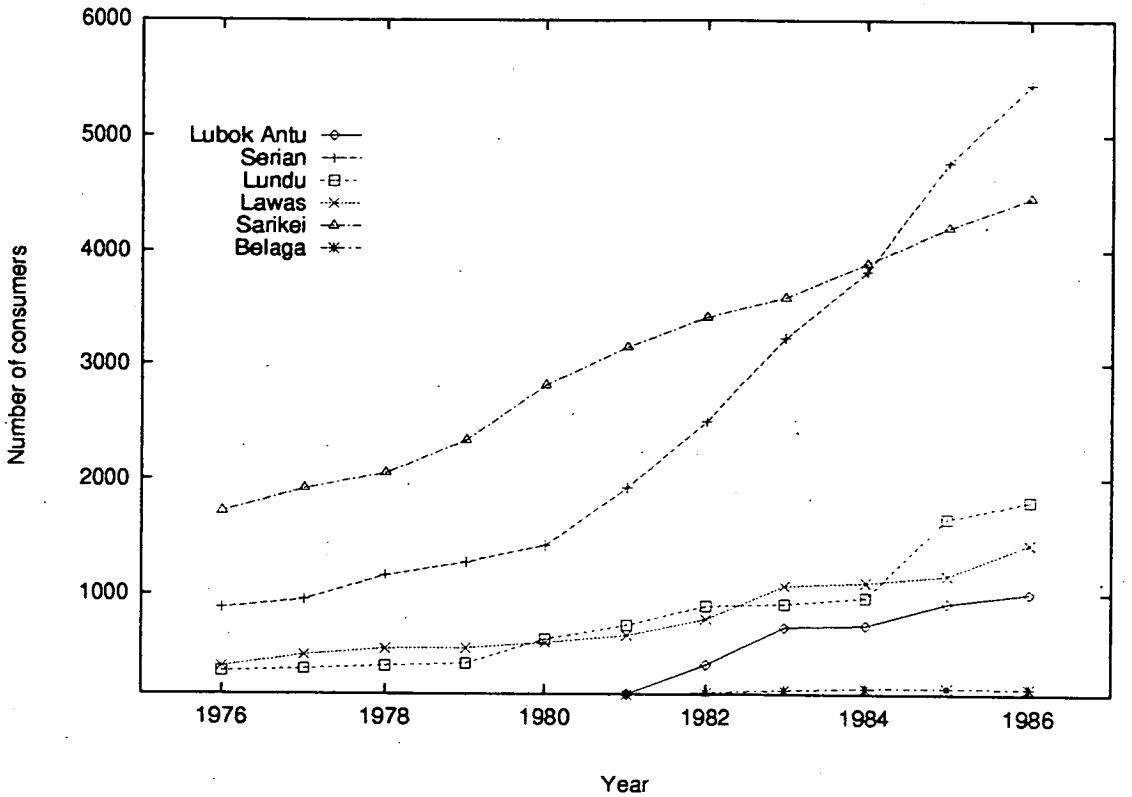

Fig. 23. *Increase in number of SESCo consumers over the ten year period 1976-1986.*

Source: SESCo 1987.

6.5.2 Consumer structure

However, an analysis of the number of consumers in each category shows the generally far higher proportion of domestic consumers compared with those in the industrial and commercial classes. A breakdown of consumer numbers in 1986 for the six Districts included in the study is given in *Table 18*. (It should be noted that the street lighting category has not been included in the table and that in Sarawak outside the main towns there are no consumers in the high voltage (HV) commercial and industrial categories.) There are no industrial consumers of electricity in either

Table 18: *Breakdown of 1986 consumer numbers.*

District	Number of consumers		
	Domestic	LV Commercial	LV Industrial
Lubok Antu	826	173	-
Serian	4,743	729	-
Lundu	1,539	258	2
Lawas	1,057	371	2
Sarikei	3,458	970	6
Belaga	91	78	1
Total Sarawak	**110,527**	**24,320**	**471**

Source: SESCo 1986 Annual Report.

Serian or Lubok Antu Districts and, in fact, the "industrial" consumers in both Lawas and Belaga are the local waterworks. The commercial category includes a total of 14 hotels in the towns of Serian, Lawas, Sarikei and Belaga. The comparable numbers of commercial and domestic consumers in Belaga District merely reflect the fact that the public electricity supply coverage is exclusively limited to Belaga town where there is a high proportion of commercial premises.

6.5.3 Electricity consumption

An analysis of the levels of electricity consumption in the main consumer categories is given in *Figure 24*. This emphasises the difference in scale of electricity demand between the busy town of Sarikei and the small bazaars of Belaga or Lubok Antu. It can also be seen that, despite the small number of industrial and commercial

consumers, these sectors account for a relatively large share of the total electricity consumption in each District.

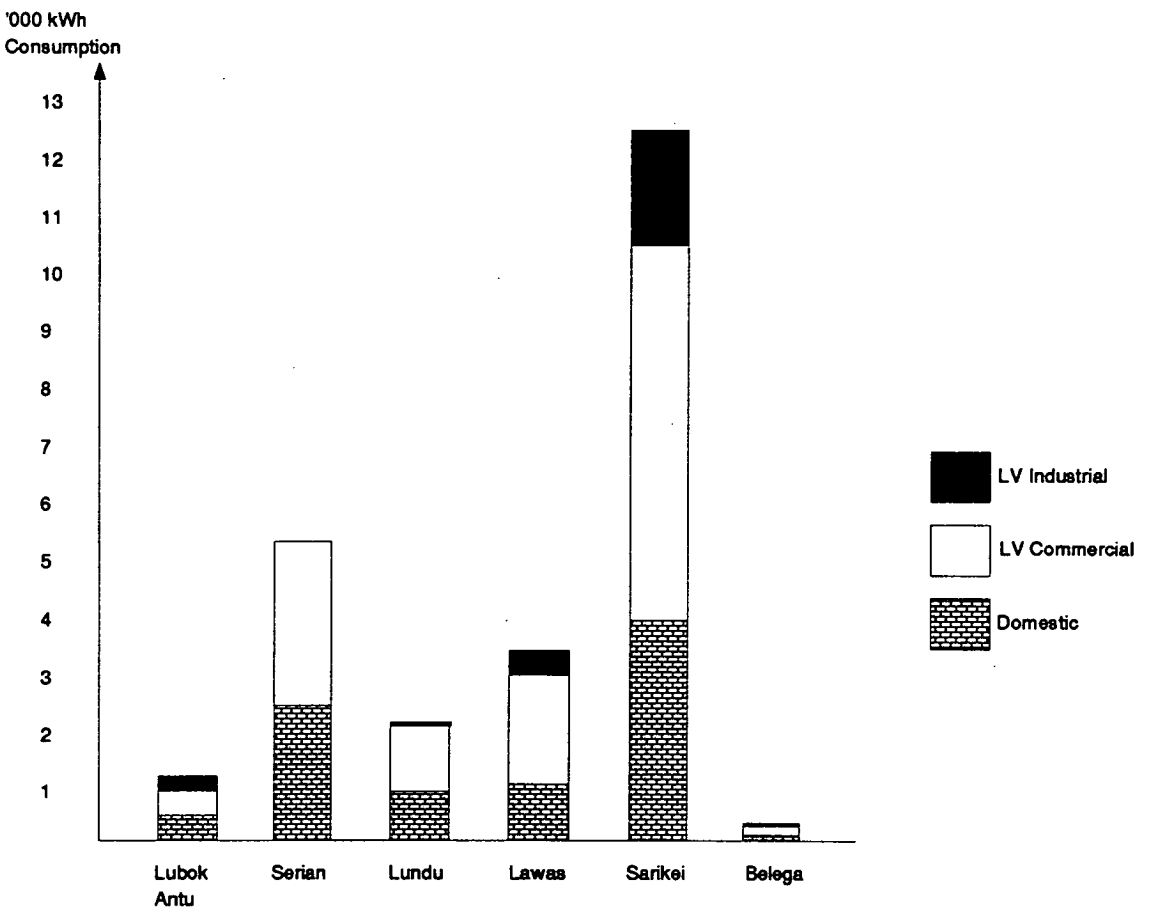

Fig. 24. *Analysis of electricity consumption in selected Districts.*

Source: SESCo 1986 Annual Report

6.6 Planning for Infrastructural Development

The key infrastructural development priorities concerning both State and Federal governments are the improvement of communications, including roads and ports, and the provision of basic services such as public supplies of water and electricity. Opportunities for the development of industry in rural Sarawak are mostly associated with agriculture and natural resource extraction. However, the location of industrial projects is constrained by the lack of good communication links, especially roads.

At the District level, planning for development of the infrastructure is coordinated by District Office staff. Separate departments are responsible for the various construction programmes. Road building is the preserve of the Public Works Department, who sometimes also assist with the planning of kampung roads, for which there is an important programme in Serian District. Public water supplies (in towns) are also the reponsibility of the Public Works Department. The programme to provide clean, but usually untreated, water supplies for villages in Sarawak is administered by the Department of Health. SESCo also liase with the District Office in preparing prioritised lists of kampungs which have requested an electricity supply. The Minor Rural Projects programme, which often includes the construction of kampung roads and the distribution of small generating sets, is administered by the District Office.

However, all of these development programmes depend on the allocation of the necessary resources according to central government (both State and Federal) priorities. There are often long delays, sudden changes of priority or cancellations which make coordinated long term planning difficult. Industrial planning in Sarawak tends to be dominated by the large-scale enclave industries; the only Regional Development Authority in Sarawak is the Bintulu Development Authority. At a District level there is no scope for planning for industrial development or its associated infrastructural requirements.

There was general agreement amongst the development planners interviewed that the priority for the rural areas, in terms of infrastructural development, should be the construction of roads. This would reduce transport costs and allow small and large producers of agricultural commodities increased access to markets. The extension of the grid electricity supply to most towns was seen as inevitable but the provision of an electricity supply for the villages was not accorded highest priority. However, the availability of electricity has been cited as an important factor in the location of new industries in the Lundu area, together with the existence of relatively good road links between Lundu and Kuching.

6.7 Summary and future prospects

The industrial consumption of electricity is currently based on very few consumers who account for a relatively large proportion of total demand. In terms of demand levels the most significant consumer category is the commercial class, which in rural areas often accounts for over half of total electricity consumption.

Little use is currently made of electricity for the craft activities and small-scale processing of crops which are practised in villages in Sarawak. These processes are labour-intensive and require energy inputs in the form of fuelwood and solar power, thus utilising readily and locally available resources. By contrast, the energy requirements of industrial activities eg. for drying, heating, lighting and operating machinery for the processing of agricultural products and timber, are well suited to the application of electric power. Once the network has been extended, owners of saw mills and the many other establishments which currently operate their own diesel generators find it more economically attractive to buy their supply from the grid.

However, unless there is an improvement in the communications infrastructure, especially the road network, it is unlikely that many industrial concerns will find it financially viable to locate in rural areas. Therefore the number of industrial users is not set to increase in predominantly rural Districts where there is no major town with access to important communications links.

In towns and bazaars with an established electricity supply almost all commercial businesses have already been connected to the supply. As has been noted in Lundu and Lawas Districts a dramatic increase occurred in demand levels following the opening of hotels with air-conditioning systems. This indicates a limited opportunity for demand growth in the commercial sector.

Chapter 7:

DISCUSSION OF FINDINGS

In this chapter the ideas presented and analysed in Chapters 4 - 6 are drawn together and discussed. The motives for and effects of rural electrification, as practised in the context of Sarawak, are questioned and the strategies adopted to tackle electrification are examined. Finally policy and practical recommendations are presented with a view to achieving efficient and effective comprehensive electrification in the State of Sarawak.

7.1 Questioning rural electrification

Rural electrification forms an important part of the Malaysian Government's strategy to modernise the rural areas. In this section the motivation for the rural electrification of Sarawak and its relevance for rural development in the state are questioned. The priorities and perceptions of both the authorities and the rural population, with regard to the current nature of the electrification programmes and their value, are analysed in the light of the research evidence.

7.1.1 Motives for the promotion of rural electrification

The Malaysian Government originally promoted rural electrification in areas of communist activity in Peninsular Malaysia for security reasons (Gill 1987). The emphasis is now on the broad socioeconomic objectives of raising the standard of living and increasing productivity in rural areas. Other important motives include developing and improving the infrastructure of the country, as part of the general effort to transform Malaysia into a developed nation (currently known as "the 2020 vision"). In addition, the wide discrepancy between levels of electrification in the states of Sarawak, Sabah and Kelantan and the rest of Peninsular Malaysia is perceived as an indication of the extent of imbalance between the less developed and more prosperous regions of Malaysia. This problem is now receiving the attention of the authorities in an attempt to redress the inequalities of development.

Progress made by the rural electrification initiatives is regarded as tangible evidence of rural and national development and is conveniently measured in terms of the number of additional households electrified. The high profile of the rural electrification programmes is maintained by publicising the setting of targets, the announcement of budgets and the regular achievement of milestones.

A further motive for those in authority to promote rural electrification is that it is in the interests of politicians at all levels to play a part in the selection of new areas to be electrified, the allocation of budgets for RE or the approval of funds for a village generator set.

7.1.2 The context

The rural electrification of Sarawak takes place in a context which is quite distinct from that which exists in Peninsular Malaysia. This is true in terms of:

- the generally much lower level of
infrastructural development (especially regarding the road network),
- the low level of involvement of the rural population in the cash economy,
- the strong predominance of the agricultural sector and
- the very limited industrial base.

In addition there are geographical differences, Sarawak being characterised by its low density of population, the large number of remote settlements and the difficult terrain. For these and other reasons rural electrification is a much more costly exercise in Sarawak than in Peninsular Malaysia.

In the context of rural energy, rural electrification plays a fairly minor role in Sarawak, mainly meeting the lighting requirements of rural communities. Firewood is still largely relied upon for cooking fuel needs and diesel or petrol are used to drive small engines for transport, milling rice, pumping water and sawing wood. Usage of electricity is limited by the low cash incomes of the rural people who are not able to afford high electricity bills nor buy many appliances.

Within the context of rural development in Sarawak, other government programmes include the introduction of clean village water supplies, the construction of rural feeder roads to provide reliable communication links between the villages, towns and markets, and a variety of agricultural programmes promoting both in-situ development for small farmers and large-scale estate-style schemes. By comparison with the village generator programme, the Medical Department's rural water supply programme, which began in year 1963, had achieved 80 percent coverage by the end of 1991 (Medical Department 1991). The programme is characterised by the

application of low technology designs and involves a high degree of local cooperation, whilst still requiring a financial contribution from the community. In contrast to the village generator programme, the Medical Department provides long term technical support and seeks to update and replace the schemes as necessary. The rural water supply programme is thus regarded by the development authorities in Sarawak as being of key importance in improving living conditions in the rural areas. However, it is interesting to note that it was only the scale of the protestations of Members of Parliament for constituencies in Sarawak that overturned a Federal proposal to bring the rural water supply programme to an end on the assumption that it was no longer necessary, which is certainly not the case in Sarawak or Sabah.

7.1.3 Priorities and perceptions

The Malaysian Government accords high priority to rural electrification, both as part of its endeavour to establish a comprehensive national infrastructure and in order to improve living conditions in rural areas. The level of rural electrification attained is perceived to be a good indication of the level of development of the country in general and the progress made is regarded as a sign of the commitment of the Government towards improving the lives of the rural population. Perceptions of living conditions, the problems and priorities of the rural areas in Sarawak are often quite different at Federal and State levels (see previous section). This affects the relative emphasis placed upon rural electrification and the climate within which targets are set and pursued.

Rural electrification is generally taken to be the extension of existing grid systems or the construction of small rural power stations by the public electricity supply utility. The village generator programme in Sarawak is regarded as an interim measure to supply the more remote villages with electricity until such time as SESCo is able to provide a supply.

The lower administrative ranks involved in the implementation of rural electrification projects respond to directives from above as required. However, some find that the allocation of funds and level of action required are in conflict with what they perceive to be more pressing problems of rural areas. In particular, the construction of roads is regarded by many local development administrators as being of highest priority in the infrastructural development of rural Sarawak. Although they generally welcome the extension of grid supplies, rural electrification construction projects are rarely integrated with other rural development programmes. In addition, although the availability of grid electricity is regarded as an important incentive for small industries to locate in rural areas, reliable communications and transport links are considered to be of paramount importance.

Development administrators based in rural towns have mixed opinions on the value of the village generator programme. Their views depend, to some extent, on the success of any District organisational structures which have been instituted to manage the programme and support the communities involved. Also of relevance are the extent of SESCo coverage in the District and the likelihood of further extensions being constructed.

Communities living in villages close to existing SESCo networks are generally impatient to be connected to the public supply. The increased self-regard and perception of status of a village with an electricity supply was made clear during interviews with rural people. In particular, they expressed a wish to enjoy some of the same facilities that are available to town-dwellers. However, when people living in villages without an electricity supply were questioned about which development projects would be of most benefit to the community, stress was usually laid on the building of roads to improve access to markets, agricultural schemes and opportunities for wage labour. In most cases the main use of electricity is for lighting, since the rural people are too poor to afford electrical appliances or the higher bills resulting from increased electricity consumption.

7.1.4 The role of rural electrification in rural development

Although electricity is primarily used for lighting, and in some areas television sets, its significance extends beyond the level of consumption and the type of appliances used. As evidenced by interviews held in the villages an electricity supply plays an important role in demonstrating to rural communities that despite their geographical isolation they have not been overlooked by the authorities and that they too are benefiting from the fruits of national economic development. The introduction of electricity can also have a positive effect on the attitude of the community towards the development and change process and increase the perceived status of the village.

The desire for an electricity supply is consequently capitalised upon by local political figures, within whose power it is to approve Minor Rural Project funds for a village generator, the cost of which is generally outwith the capability of the rural communities. Conversely, it is often claimed that the main reason that certain villages remain unelectrified is also due to negative political bias.

There is also an ongoing controversy about whether it is preferable to make infrastructural provision for the most widely scattered rural settlements or whether some form of resettlement to cluster communities into more accessible centres is necessary. This has been proposed as a more practicable long term solution, in line with the Government's National Urbanisation Policy and also given the tendency for the rural population to drift to the urban areas over time.

An indication of the value placed on an electricity supply is given by the price that the rural people are prepared to pay to secure a supply. Clearly this is dependent on the level of cash income of each household. However, it has been noted that although for the same quality of light electricity is cheaper than kerosene, a higher level of expenditure on electricity is common. The willingness of each household to pay the collateral deposit for connection to a SESCo supply, to contribute towards the cost of repairing a village generator or, in the case of the villagers of Buduk Nur,

the installation of a hydro scheme is evidence of the popularity of electricity.

However, there is also the risk of exacerbating societal divisions both between and within communities. Divisions are apparent between neighbouring villages which have an electricity supply and those which do not, especially if political motives are suspected to have been involved in the selection of beneficiaries. In addition, a village generator set is regarded as second best compared to the public electricity supply by those communities living in the vicinity of the SESCo network. Within the village, those who can afford connection to the SESCo supply, expensive electrical appliances, high levels of electricity consumption or who are simply able to replace burnt-out bulbs stand out from those with prohibitively low cash incomes.

Currently there are few "productive " uses for electricity in the rural areas of Sarawak. In addition, there is little emphasis on the promotion of small-scale rural industries. It has been suggested that rural electrification schemes bring most benefit and are most economical when they are integrated with other rural development initiatives, especially those which stress productive consumption (UNDP/ESCAP 1990). However, it was the view of administrators at all levels that there was little scope for the development of cottage industries. For the foreseeable future, productive use of electricity appears to be limited to the processing of agricultural produce at a factory scale, often in association with an agricultural scheme such as the Mayang Tea factory.

To conclude this section of the discussion, it appears that rural electrification is not regarded by administrators and villagers in Sarawak as an issue of the highest priority. Furthermore, the main use for electricity in rural areas is for lighting rather than any productive applications. However, rural electrification does play an important role in redressing the imbalance of development and discrepancy in living standards between rural and urban areas. Given the emphasis placed on the electrification of rural areas by the Federal authorities and the scale of funding

involved, it is absolutely crucial that efficient, realistic and appropriate strategies are employed to ensure optimum utilisation of resources.

7.2 Strategic considerations for rural electrification in Sarawak

In this section, the current strategies and technological options for the rural electrification of Sarawak are examined. The effectiveness of the present programmes is considered with a view to presenting future options.

7.2.1 Current approach to rural electrification

The current approach to rural electrification in Sarawak is modelled on the procedure which has been adopted in Peninsular Malaysia. Federal funds for the Rural Electrification Scheme (RES) are channelled through the Ministry of National and Rural Development to the public electricity supply utility, SESCo, which plans and implements individual projects. Electrification projects take the form of either an extension to an existing public supply network, involving the construction of transformer substations and transmission lines, or, in areas where this is not economically feasible, the construction of a small rural power station. Requests for rural electricity supplies are processed and prioritised in accordance with the need to minimise costs, electrify the maximum number of households and in order to provide an electricity supply for any special development projects. Naturally, political pressures also have a part to play in the selection process.

In addition to the programmes of rural electrification pursued by SESCo, a mechanism exists to provide remote villages with small diesel generator sets until such time as they can be connected to a SESCo supply. In contrast to the RES approach used by SESCo the villagers are expected to take full control of the

generator and assume responsibility for operation, purchase and transport of fuel, maintenance and repairs.

7.2.2 Technology options

The principal technology employed for rural electrification in Sarawak is the extension of interconnected grids linking the major and urban power stations operating in the state. Decentralised electricity generation is largely based on the operation of internal combustion engines running on diesel. SESCo has installed diesel generating sets in 62 rural power stations across the state, although currently only about 40 operate as autonomous units following large scale expansion of the transmission grid system. Diesel generators are used in the village generator programme and private operators across the state depend on diesel or smaller petrol engines for power generation.

Although the internal combustion engine is a mature technology and one that is familiar to a surprising number of people living in rural areas, there are a number of major drawbacks to its application for rural electrification. The most obvious problem is the transport of fuel, which is often very expensive for remote villages and power stations with difficult access. In addition, sufficient technical expertise is rarely available in the villages to ensure that proper operations and thorough maintenance procedures are followed regularly in order to ensure a long operating life for the generator. Even the SESCo attendants at rural power stations are rarely able to deal with more than the most minor breakdowns. Consequently trained technicians must often travel to the site with few clues as to the tools and spare parts which will be required. Village generators that are in need of major repair must be transported to the nearest town, again at great expense.

The two main alternatives to diesel engine generators, which are under consideration for rural electrification in Sarawak, are hydroelectric and solar photovoltaic power:

Hydroelectric power

The vast hydro potential which exists in Sarawak has been recognised and assessed by the Malaysian Government which has a policy of promoting the development of hydroelectric power and reducing reliance on oil. In addition to the diesel power stations which SESCo operates in rural areas to supply towns and nearby villages in rural areas, a total of seven mini hydroelectric stations have been constructed as part of the Federally funded mini hydro programme. However, schemes in the low range from 50 - 300 kW, and especially those which supply villages and longhouses in previously unelectrified areas, are now considered to be uneconomical due to the high cost per installed kilowatt of capacity. SESCo is consequently keen to gear further development towards small hydro and the upper end of the mini hydro range (above 500 kW) to supply interconnected grids which serve towns with a well established demand. It has been recommended that to complement this shift in emphasis, a less costly micro hydro (1 - 10 kW) programme might be more suitable to supply the electricity requirements of those individual villages which are located near to a potential site (Soon & Suling 1990).

However, there has been no experience of village-scale hydro schemes in Sarawak, apart from the two private micro hydro schemes operating in the state, nor is there an indigenous tradition of harnessing hydropower such as exists in Nepal. In order to keep the costs of a microhydro programme low it would be necessary to use low technology designs appropriate to the availability of local resources and labour. In addition, a high level of local cooperation would be required during the planning and construction phases and thereafter for operation and maintenance purposes. This could initially present problems since there is no established precedent in Sarawak for a high level of community involvement and participation in rural development programmes, which are generally of the top-down variety.

Experiences in China have shown that the most successful large scale microhydro programmes involve standardised designs which can easily be replicated at a variety of different sites with minimal adjustment, thus avoiding high engineering overheads (UN 1989, 155). It is also important to limit the imported elements of the plant and machinery to a minimum and to avoid or severely limit the input of foreign consultants in an attempt to reduce costs as much as possible. However, before any serious decisions can be taken as to the advisability or format of such a programme, it is necessary to mount a small number of pilot projects in villages which are keen to cooperate, whilst ensuring that the communities will not suffer if unforeseen problems are encountered.

Solar power

The potential for rural electrification projects utilising solar photovoltaic technology in Sarawak does not appear to be as favourable as that for micro hydro. The main drawbacks rendering it unsuitable for widespread use are the extremely high capital costs involved and the low power generation capability. In addition the high recurrent costs of replacing batteries must be taken into account. However, photovoltaic generation has been found to be cost-effective and suitable in remote areas for low power applications such as communications equipment, since no fuel is needed and due to the low maintenance requirement.

Existing projects in Sarawak (and elsewhere in Malaysia) have already encountered problems which demonstrate the potential difficulties of further exploiting solar power for rural electrification. The Belgian-aided project which supplies two longhouses with electricity for lighting and television sets is sited on the main road for convenience of access for monitoring and official visits. However, the location of the settlements mean that the community has the means to generate cash and is easily influenced as to how to spend it on new appliances. The low power capability of their electricity supply is certain to lead to problems of dissatisfaction and damage as

villagers seek to adapt the system to meet their requirements.

Dissatisfaction has already been encountered at the remote Penan longhouse which has low power lighting facilities supplied by a small photovoltaic system. Attempts have been made to recharge standard lead-acid batteries from the special solar batteries and consequently the solar batteries have been discharged below the specified limit. This has led to equipment failure and will subsequently shorten the lifetime of the costly solar batteries.

It should be noted that attempts had been made to involve the Penan community in the project, since cooperation was required in monitoring discharge levels and limiting hours of use accordingly. However, it is now clear that the project has not been taken seriously and is not sufficiently valued by the people, who were not required to make any financial contribution due to the low and sporadic nature of their cash income. The longhouse dwellers living next to the Serian main road have been involved in the project to an even lesser extent. They have no operation or maintenance responsibilities and are simply billed by SESCo as if they were connected to the grid, like the other longhouses in the area.

7.2.3 Consumer perspectives

Many of the communities visited during the study seemed to attach great value to the provision of an electricity supply for the village. It was seen as part of the effort to narrow the gap between living standards in the village and the town. Villages with "facilities" are more highly regarded than those without, both by rural people and those townspeople whose occupations require that they often spend the night in villages.

Amongst those communities with some experience of what a SESCo supply could mean, there was a clear preference for SESCo connection over a village run

generator. Reasons for this preference, often cited by those frustrated by the limitations of a village generator, were the increased possibilities for individual control and use of a variety of appliances.

It is not anticipated that there will be any great changes in electricity usage in rural areas. The main uses will still be domestic, in particular lighting, television sets, radios, irons and fans for a long time to come. The limiting factor here is the disposable income of the rural population which restricts not only the level of electricity consumption but, perhaps more importantly, the purchase of expensive appliances such as refrigerators. Consequently only a gradual increase of refrigerator ownership can be expected, and only in those areas with the highest rural incomes.

Although cooking with gas can be viewed as an indicator of status, as well as of income, firewood remains the most popular and widely used cooking fuel. The use of other commercial forms of cooking fuel is becoming less rare, but the application of electricity in the preparation of food is certain to remain limited to the occasional rice cooker and perhaps electric kettles in the future.

Productive uses of electricity in rural areas are limited. Currently mechanical power for pumping, milling and sawing processes is provided by diesel engine and this is unlikely to change. Small scale processing of agricultural produce is largely limited to fermentation and drying processes, neither of which, at a village level, require the application of electricity.

Often the existence of an electricity supply, especially when this was in the form of a small diesel generator, seemed to have a very slight effect on the day-to-day life of the community. Electric light was available for two or three hours each evening and more importantly, in case of visits by dignitaries or during times of celebration. For those communities who could afford television sets, and nearer to town the television is fast becoming ubiquitous, its impact was much commented upon. Whilst there are

undoubtedly negative social effects, there has been an unprecedented widening of horizons and increase in knowledge and understanding of the rest of Malaysia and the outside world, especially amongst the young people.

However, even those communities showing most enthusiasm for electricity did not rank its acquisition at the top of their list of development priorities for the village. Road construction or opportunities for increasing their cash income were most mentioned as top priority concerns.

7.2.4 Effectiveness of the programmes

The effectiveness of the rural electrification programmes, as an integral part of the development of rural areas in Sarawak (and in Malaysia as a whole), is rarely questioned by the policy makers and programme planners. Progress is generally evaluated in terms of the numbers of additional households electrified, kilometres of transmission line erected, rural power stations constructed and the level of expenditure at each stage of the current Malaysia Plan. For an indication of the success of the programmes these figures are then compared with targets set at the start of the Plan. In other words, the efficiency and pace of the rural electrification *process*, measured by the rate of connection of new consumers, the cost per connection and the calculated percentage of the population which has been electrified, appears to be the paramount consideration of the Malaysian Government. Judged in these terms, the effectiveness of the rural electrification initiative in Sarawak is discussed below.

Until now the RES programme, as implemented by SESCo, has been modelled on the approach of early rural electrification efforts in Peninsular Malaysia. A similar remarkable increase in the level of electrification has been achieved, if at a higher cost and slightly slower pace than in Peninsular Malaysia, due to the rather less developed nature of the State of Sarawak. However, as the most accessible

settlements are gradually and progressively electrified, the conventional approach of extending existing grid systems and building 24-hour rural power stations, complete with attendants and bill collection, becomes less appropriate. Furthermore, the electricity consumption of these remote communities is likely to be extremely low (beneath the minimum charge threshold) and concentrated for a short period in the evening when electric lighting and television sets are in use. Consequently the process becomes even more uneconomic, and possibly technically unfeasible, as outlying villages are targeted.

Currently the only official alternative to the full-blown approach to rural electrification in Sarawak is the village generator programme. However, there are many questions being asked about the effectiveness of this programme. One of the main problems is that the lack of technical expertise in the villages means that adequate operation and maintenance procedures are rarely undertaken. Overloading of the generator is common due to a lack of understanding of the limitations of the system and the possible consequences. This state of affairs often results in frequent breakdowns and a subsequent deterioration of the generator set. To exacerbate the situation there is generally no provision for technical or financial support if a major breakdown occurs and repairs are necessary.

The outcome of this situation is that many of the generators have major breakdowns after only a year or two. It has been estimated that at least half of the generators issued through the programme currently lie idle. The village generator programme can thus only be regarded as a short-term solution to providing electricity to remote communities. In addition, the generator may become a burden to the the community due to the costs of repair once a major breakdown occurs. The legacy of a failed generator project is that the local people subsequently regard a village generator as a second-class form of electricity which cannot be relied upon. Unfortunately, in many remote villages this is probably the only form of electricity supply which will ever be available.

The effectiveness of the rural electrification initiative can be further considered in terms other than level of coverage, if the contribution to development and change in the rural areas is considered to be a measure of its relevance. Additional indicators of effectiveness might be the level of consumption, range of applications for electricity, extent of productive use and attitudes and confidence displayed by the rural consumers. The research findings support the view that rural electrification currently has little impact on the level of economic development of the rural areas in Sarawak. Levels of electricity consumption are extremely low, the range of applications is small and productive uses are few. However, the attitudes of the rural population indicate that rural electrification, as implemented by SESCo, is an extremely popular way of redressing the imbalance in standards of living between the rural and urban areas.

7.3 Recommendations

The policy implications of the research results are outlined in this final section. The electrification of remote areas is identified as a key problem area and, in the light of the Malaysian Government's commitment to rural electrification, specific suggestions are made. These recommendations were presented to the authorities in Sarawak in the form of a report (Randell 1991). Comments and reactions which arose both as a result of the report and following discussions on the return visit to Sarawak have been incorporated into the recommendations.

7.3.1 Future policy directions

On balance, rural electrification has a valuable role to play in reducing the difference between the living conditions in rural and urban areas. A large part of the population regard the rural towns and villages as lagging a long way behind urban centres in

terms of living standards and opportunities and this perception is improved with the advent of electricity and other facilities. However, it is important to balance the highly publicised activities of SESCo with other rural improvements. The problems of the rural population vary considerably and in some poor communities access to an expensive electricity supply can be irrelevant or even a burden. The heavy emphasis on the number of households electrified does not address the problems of very poor consumers who cannot afford appliances and who have minimal consumption levels due to to low or seasonal cash incomes.

An attempt should be made to integrate rural electrification with other rural development initiatives such as the building of new clinics, schools or crop processing facilities. Electricity would then become available for refrigeration, communications and audiovisual equipment, fans and to drive machinery as well as for lighting. This requires wide-spread coordination of government departments and agencies concerned with rural development and change. In addition, promotion of productive uses of electricity, especially during the daytime, should be a priority in order to improve load factor and return on investment. For example, lower commercial rates will allow an increase in the use of refrigerators, freezers and fans by coffee shop owners. Small workshops can be similarly encouraged to make use of electrical tools and machinery.

Furthermore, current strategies for the electrification of rural areas need to be reviewed in order to render their significance and level of sophistication more appropriate for remote settlements. Specific recommendations are outlined in the next section.

7.3.2 Electricity supply for remote areas

Even in Peninsular Malaysia, despite the high level of electrification attained, it has been recognised that small isolated pockets of the rural population will never be

connected to the national grid network. Realistically this assessment must also be accepted in the case of Sarawak and policy objectives adjusted accordingly. The current capital-intensive methods used by SESCo are inappropriate for the electrification of small, remote communities and the existing village generator programme is considered to be seriously flawed in its present form. Clearly a complementary decentralised village electricity supply programme is the only feasible solution. However, the long term viability of a village programme requires that all of the following key aspects are considered:

1 Funding and administrative structure
2 Priorities and perceptions of the villagers
3 Financial contribution from the community
4 Choice of technology
5 Technical support
6 Responsibilities and organisation
7 End use of electricity

Although many of these items are essentially practical details, they need to be taken into account during the policy making process since they determine the nature of the programme and the style of funding required.

1 Funding and administrative structure

The funding structure for remote village electricity supplies should reflect the ongoing nature of the programme. In particular, funds are necessary to provide technical back-up for all communities taking part in the programme and to cover the costs of major repairs and replacements as required. Consequently, it is recommended that funding for village generators is removed from the Minor Rural Projects umbrella, which is most suited to single funding allocations for construction projects. Being less concerned with profit and loss and more motivated by overall rural development, a Rural Electrification Unit specially created to oversee the

electrification of remote villages is likely to operate most effectively as part of the State development administrative structure. Clearly such a unit will need to liaise closely with the RES section of SESCo. However, since the activities of the RE Unit are by their nature highly decentralised, the majority of staff will be based in rural areas. A high level of cooperation with the regional and local SESCo offices and District Offices will thus be essential. The RE Unit will be charged with identifying and facilitating the electrification of those communities prepared to take on the responsibilities and commitment of managing their own supply. It will be necessary for the staff to have sufficient technical experience and competence to assist with minor repairs and training, deal with equipment suppliers and arrange for effective repairs and replacement.

2 Priorities and perceptions of the villagers

It is crucial to ascertain the true priorities and perceptions of the community and whether these match the assumptions of the authorities. In particular it is important for the request for an electricity supply to have originated from the community rather than a promise made by a local political representative. Firstly, RE must be ranked with respect to other development concerns in order to determine the degree of priority with which it is regarded by the community. The level of interest and cooperation which can be expected with regard to labour-intensive tasks such as the construction of a power house and erection of distribution lines should be assessed. In addition, the willingness of members of the community to undertake training and assume responsibility for operation, maintenance and administration of a generator is crucial. Finally, the expectations of the villagers as to the benefits and applications of a village electricity supply are important. These are likely to be most realistic if there are households which currently operate private generators or pay for connection to a commercial supply.

3 Financial contribution from the community

The generator is likely to last for longer if the community feel that they have a substantial stake in the project. Clearly the size of the financial contribution that can be demanded should be related to the cash income of the villagers. Labour can form a large share of the contribution made by poorer communities but the central objective is to instill the sense that the community itself *owns* the generator.

4 Choice of technology

In most cases a diesel generator project is the most suitable and cost-effective option. However, if the proposed micro hydro pilot projects are successful then this technological choice will be an additional possibility. Solar photovoltaic systems are unlikely to warrant consideration for village electrification due to the high costs and low power capability. In calculating the overall costs of each option the running costs, including the transport of fuel, should be taken into account.

In addition to the above village operated generation schemes, the option exists to encourage private commercial operators, such as those which already exist near to main roads. However, it would be necessary to devise a scheme to regulate tariffs and enforce safety standards without dissuading the operators from continuing their business.

5 Technical support

In order to cut costs and maximise the lifetime of the generating equipment, it is essential that local people are trained to carry out basic operations and maintenance procedures. In addition, it is important that the villagers understand that the applied load must be limited to within the capacity of the plant. Comprehensive technical back-up could possibly be provided through an agreement with SESCo and unlike the existing small generator programme, provision must be made for repair and

replacement of plant.

6 Responsibilities and organisation

The responsibilities of the participating community must be clearly laid out prior to commencing the project. In such situations a committee is normally appointed to oversee the project and whose duties include collection of monthly payments to cover the cost of fuel and maintenance. A strong village leadership is often necessary to sort out disputes and to enforce the limits on demand. District Office staff are normally well aware of strengths and weaknesses in the leadership structure.

7 End use of electricity

Although the end use of electricity is likely to be predominantly for lighting and possibly television, an assessment of future demand should be carried out prior to selecting the generation plant. A common affliction of village generator projects in Sarawak is the tendency for the evening demand to increase beyond the recommended load of the generator. This situation can lead to frustration and misuse of the generator. Potential heavy users and those who can afford new appliances should be identified in an attempt to predict growth in demand. In addition, an appropriate payment structure, which will cover at least the running costs, must be devised and agreed with the villagers, in order not to discriminate against low income light users.

Chapter 8:

CONCLUSIONS

This research project has examined the role of electrification in the development of rural Sarawak both from the perspective of the development administration and as perceived by the rural people themselves. This chapter outlines the conclusions of the study on both the significance of rural electrification and the problems of current strategies, as well as incorporating specific recommendations for the electrification of remote villages.

8.1 Priorities and perceptions

The drive to electrify rural areas is given relatively high priority in Malaysian development planning. The goal of establishing a universally accessible electricity supply is one that has long been associated with the idea of a nation undergoing modernisation. In the case of Malaysia, it is acknowledged that the primary objectives of RE are necessarily of a social and equitable nature unlike countries such as India, for which an important motivation has been to increase rural productivity through improved irrigation. By contrast, there is little prospect for the wide-spread development of productive or commercial applications in the rural areas of Sarawak in the near future.

Rural electrification, as implemented by SESCo, is a federal concern. Funding allocations are determined by the Economic Planning Unit and distributed by the

federal Ministry of National and Rural Development. Therefore the scale of funding does not reflect the true degree of priority accorded to rural electrification by the Sarawak state development administration.

At the local administrative level in Sarawak there is general acceptance of the value of extending a grid electricity supply to rural areas throughout the state. It is, nevertheless, acknowledged that this development goal is of less immediate importance than that of ensuring the provision of piped rural water supplies or of accelerating the construction of a comprehensive road network.

The popularity of small generator projects amongst political representatives, who approve funding allocations for Minor Rural Projects, is generally in response to local demand and perceived local conditions. Projects usually take the form of a single allocation and are consequently of short-term impact only. Furthermore, since there is little or no coordination with RES or other rural development programmes, there is some scepticism about the value of the programme as anything other than a stop-gap measure. However, the results of a development programme to introduce electricity to rural areas are highly visible and invariably well-received by the local population. Consequently, expectations are high and there is increasing pressure on local representatives to speed up the electrification process.

Whilst great value is often placed on the acquisition of an electricity supply for the village, even those communities showing most enthusiasm for electricity did not place it at the top of their list of development priorities. Road construction or opportunities for increasing their cash income were most mentioned as top priority concerns.

Communities living in settlements near to the SESCo transmission system network were clear of their preference for a public electricity supply over a village-run generator. Reasons often cited for this preference were the opportunities for individual control of consumption and use of a wider range of appliances. However,

remote communities were generally satisfied with the prospect of a village generator to provide electricity for lighting. Many villagers explained that they could, in any case, not afford other electrical appliances nor the subsequent higher bills.

Electricity consumption in rural areas is almost exclusively limited to the domestic sector and the chief use is for lighting and running television sets. Consequently consumption levels are low and demand is highest in the evening. The majority of rural households consume sufficient electricity to incur only the minimum monthly charge. This situation is unlikely to change in the near future due to the lack of opportunity for rural people to increase the level of their low incomes. However, despite the low economic impact of rural electrification in Sarawak, it is concluded that the introduction of electricity to villages plays an important role in reducing the difference in living standards between rural and urban areas.

8.2 Problems with existing RE programmes

A number of problems confront the rural electrification initiatives in the state. The creation of any kind of comprehensive infrastructure in Sarawak is a daunting task, and the provision of a reliable and affordable electricity supply is no exception.

The problems currently encountered by SESCo are mainly geographical in origin but also institutional and are dealt with in full in Chapter 4. Up until now the approach adopted by SESCo in implementing RES has been very similar to the strategy used so successfully in Peninsular Malaysia. However, given the very different geographical conditions in Sarawak, it is unlikely that this approach would suffice if operations were to be extended to include the many scattered and distant communities in the interior of the state which are still without supply.

On the other hand the very programme which was conceived to tackle the electrification of those villages which SESCo will be unable to reach in the near

future is also encountering serious problems. An important limitation on the effectiveness of the programme is that there is no support structure to assist with the maintenance and repair of generating sets once they have been distributed. The funding for each project usually comprises a single allocation which is intended to cover purchase, installation and wiring.

The generator set is not always as valued by the recipient community as might be expected. Perhaps, given the option, they would have put the same money to some other use, such as building a feeder road. Those communities which had been obliged to make a contribution towards the cost of the project, due to an unexpected shortfall in funding, probably felt that they had a vested interest in the success of the project.

This kind of community project requires a high level of cooperation on the part of the recipient community who are left with the responsibility for organising its administration and daily operation, not to mention maintenance and repair. If the project becomes a burden on the community, the people will soon lose enthusiasm and grow to resent the drain on their, often already meagre, financial resources. The effectiveness of the programme contrasts with that of the rural water supply programme. Unlike a generating set, a gravity feed water supply requires a level of maintenance which can easily be tackled by the villagers themselves. Indeed the value placed on the project can be judged by the speed with which they respond to damage following heavy rains. On a long term basis the present system is neither cost-effective nor efficient and convinces rural people that a village generator is at best a second rate form of supply, whereas realistically there might be no alternative.

In addition, there is currently little coordination between the implementing authorities, and the rural electrification programmes are virtually independent. Records of the village generators distributed under the State Development Office programme are not comprehensive and cannot be updated due to the lack of

provision for monitoring the projects at District level. Consequently the number of village generators still functioning is unknown. Problems with the small generator programme are exacerbated by the lack of a support structure to ensure and assist with the regular servicing and repair of generators.

8.3 Recommendations for the electrification of remote settlements in Sarawak

Due to the special conditions in Sarawak of low population density, difficult terrain, the large distances involved and low levels of electricity consumption, further progress in electrifying the less accessible rural areas cannot be easily achieved using current strategies. An alternative approach incorporating elements of both the RES strategy and the small generator programme is recommended for consideration, as laid out in full in Chapter 7. This approach would require a substantial contribution (either financial or in the form of labour, depending on the level of income) from the communities involved, as an indication of their commitment. The projects would be community-run but have the underlying support of a centrally funded technical support service which would assist with acquisition, maintenance, repair and replacement of generators.

Consideration should also be given to the role of private commercial supplies in the rural electrification of remote parts of Sarawak which are far from a public supply network. In certain circumstances there might be scope for encouraging the proliferation of commercial supplies. This might involve financial assistance being made available to potential suppliers, provided that price controls and safety standards are applied.

8.4 Recommendations for further research

It has been suggested by development administrators that there is scope for more detailed and specific research on the impact of rural electrification on communities in Sarawak. However, it is the opinion of the author that the issue of rural electrification cannot be effectively examined or discussed in isolation from other processes of socioeconomic change. This study attempted to set rural electrification in the context of the policies and pressures relevant to rural life in Sarawak. Since it is clear that research is needed in other key areas of rural development policy and planning, further work would be of most relevance in the context of an integrated (and consequently more cost-effective) research project examining the whole range of development initiatives and needs.

In addition, specific further work is required to determine the suitability of renewable energy alternatives to diesel generation for community-run power supplies. In particular the high rainfall and rugged terrain which characterises so much of rural Sarawak indicates a potential role for micro hydro power in rural electrification. However, careful preparatory research is essential since there is little experience in Sarawak of either micro hydro technology nor the low cost design approach appropriate to village-scale projects.

Fig. 25. *Photograph of the homemade dam at Bakelalan.*

GLOSSARY

autogenerator	An autonomous generator.
Bahasa Malaysia	The Malaysian national language, based on Malay.
Barisan Nasional	The ruling national coalition of political parties.
Batang	A big river.
biomass	Organic carbon-based material, deriving from plants or animals, which reacts with oxygen, in combustion and natural metabolic processes, to produce heat.
British North Borneo	The former name for Sabah, prior to the formation of Malaysia.
Council Negri	The State Assembly in Sarawak.
Dayak	The collective name given to indigenous ethnic groups inhabiting the interior of Borneo.
Dewan Negara	The Malaysian Senate.
Dewan Ra'ayat	House of Representatives.
District	There are a number of Administrative Districts within each Division.
District Officer	A District Officer is in charge of each District.
Division	For administrative purposes Sarawak is divided into nine Divisions.
Door	The commonly used vernacular term for household.
East Malaysia	A term used to describe the two Malaysian Borneo states of Sabah and Sarawak.
Gawai Dayak	The most important Dayak festival, to celebrate the end of the harvest, now represents Sarawak's major official holiday.

Hari Raya	The most important festival in the Islamic calendar marking the end of the annual pilgrimage to Mecca.
kampung	The Malay word for a village.
landas	The rainy season which occurs between November and March in Sarawak.
load curve	A 24 hour electricity demand profile for a typical day.
load factor	The ratio of average to peak power requirement for an electricity supply system.
longhouse	This is the characteristic dwelling of the Dayak. It is essentially a village, raised on stilts, with the separate apartments of individual households joined together in a continuous series (Ave & King 1986).
micro hydro	The definition adopted by SESCo has been used throughout the thesis. Micro hydro, therefore, refers to hydroelectric installations of below 50 kW installed capacity, rather than the more conventional cut-off point of 100 kW.
mini hydro	Hydroelectric plant of installed capacity in the range 50 kW - 1 MW.
Minor Rural Project	This is the umbrella term used for small-scale development (mostly construction) projects for villages.
Orang Ulu	Refers to the "peoples of the interior", including the Kayan, Kenyah, Kelabit and Penan.
Penghulu	Native chief for a group of small villages.
Peninsular Malaysia	This is the official name given to the Malay Peninsula and is often also referred to as West Malaysia.

Resident	The officer-in-charge of a Division.
Temenggong	The highest level of Native Chief.
West Malaysia	see Peninsular Malaysia.
Yang di-Pertuan Agong	The title of the King of Malaysia.

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Appendix A

PROPOSAL FOR A STUDY OF RURAL ELECTRIFICATION IN SARAWAK

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Introduction

A postgraduate project to study the progress of the Malaysian rural electrification programme, and in particular its significance within the development policies of Sarawak, is proposed. This project would be part of a programme for collaborative research which has been set up between the Institute of Strategic and International Studies (ISIS) Malaysia in Kuala Lumpur and the University of Edinburgh in the UK, to examine specific energy policy issues.

A preliminary study to decide more fully upon the scope of such a project and ascertain its limits has been undertaken. The study was carried out in July and August of this year and comprised meetings with relevant authorities and field visits to selected sites in Peninsular Malaysia, Sabah and Sarawak. Approval and support for the study was sought from appropriate officials and bodies, and contacts have been made in preparation for the planned fieldwork.

Rationale

The energy sector is a key component in the economy of every country and plays a crucial role in its long term economic development. A reliable supply of reasonably priced fuel and in particular the provision of electricity is of prime importance in promoting economic growth and national development. However, the objective of the rural electrification strategy adopted by the Malaysian Government is to contribute to an overall increase in the standard of living in rural areas.

It is proposed that this study investigate the various methods of supplying rural areas with electricity and examine their consequent impact on the lives of the local people. It is hoped that the results of the study could assist in optimal allocation of scarce resources and in the selection of future policy options.

From a development research point of view, Sarawak is particularly interesting as, within a relatively small area, are to be found a wide variety of rural communities at various stages of development, with and without an electricity supply. In addition the electricity may be provided by a direct connection to an existing system or an isolated generator requiring some involvement of the local people in its operation and maintenance.

Objectives

These are:

(1) to ascertain the extent and form of rural electrification in Sarawak

(2) to identify the constraints and problems in implementing the programme

(3) to determine the priority assigned to the electrification of rural areas at each level of administration

(4) to examine the effects of the rural electrification initiative on selected communities

Method

Interviews will be conducted with officials in the relevant government departments, the Sarawak Electricity Supply Corporation (SESCO) and at the various administrative levels. Documents and statistical records will be consulted. Visits will be made to SESCO sites and other generation projects.

A number of categories of rural community have been identifed for the purposes of the study, namely:

(i) without electricity
(ii) with a SESCO connection to an existing system
(iii) with a mini hydro supply
(iv) with a diesel generating set

Additional categories of interest include a longhouse which has a non-operational diesel generator and one which is in the vicinity of an overhead high-voltage line but itself has no connection to the system.

Appropriate longhouses and kampungs will be selected to represent the various categories, drawing on the experience and knowledge of other researchers and personnel in Sarawak. The selection procedure will necessarily take into account:

(a) Location - relative to other settlements
- geographical classification of area
- accessibility
(b) Ethnic group
(c) Predominant activity and level of cash-economy involvement
(d) Longhouse/kampung
(e) Number of people and number of households/doors
(f) Level of infrastructural development
(g) Traditional/resettled
(h) Electricity supply and date of installation

Short field-trips of one to two weeks will then be undertaken in each of the selected communities enabling the compilation of a number of case studies. Basic data characterising the community as well as more specialised information on certain topics will be sought, utilising techniques of participant observation and informal interview.

Five general categories of data will be collected:

(i) Basic community details
(ii) Subsistence and economic activities
(iii) Evening activities
(iv) Energy - sources, uses and costs
(v) Electricity - details of supply, administration, operation costs and problems
(vi) Opinions - priority attached to electricity, advantages and disadvantages and changes which have occurred since installation

Resources

The study is being wholly funded by the UK Science and Engineering Council with additional support from the Department of Electrical Engineering at the University of Edinburgh. In addition to the standard maintenance allowance, a travel grant has been awarded to cover the costs of a return flight to Malaysia and internal travel during the course of the field work.

For the purposes of the preliminary study the researcher was initially based at ISIS in Kuala Lumpur. The direction and progress of the work plan have been discussed at regular intervals with ISIS personnel to ensure the validity and relevance of the study, and to incorporate ISIS experience and perspective.

Findings of the Study

Following the termination of the field work the results of the research conducted in Malaysia will be published in a report. Copies of this report will be made available to the Sarawak State Planning Unit and ISIS Malaysia for distribution to interested parties as they see fit. It will also be submitted to the University of Edinburgh as part of the requirement for a postgraduate degree in the field of energy policy.

APPENDIX B: LIST OF PERSONS AND ORGANISATIONS VISITED

IN SARAWAK:

Yao Sik Heng	Senior Elec. Eng., SESCo Sarikei Regional Office.
YB Dr James Masing	Political Secretary to the Prime Minister of Malaysia attached to the Minister of Works.
Jayl Langub	Principal Assistant Secretary, State Planning Unit.
Lucas Chin	Director of Sarawak Museum.
Dr Hatta Solhee	Deputy Director of Development, State Development Office.
Gabriel Adit	Senior Research Officer, SESCo.
Tan Ah Hock	RES Engineer, SESCo Western Regional Office.
Haji Mohd. Anis	Deputy Director of Development (Implementation), Sarawak Department of Development.
Datuk Leo Moggie	Federal Minister of Works.
Andrew Gumba	Sarawak Administrative Officer, Lubok Antu District Office.
Abdul Rahman	Sarawak Administrative Officer, Belaga District Office.
Sia Yuk Siew	Senior Electrical Engineer, System Development, SESCo.
Edward Rajit	Chief Accountant, Finance-Budget Section, SESCo.
Bernard Souling	Senior Civil Engineer, Mini Hydro, SESCo.
Walter Chambers	Assistant Secretary, State Development Office.
Nicholas Patrick	Senior Engineer, Mechanical Section, JKR.
Umar Ali Seman	Engineering Assistant, SESCo Lundu Office.
Stell Sindau	Station Manager, Batang Ai Hydroelectric Power Station.
Edward Sadai Anja	District Officer, Lubok Antu.
Dennis Langub	Sarawak Administrative Officer, Lawas.
Ong Ngiok Siang	Electrical Engineer, System Operation, SESCo.
Lawrence Tan	Solar Energy Company.

Ubaidillah Abdul Latip	Assistant Secretary, State Planning Unit.
Francis Manggie	Civic Development Officer, Serian District Office.
Sim See Sheng	Civil Engineer, Mini Hydro, SESCo.
Yusuf Abdul Wahab	Civil Engineer, Mini Hydro, SESCo.
Chua Say Kiat	Chief Engineer, System Development, SESCo.
Abang Ali Bolhassan Wylie	Extension Service Department, SEDC.
Dr Joseph Ko	Senior Statistician, Department of Statistics, Sarawak Branch.
Michael Saweng	District Officer, Lundu.
Jonathon Saga	District Officer, Sarikei.
Philip Chen	Electrical Engineer, SESCo Sarikei Regional Office.
Alice Doria Muti	Consumer Engineer, SESCo Sarikei Regional Office.
Junaidi bin Reduan	District Officer, Lawas.

IN PENINSULAR MALAYSIA:

Abdul Rauf Salim	ISIS analyst
Dr Mohd Noh Dalimin	Physics Department, UKM.
Dr Rozali	Development Planning, LLN.
K.V. Ramani	Energy Programme Coordinator, Asia Pacific Development Centre
Ray Avery	Second Secretary, Commercial Section, British High Commission
Dr Salim Sairan	LLN R&D Department
Mohd. Yasi	Energy Section, Economic Planning Unit of the Prime Minister's Department.
Zainuddin Zakariah	Ministry of National and Rural Development.

APPENDIX C: SETTLEMENTS AND PROJECTS VISITED

Rumah Sunok, Nanga Stamang	Engkari, Lubok Antu.
Kampung Sejingkat	Kuching District.
Batu Keling	Balui, Belaga.
Uma Kulit, Long Jawe	Balui, Belaga.
Uma Ukit, Long Ayak	Balui, Belaga.
Uma Lahanan, Long Pangai	Balui, Belaga.
Lubok Antu Oil Palm Mill.	
Batang Ai Hydroelectric Power Station	Lubok Antu.
Rumah Nisau, Panjai Ruai	Lubok Antu.
Rumah Rabong, Sebangki Panjai	Lubok Antu.
SALCRA Cocoa Scheme	Batang Ai Resettlement Scheme.
Tinting Lalang	Lubok Antu.
Batu Lintang Hydro Project	Sri Aman.
SEDC Silkworm Project	Biawak, Lundu.
Lundu Mini Hydro Project	Lundu.
Mayang Tea	Tebakang, Serian.
Rumah Saong	Sungei Engkabang, 53rd Mile Kuching-Serian Road
Kampung Jerok	67th Mile Kuching-Serian Road.
Kampung Talagus	65th Mile Kuching-Serian Road.
Kampung Tangga	Tebakang Road.
Kampung Munjau	21st Mile Kuching-Serian Road.
Kampung Stunggang Melayu	Lundu.
Kampung Pueh	Lundu-Sematan Road.
Kim San Road	SESCo "Gotong Royong" Project, Sarikei.
Rumah Jimbai	Bayang, Sarikei.
Meradong Scheme B	Bintangor.

Rumah Pak	Bintangor.
Rumah Tutang	Bintangor.
Matu-Daro RES project	Daro.
Seafood Processing Factory	Sarikei.
Kalamuku Hydro Project	Lawas.
Buduk Nur	Bakelalan.
Buduk Bui	Bakelalan.
Long Langgai	Bakelalan.

APPENDIX D

EXECUTIVE SUMMARY

PRIORITIES AND PERCEPTIONS : A STUDY OF PROGRESS MADE IN THE RURAL ELECTRIFICATION OF SARAWAK

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Energy Systems Group

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SCOTLAND, U.K.

20th April, 1991.

This study is wholly supported by the UK Science and Engineering Research Council and has been made possible by the kind cooperation of the Sarawak State Government.

This is a summary of the draft Final Report which has been prepared following analysis and discussion of the results of nine months of fieldwork in Sarawak. Meetings have been organised for consultation and discussion, with a view to incorporating the advice and opinions of Malaysian development administrators and experts in the field. It is hoped that the results of the study may prove of value as an input into the discussion currently taking place into the problems of rural electrification in the State.

1. INTRODUCTION

The present study of rural electrification in Sarawak and its problems and prospects is deliberately broad in scope. It is anticipated that it will have prepared the ground for a more detailed and quantitative assessment of the options for, and the effects of, rural electrification. An attempt has been made to view the issues from the "top-down" and "bottom-up" approaches, that is, from the perspective of the authorities and the viewpoints of the rural people. As is the current trend in development research, a multi-disciplinary approach was adopted in which socioeconomic as well as technical and organisational factors were under consideration.

2. OBJECTIVES

The main objectives of the study are:

(1) to investigate the extent and form of rural electrification in Sarawak;

(2) to identify constraints and problems facing implementers and consumers;

(3) to discuss the priority assigned to the electrification of rural areas at each level of administration;

(4) to examine the effects of the rural electrification initiative on selected communities;

(5) to make recommendations with reference to the policy issues associated with rural electrification.

3. SCOPE

The study is concerned with issues of rural electrification in the context of overall rural development and involves inputs from policy makers, programme planners, implementers and members of rural communities. A wide range of communities was selected from six Administrative Districts according to the nature of their electricity supply, but necessarily taking into account population, location, level of cash economy involvement and degree of infrastructural development.

4. METHODS

Fieldwork methods involved:

(1) review and detailed study of documents and publications held by Government departments, SESCo and the Sarawak Museum Library;

(2) discussions with relevant officials from both Government and Statutory bodies;

(3) field visits to the selected Districts for:

- interviews and discussions at District Offices and local SESCo Offices;
- group interviews in selected rural communities;
- visits to special development projects.

5. CONCLUSIONS

(1) High priority is awarded by the Government of Malaysia to the electrification of rural areas, as one of the higher profile rural development initiatives. The Sarawak Electricity Supply Corporation (SESCo) has recently set a target of achieving 90% electrification in Sarawak by the year 2000.

(2) Electricity use in rural areas is almost exclusively limited to the domestic sector, with little prospect for the development of productive or commercial applications in the near future. Rural electrification is therefore acknowledged as primarily fulfilling social and equitable objectives.

(3) Whilst great value is placed by many communities on the acquisition of an electricity supply for the village, even those showing most enthusiasm for electricity did not place it at the top of their list of development priorities. Road construction or opportunities for increasing their cash income were most mentioned as top priority concerns.

(4) Existing forms of electricity supply include:

* the state utility's steadily expanding grid transmission system and many smaller unconnected rural stations serving small towns and clusters of villages;
* small generators distributed to individual communities under the Minor Rural Projects programme, as administered by the State Development Office;
* private commercial supplies, which are generally unregistered.

The emphasis is heavily weighted towards electrification by the state utility, with the ultimate aim being to grid-link all consumers.

(5) There is currently little coordination between the implementing authorities, and the programmes are virtually independent. Records of the small generators distributed under the State Development Office programme are not comprehensive, and cannot be updated due to the lack of provision for monitoring the projects at District level. Consequently the number of generators still working is unknown.

(6) Problems experienced by the communities involved with the small generator programme are exacerbated by the lack of a support structure to ensure and assist with the regular servicing and repair of generators.

(7) It is suggested that further progress in electrifying the less accessible rural areas of Sarawak cannot be easily made using current strategies. An alternative approach, put forward for consideration, is that the best features of both the SESCo and State Development Office programmes be combined to form a more cost-effective and longer term electrification initiative for remote villages. Some form of contribution would be required from the communities involved as an indication of their

commitment. The approach would also rely on the community itself for organisation and day-to-day operation, following appropriate training, but full technical back-up would be provided by the authorities, to ensure maximum lifespan and optimum performance of each installation.