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PARTICIPATION OF THE PRIVATE SECTOR IN POWER SUB-SECTOR IN KENYA: A CASE STUDY OF BROOKE BOND (K) LTD IN KERICHO DISTRICT, KENYA

By

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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This thesis has been submitted for examination with my approval as University Supervisor.

Signed ....

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DEDICATION

This work is dedicated to my old grandparents, Solomon Kiplelei Arap Sinei (96) and Martha Taputany Sinei (89).

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ABSTRACT

Recent discussion of approaches to power sub-sector improvement in the energy sector in developing countries have tended to concentrate exclusively on privatization of the public power utilities. There is need for substantive studies on the ways to improve the level of efficiency in the sub-sector. This study provides an overview of the issues and/or challenges related to the private sector participation in the power sub-sector in Kenya. From the very limited number of private companies having their own power production projects existing in Kenya ;Brooke Bond (k)Ltd in Kericho has been one of the most active in small-scale power production.

The main objective of this study was to find out the role the private sector could play in the power industry. The extent of power generation by the company was assessed in the context of supply and demand .The guiding principal of the study was that production of power by the company for its own consumption is ,in itself ,participation.

Chapter one of the study presents the introduction which include statement of the problem ,the scope of the study ,study objectives and study assumptions. Chapter two reviews energy sector's current status in the world. Chapter three examines the various issues which determines the location and/or sitting of power stations. Further, it bring out various attributes associated with different power sources ,and the consideration in their location. The chapter ends by coming up with a conceptual model which outlines the way the private sector should be involved in the power industry. The concept of multi-regional and multi-sectoral approach to power generation, distribution and transmission is

discussed. This is focused on diverse renewable power resources prevailing in different regions.

Chapter four presents background information of the study area. The physical characteristics of the study area are discussed ,as they relate to generation of power from hydro. Chapter five explains the methodology which was used in undertaking the study. Chapter six examines production of power by the company .It evaluates the generation of power by the company and the amount it imports from the national utility. The study found out that the company can generate power efficiently for its own consumption.

The problem of formulation of relevant institutional and legal framework is discussed in chapter seven. The study suggests the various ways of incorporating the private power producers into the national utility system or supply power at regional level. The study gives recommendations on the ways which power development can be planned ,which involves the private sector ;directly or indirectly. Lessons learnt from the case study are outlined in this chapter. The study concluded that the private sector has a role to play in power industry ;and therefore the various renewable energy sources at different regions can be harnessed for power production by not only the public institution(s)but also the private sector.

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Abbreviations and Acronyms

IPP	Independent Power Producer
KWH	Kilowatt Hour
BOOT	Built - Own - Operate - Transfer
BOO	Built - Own - Operate
IFC	International Finance Corporation
UNEP	United Nations Environmental Programme
UNDP	United Nations Development Programme
NDP	National Development Plan
KPLC	Kenya Power and Lighting Company
BBK	Brooke Bond Kenya.

Operational definitions

1. Backup power - Reserve power for special circumstances, such as an emergency or systems failure.
2. Business interruption - stoppage of normal business operations.
3. Independent Power Producers - Private power producers who have developed power plants, typically on a project finance basis, to sell power to an existing utility or directly to distributors or large consumers.
4. Non-utility generators - Power producers other than public utilities.
5. Peak power - The maximum non-instantaneous electric power in a specified period of time.
6. Plant downtime - time when the power plant is not producing Power because of a schedule or forced Outage or shutdown.
7. Power purchaser - the entity purchasing power from a private power developer. Usually the public utility of the host country is the power purchaser.
8. Private power developer - an individual, group or company that develops power plant (s) on a private basis to own, operate, lease and / or transfer.
9. Tax holidays - Exceptions from some or all taxes for a specified period of time.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

Efficient networks of physical infrastructure in both rural and urban areas are, indeed, crucial and/or important requirement of any economy to grow. The acceleration of industrialization and faster development in agriculture, commercial sector and other sectors of the economy calls for the increased provision and efficient management of the energy sector among others (National Development Plan, 1997)

Most governments recognize the over-riding importance of the energy sector and this is demonstrated by the heavy investment made by various governments on the sector. Despite the fact that most countries have succeeded in increasing the provision of energy, especially electricity, in the developing countries the deteriorating quality of facilities now in place, and the problem of unpredictable weather patterns (in the case of Hydropower generation) poses a challenge to the governments. The weak economic bases worsen this situation (Askin, 1976).

Further, development of new facilities to generate power and operation and proper maintenance of the existing ones have been constrained. One of the reasons include the ever growing demand for power arising from rapid population growth industrialization; coupled with poor planning and/or management capacity in the energy sector. Moreover, the monopoly in the provision of power by the governments in the past has had serious implication in the current energy sector status, particularly in power sub-sector(World Bank,1996)

1.1 Research Problems and Justification of the Study

It is noted that in Kenya the current electric generation is not adequate, with demand regularly exceeding the supply particularly during the peak hours. The supply problem is especially worse during dry seasons (drought) when the dam levels are low and / or when some of the generating plants break down or are out of service for maintenance (NDP, 1997).

On such occasion power has to be rationed. Such rationing normally has harmful effects on the productivity of most sectors of the economy and thus discourages additional investments in the country(Daily Nation May 2000). The year 2000 was a trying period in Kenya's energy sector, especially in terms of power generation. The country was on the brink of severest power deficiency ever - the consequence of an unprecedented fall in the water levels of Masinga dam, the main reservoir of power generation plants on Tana River.

The situation lead to a power shortfall of 100MW in the national power generation capacity from 690MW to about 590MW. The country missed long rains for two successive years. The situation was further worsened by the fact that the levels were at unprecedented low levels at the time when the long rainy season had passed (Daily Nation, May 2000)

n power generation systems, hydropower is important only next to thermal power in terms of lectricity generation. Approximately a third of the total power of the world is met by ydropower generation (Mitchell, R, 2000). In Kenya, electric power generated from hydros urrently accounts for nearly 75 percent of the total domestic installed capacity(NDP,1997). It is orth noting that due to the problem of unpredictable climatic conditions, especially rainfall, provision of power from hydropower generating stations is curtailed. The encouragement of provision of power by the private sector through diversified sources would add some wattage to the national grid, which would then be utilized in other areas of development. Even if the private generator does not supply power to the national grid, still power would be saved by not supplying power to the organization generating its own power from the national grid. Further, companies which are located in climatically favourable areas will be able to generate power without any problem by utilizing natural resources which can be harnessed for power generation. For example areas which receive relatively adequate rainfall throughout the year can develop a mini- hydropower station.

It is for the above reasons that one concludes that in order to address the problem of power deficit in this country, the private sector should be supported in its effort to develop power generation plants, be they hydro or other sources, by providing them with favourable incentives. Power generated could be for their own consumption or to supply the national grid through contractual agreements.

This study gives a detailed evaluation of the role and / or participation of the private sector in the power sub-sector by taking Brooke Bond (K) Ltd as a case study. The study will attempt to nvestigate the various problems, which hinder the private participation in power production nd/or expanding their generation capacity. An attempt will be made to find out the capacity the ompany produce at the moment and inquire whether there is a deficit or surplus of power gainst the potential capacity it can produce. The study will also examine the various pportunities the company has which can assist in enhancing power production.

Analysis has been done to compare what is supplied with from the national grid and what is produced in case of power rationing/power failure from the national grid; and the savings made if it utilizes its own power. Finally, the study has shed light on the role of the government in power sub-sector; opportunities and constraints it offers in the industry and therefore how it relates to the Independent Power Producers (IPPs).

1.2 Key Research Questions

Specifically, the study poses the following questions:-

(a) How feasible, effective and sustainable is the generation ,distribution and transmission of electricity by the private generator at micro level?

(b) What lessons can be learned from the experiences of participation by the private sector in the power sub-sector at the micro level?

(c) What are the economic and management experiences from a successful local private power generator, and therefore what lessons can be learned from the case study?

1.3 Study Objectives

The main goal of the study is to provide a conceptual foundation and/or framework on which power generation distribution and transmission at small-scale level by the private sector may be based on in future with respect to planning policies and practice in the power sub-sector.

Three specific objectives have been outlined: -

) Finding out the power capacity, which the company generates with, regard to demand and/or supply from its power generation stations.

ii) Establishing the possibility of a private power generator to supply power at a local level; without connecting to the national grid.

(ii) Finding out whether encouragement and/or planning for small-scale power generation, distribution and transmission by the private sector could be realized effectively if government provides legal framework to encourage the private sector participation.

1.4 Study Assumptions

The power sub-sector in Kenya has not been privatised nor has it been totally liberalized. Therefore, it is imperative to make various assumptions, which could guide the study throughout to the end. Therefore, the study is based on three basic assumptions. These are:-

(i) The sub- sector is on the process of being privatized/liberalized.

(ii) The government, through Electricity Regulatory Board, remains the sole agent, which determines the rates/tariffs in power sale to the consumers.

(iii) Policies and regulations on multi-regional/multi-sectoral generation, distribution and transmission of power have been formulated.

In order to address the research questions above the following hypothetical statements are made, hat:

a) Participation of the private sector in power sub-sector will lead to Improved /increased efficiency in power supply in the country.

b) Planning and/or encouragement of power provision by the private sector will influence other developments in their neighbourhood hence contribute towards regional growth and development.

1.5 Scope of Study

The study will be confined to Brooke Bond Tea Estates and its environs. It is important to note that the tea estates in this case comprise of the Factories, Offices, Residential estates and other facilities. The focus of this study will be on the electric power generation, distribution and transmission by the company for its utilization. The dams for the hydroelectric power generation are located on the rivers passing through the tea estates.

Its conceptual scope is limited to the provision of a comprehensive approach towards planning for and encouragement of the provision of power by the private sector either for their own consumption and / or for supply to the national grid to boost national supply.

1.6 Limitations of the study.

In undertaking this study, the researcher experienced various constraints, which affected the output to the study. The study was undertaken at a time when the country was experiencing problems it power industry. There was low rainfall amount received in the country over two consecutive years and this hydropower generation, which the country relies on .As a result there was difficulty in getting information from relevant authorities because of the fear that it could be bused for sinister motives.

The researcher also had financial constraints in undertaking the study .The little financial resources offered by the university for research purposes were inadequate. However, the study sets a foundationfor, which other related studies could be undertaken in Kenya in the future so that problems in the power industry can be addressed.

CHAPTER TWO.

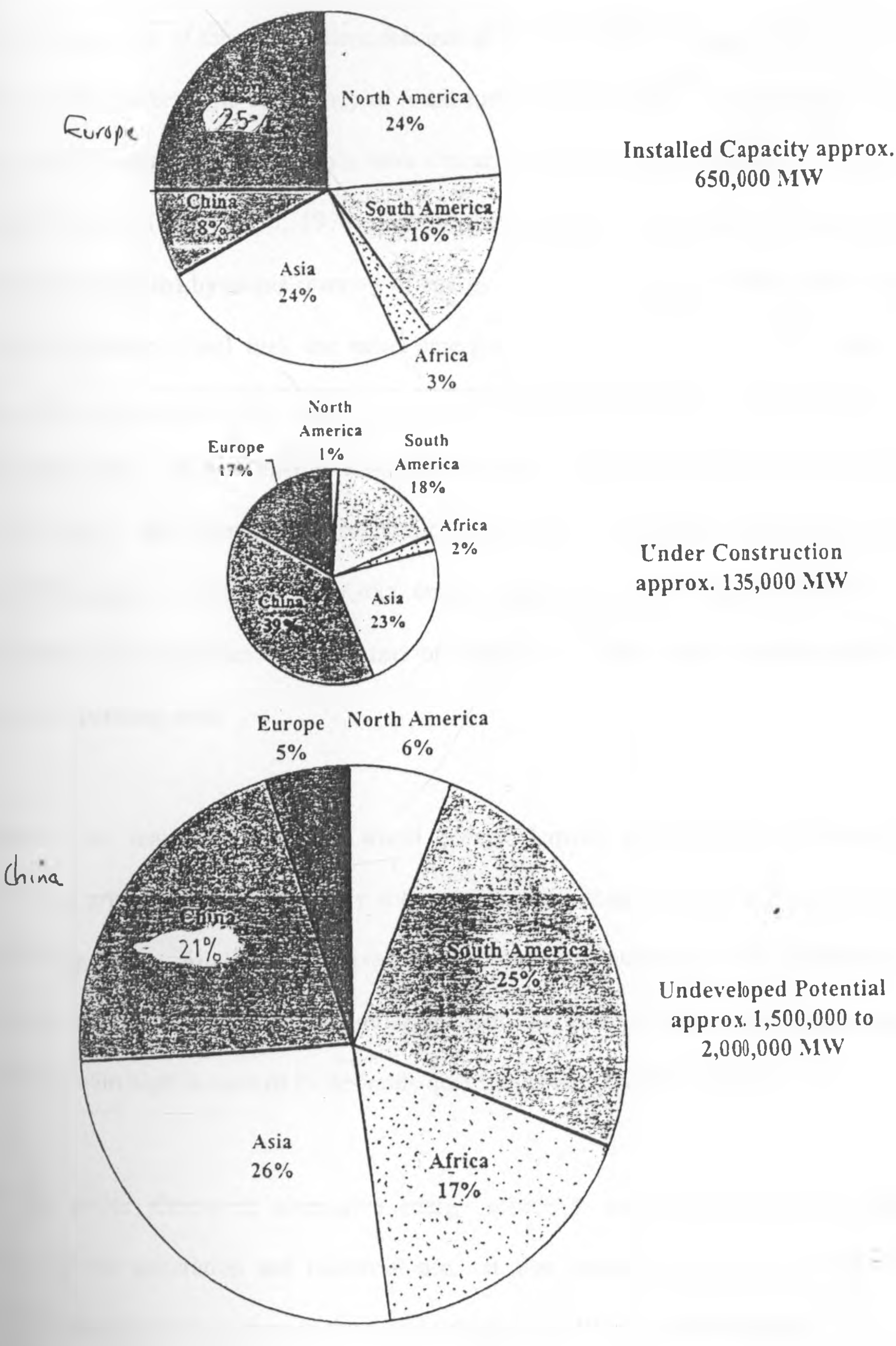
2.0 A Review of Global Energy Status.

2.01 Introduction

It is important to note that energy requirements of almost all countries are indeed spiraling up inexorably. In order to get a general idea of energy status in the world, the 1972 figures have been used for illustration purposes.The total generated energy in the entire world for 1972 was 5620 TWH (1 TWH = 1 billion KWH). During the period of 1971-1972 the increase of energy was about 400 TWH (Sharma, 1991). This represents approximately 8 per cent increase, and this would mean that the output would be, approximately, doubled every 10 years. Out of this; hydro-energy was 1290 TWH and nuclear energy was 57 TWH, that is about 23 percent and 1 percent respectively. The bulk of the remaining power was from fossil fuels. It should be noted that the bulk of this energy was generated and consumed; surprisingly, by two countries, the USA and Russia (former USSR).

According to Sharma, consumption figures for USA in 1973 was 1856 TWH while consumption for the former USSR in the same year was 1000 TWH. This represents about 50 percent of the total generated energy of the world for that year. The share of hydro in the above in the above figures is 272 TWH and 160 TWH respectively. Total installed hydro-capacity of USA was 61.3 GW (1 GW = 1 million KW) from the 1973 figures(Sharma,1991).The total global hydropower installed capacity in the world is about 650,000Mw. This is against an estimated total exploitable world's hydro-energy in the order of 11,000 TWH per year but early88 percent still remains untapped (Sharma, 1991). The diagram below shows the worldwide hydropower situation (1998).

Diagram 1: Worldwide hydropower development-1998.



Source:Head,C. (2000) Pg 3.

2.02 Alternative Sources of Energy in the World.

Over the last century, one of the most salient features of the evolution of energy consumption throughout the world has been the emergency of fossil fuels, coal, crude oil and natural gas - as the primary source of energy. Several trends have characterized the world energy development since the World War II (Hagel III, J, 1976). These include, high growth rates in aggregate energy demand accompanied by ample reserves of energy sources; a progressive shift from coal to crude oil as a primary fossil fuel, the rapid emergence of natural gas in overall energy consumption and unanticipated delays in the commercial development of the major short-term alternative to fossil fuels - nuclear energy. Emphasis should be placed the enormous degree of uncertainty involved in any comparative economic evaluation of alternative energy sources. Such an analysis requires the forecasting of total energy demand and the evaluation of relative resource economics involving the various forms of energy, consumer prices, and investment requirements and operating costs.

Oil has supplied the major share of the world energy demand growth since 1950(David RC,1984). This is primarily due to flexibility and economic advantage of oil in serving a broad spectrum of energy needs. Another alternative source of energy is natural gas. The geography of natural gas production displays certain similarities with the crude oil situation. Demand for natural gas will remain high in view of its desirable qualities as fuel(David R.C1984).

Coal offers the major short-term alternative energy source to crude oil and natural gas, particularly for power generation and industrial use. It also represents the most abundantly available fossil fuel, over the long term in the world (Hagel III, J, 1976). But despite vast untapped reserves in most parts of the world, coal has rapidly been declining in terms of its share of the total energy consumption in each of the major consuming regions. The relative decline in coal's position in the supply of energy can be attributed to three factors:-

1. Increasing competition from petroleum, natural gas and other more convenient sources of energy.
2. Environmental legislation restricting the use of high-sulphur, coal and
3. Increased production costs (Hagel,1976).

The history of the commercial development of nuclear energy has paradoxically been characterized by continuing enthusiasm regarding its long-term potential accompanied by persistent disappointment over its actual attainments (Hagel,1976). Optimistic projections of the contribution of nuclear energy to overall power supply often obscure the fact that so far the only practical commercial application of nuclear energy will be largely limited to this one sector of energy supply, and its long-term contribution will depend on the relative importance of electric power in the advanced industrial economies(Askin,1979).

In terms of electric power generation, the cost comparison among alternative sources are lifficult to make, and attempts to compare the economic costs of electric power generation from ne convectional fossil fuel plants, hydroelectric power plants and from various models of uclear reactors have encountered great obstacles. For example, the different cost structures of arious nuclear models relative to convectional power plants is a significant issue. Moreover, mparisons between nuclear-generated electricity and fossil-fuel generated electricity, among ner sources of generation that are restricted to economic estimates, ignoring the broader factors ich will have substantial role in determining the pace of commercial nuclear development.

In addition to convectional fossil fuels and nuclear energy source, there are a number of other alternative energy sources that have considerable potential for development. Of these, geothermal energy is perhaps the most readily accessible. Geothermal energy is the product of heat radiated from the interior of the earth, which accumulates in subterranean reservoirs in the form of steam, hot water or hot rocks. The commercial exploitation of high-quality geothermal steam for electric power generation in, for example, USA provides sufficient experience to permit compilation of comprehensive cost figures for the electric generating plants(OECF,1995). The commercial development of all varieties of geothermal reservoirs will require an active exploration programme supplemented by a research programme to develop more accurate exploration techniques. This source of power is to be utilised in Kenya.

Another alternative source of energy is the solar energy(World Bank,1996). The enormous potential represented by solar energy has always fascinated researchers interested in developing a virtually inexhaustible supply of energy that would not generate the pollution associated with more convectional forms of energy. There have been numerous suggestions regarding the possibility of building large-scale solar-powered generation systems. Most of these systems involve the collection of solar energy through focused concentrators spread over large areas of the earth's surface, the storage of the resulting high-temperature/ heat in salt or metal tanks, and he use of convectional steam turbines and alternators to generate electricity.

number of alternatives may also be available for more indirect utilization of solar energy: new esigns for windmills. Wind energy provides one of the earliest sources of mechanical power rough such devices as windmills and sailing shifts. Wind energy has proved to be a viable substitute for convectional fuels in the large-scale generation of electricity as the case now in Germany and Netherlands. Commercially available wind-powered generators are generally in low wattage and they supply the power needs of farmhouses or remote locations. Wind-powered systems have environmental advantages of a "clean" power source.

2.03 Hydropower: A General Review

Hydropower is, indeed, important only next to thermal power in terms of electricity generation (Goodland, 1994). It is noted that approximately a third of the total power of the world is met by hydropower generation (Sharma, 1991). There are countries in the world where almost entire power production is hydro-based. For example, in Norway the hydropower constitutes more than 99 per cent of the total installed capacity. In Kenya electric power generated from hydro currently accounts for nearly 75 per cent of the total domestic installed capacity.

Available estimates indicate that, of the total hydro potential of the entire world is 5,000 GW with full utilization (Sharma, 1991). If it is compared to the installed capacity of about 2,000 GW, then it is realized that approximately 60 per cent are still untapped. Surprisingly, even in countries like France; where convectional hydropower is fully developed, large scale development in pumped storage schemes is still being developed. There are various inherent advantages, which make water attractive for power generation (Sharma, 1991).

These include inter alia: -

1) The use of water as a source of energy has an advantage in that water is a renewable resource. Water passes through turbines, without decreasing its utility in any way

Subsequently down stream. It still remains capable of being utilised in other things e.g. irrigation and domestic use. The running costs of the hydropower installation are relatively low as compared to the thermal stations or the nuclear power stations. The hydropower plant is simple in concept and self-contained in its operation. Its system reliability is, therefore, greater than of other power sources.

(2) Modern hydropower equipment has a great life expectancy and can easily last 50 years or more. This can be compared with the effective life of hardly 30 years of, say, a nuclear station.

(3) The modern developments in hydro-turbines have made it possible to utilize a variety of turbines to suit a variety of conditions.

(4) Hydropower also provides ancillary benefits like recreation, fishery, etc, incase of run-of-river plants and additional uses like irrigation and flood control where a storage reservoir is contemplated.

There are, on the other hand, some limitations on the use of Hydropower project. Besides being capital intensive and consequently the rate of return being low, they depend upon natural flows in rivers. Since the flow is extremely variable, the dependable power is considerably less compared to the total capacity.

he power grid has to be capable of catering to the maximum demand rate of power. This is nown as the Peak-Load. It is noted that the Peak-Load demand may be present for only a short riod. It is customary to distinguish the demand in two parts i.e. the base load demand, which is esent for most part of the year against the peaks or daily peaks.

In grid system, the general planning is such that some stations may be run as base-load stations while some others may be run as peak load stations. This is the issue, which this study tries to address. For example, the private sector with extra power can supplement the national power grid system during peak hours, and therefore these stations can serve as peak load stations. The questions, which arise, are how to operate the general system to which a number of powerhouses feed. This again needs careful analysis. As far as hydropower is considered there basic principles can be used:-

(a) Load sharing by hydro ought to be maximum. In Kenya, during the long rains, the flow is at its maximum and advantage of this natural flow has to be taken. On the other hand, the load on the national hydro-systems must be as less as possible when the season is dry and the reservoirs are depleting.

(b) In effecting load sharing, advantage ought to be taken of the fact that the hydropower is naturally suited for peaking purposes.

(c) The privately owned hydro plants and other sources could provide peaking power for limited hours of the day and, therefore, need to be assessed for possible utilization.

.04 Power Generation Systems in Developing Countries

'ower generation systems in developing countries particularly Africa, are relatively small, a sult of low levels of electricity consumption. For instances, 3 TWH in 1971 and 81 TWH in 991, that is, a fraction of the hydroelectric potential of the site of Inga in Democratic Republic Congo (DRC). On a per capita basis, consumption has risen and fallen with GDP: from 134 WH in 1971 to 247 KWH in 1980 and 200 KWH in 1971 to 247 in 1980 and 200 KWH in

1991 (Covarrubias, A.J, 1996). These figures are less than 580KWH for China and 350 KWH for India but congruent with Africa's low level of development and predominance of its rural sector.

According to Covarrubias, A.J. (1996), in most countries in Africa consumption of commercial energy is very low and remains so upto a per capita income of $1,000. Further, the share of electricity of commercial energy consumption does not exceed 25 percent except in very industrialized countries that are poor in fossil fuel.

It is noted that power consumption has been more resilient to economic recession in Nigeria where prices are highly subsidized and in poor countries like Burundi and Tanzania where industrial demand, which is GDP elastic, is low. Power supply seems to have been a constraint to development only in Ghana and Guinea where consumption fell because of frequent massive power outages.

Power generation and therefore supply, should not, as a rule, lag behind or race ahead of economic growth. Many LDCs have tried to use the sub-sector as a leading edge of development by setting unduly low power prices with an aim of spurring economic growth. Electricity generation is very capital intensive and therefore this policy has proven unaffordable, even in medium and high-income countries.

In most developing countries, unit generation costs are on the high side. Power distribution is also expensive in cities because of low levels of consumption and in rural areas where the cost typically doubles. The priority for the power sub-sector of developing countries, particularly

Africa, is not to catch up with accelerated economic growth, as is the case in East Asia, or repair the environmental damage caused by high-energy intensity and demand for restructuring as in Eastern Europe. The challenge lies primarily in meeting effective demand without adding to public funds for social sectors such as education and health.

According to UNEP (1985), the commitment to development, rather than growth, as a socio-economic objective has major implications with regards to power generation in developing countries. In terms of economic development increased power generation means ability to produce the necessities and amenities of life. Further it noted that the relationship between power generation and economic development is a dynamic one in which the amount, type and speed of economic growth are mutually dependent variables of the quantity, kind and price of commercial power available (UNEP, 1985).

It is noted that increasing costs of generation, transmission and distribution facilities, long gestation periods encountered in the development of these facilities and resources limitations as well as factors that adversely affect the extension of electricity grid to, for example rural areas is a major problem. Generally, the use of power grew along with the development process at the rate of 10 per cent a year from 1950 to 1974 in developing countries and at 8 per cent since then (UNEP, 1986). About 25 per cent of the developing countries commercial primary energy is used for electricity production (World Bank 1980). In Malaysia, for instance, efficiency in the production of electricity in power stations has been increased (UNEP 1986).

According to IEEE, recommended practice for emergency and standby power systems (IEEE, 1974), power was less critical. If power was interrupted oftenly, another source could be found. However, with advent of solid-state electronics and computers, the need for continuous, high quality electric power became critical. It is noted that many installations require uninterrupted power (IEEE, 1974) but interruption of power in most developing countries has been common.

Lakervi (1989) states that a reliable electricity supply is one of the prerequisites for the modern way of life. He, therefore, explains that it is very important for an electricity supply utility to have good contacts at three planning level (i.e. National level or Provincial level and Municipal level as well as with individual private companies). This concept seems to be lacking in most of developing countries where the state is the sole player in the power sub-sector.

According to UN (1973), an electricity supply system cannot be reliable unless some spare plant is provided for use when other plants are out of service for unforeseen reasons. It Further states that the amount of spare plant expressed as a percentage of the maximum load will depend upon several factors such as the number and capacity of plant units in the system and the degree of their reliability and their interconnection.

In any country, the generation and distribution of electrical power provides the life blood of successful economic and social development (UN, 1993). Therefore, the availability of cheap and efficient power, coupled with the natural resources of any nation contributes to the economic and social well being of the nation as a whole. According to United Nations report on energy (1993), since the early 1950s, the power systems of many countries have been expanded to meet the increasing demands of both industrial and domestic power users. The place of worldwide power generation development accelerated throughout the 1960s and 1970s before slowing down in the last decade; and now accelerating again as we start the new century.

Many of the power plants operating in the developing countries are, indeed, now approaching the age when decisions have to be made to either retire them or replace them with new, prove modern equipment and systems, or to extend the useful and reliable life of the existing facilities (UN, 1993). It is noted that in many cases, this seeks to improve the performance and operation of the rehabilitated equipment. As power plant age, the performance deterioration becomes apparent in two principal ways. Net power generated by the facility is gradually reduced and the reliability of the overall plant decreases.

2.05 Energy Sector in Kenya

According to the National Development Plan (1997) presently, major sources of energy in Kenya are petroleum fuels, electricity, wood and fuel (i.e. fuel wood and charcoal) and, to a lesser extent, solar energy, wind, ethanol, coal and biogas. However, though there are greater potentials of developing most of these energy sources, petroleum fuels and electricity are currently the major sources of commercial energy.

Statistics indicate that the Kenya's total demand for industrial and commercial energy has been rising steadily from 2.6 million Tonnes Of Oil Equivalents (TOES) in 1991 to over 3.0 million TOES in 1995. This represents a growth of 3.7 percent per annum. It is noted that energy imported from other countries comprise mainly of crude petroleum, coal, coke as well as hydroelectric energy, which is imported from Uganda. Energy imported constitutes about 72 percent of the total commercial energy used, leaving a balance of 28 percent to be supplied from domestic sources i.e. from hydro and geothermal energy sources.

Electricity from both hydro and geothermal sources, totaling an annual average of 830,000 TOES in one of the major sources of energy in Kenya satisfying around 29 percent of the total demand (NDP, 1997). It is noted that production from hydro, petroleum and geothermal account for approximately 94 percent of the total Kenyan electricity consumption with a balance of about 6 percent being imported annually from the neighbouring Uganda.

2.06 Historical Development of Power Sub-Sector in Kenya.

Development of the power sub-sector in Kenya started in 1875, when the Sultan of Zanzibar, Seyyid Bargash, acquire d a generator from Europe to light up his house and the nearby streets. The generator was later sold to Ali Esmailjee Jevanjee, a wealthy businessman in Mombasa then. In 1904, a Mr. Clement Hirtizart got exclusive right from the colonial government to supply electricity in Nairobi..Therefore the start of electricity supply started with the supply to Nairobi frok a small hydroelectric station ta Ruiru in 1907 and the operation of a single diesel generator at Mombasa in 1909.

In 1908, Nairobi Electricity Power and Lighting syndicate was formed. The Company installed a hydroelectric power station on Ruiru River, approximately 26 kms away from Nairobi City, to supply power to the town and its suburbs. In the same year, Mombasa Electric Power and

Lighting Company Limited (a new company) and Jevanjee agreed to sell to the former the generator in Zanzibar and a new era of development started.

In 1922, East Africa Power and Lighting Company (now KPLC) was incorporated and it acquired Nairobi Electric Power and Lighting Syndicate and the Mombasa Electric Power and Lighting Company. In 1932, the East Africa Power and Lighting Company expanded its activity to Tanganyika (now Tanzania) in its aim to be truly "East African", by acquiring controlling interest in the Tanganyika Electricity Supply Company Limited (TANESCO).

In 1936, power generation and distribution licenses were granted to East Africa Power and Lighting Company by the government of Uganda. In 1948, Uganda government formed Uganda Electricity Board (UEB) and invited (EAPLC) to purchase electricity power in bulk. The installed capacity in Kenya then was 85.4MW. In 1954, the Kenya Power Company (KPC) was incorporated with the responsibility of distributing the country's bulk electricity generated capacity. An additional 30 MW was acquired from (UEB) through a contract signed in 1955.

In 1960, EAPLC acquired the Nyeri electricity undertaking; operated then by the Director of Trade and Supplies (a government body) in order to synchronize the power supply and distribution system. In 1963, Kenya acquired independence status from the colonial government. East Africa Power and Lighting Company installed lamps in the new station near Wilson Airport for the Uhuru celebration. In 1964, the Tana River Development Company was formed to explore natural resources along Tana River including hydroelectric power resources. Until 1997, the company owned Kamburu, Kindaruma and Gitaru Power Stations.

In 1973, the government initiated rural development programme (REP) and EAPLC was appointed to be the executing agent. In 1974, Tana River Development Authority was formed to develop land and water resources (including hydropower generation) in the Tana basin. It later changed its name to Tana and Athi River Development Authority (TARDA) after incorporating Athi River into its activities in 1981. In 1983, East Africa Power and Lighting Company was renamed Kenya Power and Lighting Company.

In 1997, KPLC and KPC were finally separated in the energy sector restructuring. Generating assets, which were managed by KPLC, TARDA and Kerio Valley Development Authority (KVDA) were taken by Kenya Power and Lighting Company Ltd. In the same exercise, KPLC was mandated to handle transmission and distribution of electricity while KPC handles generation of electricity from all state-owned power stations. In the same year, two independent power producers invested in the liberalised power sub-sector. This include Westmont Power Company Ltd (43MW) and Ibeafrica (EA) Ltd (44.3 MW). In 1998, KPC was renamed Kenya Electricity Generating Company (KenGen).

2.07 Sources of Electricity in Kenya

Electric power generation in Kenya is mainly from hydro, thermal and geothermal plants. Hydroelectric supply currently accounts for 629 megawatts (MW) or nearly 75 percent of the total domestic installed capacity of 822MW. The thermal oil accounts for approximately 18 percent of the total energy. Electricity from geothermal energy at the Olkaria plant in the Rift Valley supplies 5.4 percent of the total capacity (45.0 MW) (NDP, 1997). With regard to hydroelectric power development is clear that there is great deal of untapped waterpower potential in the country as yet. For example, water potential for power generation is not fully utilized. Year in, year out, a lot of water goes into wastage essentially in the Western Region of the country with relatively more rains throughout the year.

As far as river-wise potential is concerned, the two of the great river systems in Kenya namely River Sondu, Nzoia River and Yala River in Western Kenya have, for long, been un-exploited for their power potential. The rate of development of hydropower in Kenya is less than 10% per year and nowhere comparable to the 7 per cent rate achieved by the developed nations of the world.

Against this background, the growth rate seems to be inadequate. One reason (seems) for this is that perhaps hydropower generation is a public sector activity in which the private sector has no contribution to make. It would look as if the whole Kenya policy, on power sub-sector development would need a fresh review, with focus on diversification power sources and participation of the private sector in power sub-sector.

In addition, Kenyan Government signed an agreement with Uganda in 1954 to import an average of about 30MW annually. According to the National Development Plan (1997), the total installed electricity capacity has grown over the last 10 years from 572 MW in 1985 to 822 MW in 1995, including supply from Uganda. It is noted that this growth was as a result of the development of extra power projects namely: Turkwell (106 MW) and Kiambere (144 MW) hydro plants and the Kipevu (30 MW) gas turbine plant. Electricity generation for a period of 10 years 1984/85 to 1994/95 increased from 2160 Gigawatt hours (GWH) to 3866 GWH respectively. According to NDP (1997), it is projected that by this year (2001) demand for electricity will have grown to an average of 4.9 percent per annum.

2.08 Current Electricity Generation Capacity in Kenya

It is noted that the Kenya's current electric generation capacity is not adequate, with demand regularly exceeding the supply. The problem is particularly worse during the dry seasons when the dam reservoir levels are low and when some of the generating plants break down or are out of service for maintenance. On such occasions power has had to be rationed. Such rationing normally has harmful effects on the productivity of most sectors of the economy and discourages additional investments in the country. The year 2000 was a trying moment in Kenya's energy sector. The country was on the brink of the severest power disruption ever - the consequence of an unprecedented fall in water levels at Masinga Dam, the main reservoir of power generation plants on the Tana River.

The situation led to a power fall of 100MW in the national power generation capacity from 690MW to 590MW. The country missed long rains for two consecutive years. The situation was worsened by the fact that the levels were unprecedentedly low at the time of the year when the long rainy season had passed (Daily Nation, May 2000).

Table 1: Installed Power Systems and Electricity Capacity*. 1991 - 1995 (MW)**

Source	1991	1992	1993	1994	1995
Hydro	629	629	629	629	629
Thermal Oil	168	144	144	147	148
Geothermal	45	45	45	45	45
Total	**842**	**818**	**818**	**821**	**822**

Note: * includes imports from Uganda ** 1 Megawatt (MW) =

1000 Kilowatts = 1 million Watts

Source: National Development Plan, 1997 – 2001.

The government had foreseen the problems in the power sub-sector and in order to alleviate this problem, five major projects with a combined capacity of 338MW were to be added to the system during the period 1997-2001. These projects include Kipevu 1 diesel plant (75MW), Olkaria II geothermal plant (64 MW), Sondu-Muriu Hydro plant (60 MW), Kipevu diesel plant (75 MW) and Olkaria II geothermal plant (64 MW).

Table 2: Planned Power Generation Projects: 1997 – 2001.

Project	Generation capacity (MW)
Kipevu I Diesel Plant	75
Olkaria II geothermal plant	64
Sondu Miriu Hydro plant	60
Kipevu II Diesel	75
Olkaria II Geothermal plant	64
Total	**338**

Source: Kenya National Power Development Plan (1997)

Table 3: Planned Electricity Capacity: 1996/97 - 2000/2001

Source	Fiscal Year Ending June				
	1996/97	1997/98	1998/99	1999/2000	2000/2001
Hydro*	629.0	629.0	629.0	702.0	702.0
Geothermal	45.0	45.0	45.0	109.0	173.0
Thermal steam	76.0	76.0	76.0	63.0	63.0
Diesel	48.0	98.0	98.0	244.0	244.0
Wind turbine	0.35	0.35	0.35	0.35	0.35
Total capacity **	**798.4**	**848.4**	**848.4**	**1118.4**	**1182.4**

Notes: * includes imports from Uganda ** Effective (operational) capacity will depend on hydrological conditions and plant maintenance and outages.

Source: NDP, 1997 – 2001

According to the Ministry of Energy, the first projects, Sondu-Miriu, Kipevu I, and Olkaria II would be implemented by the government through the public sector enterprises while the other two projects are to be implemented by the private sector, commonly referred to as the independent power producers (IPPS).

Table 4. Alternative Sources of Power in Kenya.

Source	Location	Percentage of total capacity generated
Hydro-power	♦ Along rivers Tana, Turkwel	72.3
Geothermal (a local resource Wind power (a local resource	♦ Olkaria in Naivasha ♦ Marsabit ♦ Ngong hills in Nairobi	5.65 0.04
Thermal power	♦ Kipevu power station in Mombasa	7.16
Gas Turbine	♦ Kipevu in Mombasa ♦ Nairobi South power station	3.77
Diesel power generation	♦ Moyale ♦ Mandera ♦ Garissa ♦ Lodwar ♦ Marsabit	0.001

Source: KPLC, 2000

2.09 Recent Developments in Power Sub-Sector in Kenya.

Kenya has long stated its quest to achieve industrialized nation by the year 2020 (NDP,1997). It is with this in mind that she liberalized the economy and licensed independent power producers (IPPs). As stated earlier, it is only when the infrastructure is intact that the industrialization process and proceed smoothly. In the power sub-sector, the government has found various private investment partners in power or power generation. Examples include Westmont Power Co. Ltd, Ibeafrica (EA) Ltd, Wartsila NSD (EA) Ltd, Orpower Inc., Aggreko and Cummins.

In September 1997, Wartsila Corporation established a fully owned subsidiary company, Warsila NSD Eastern Africa Limited (NSDEA), in Nairobi to identify and develop available opportunities in the power sector in the region in cooperation with governmental institutions and local investors. In a short span of three years, Warsila NSD (EA) Ltd. had installed power solutions in East Africa adding up to 50MW (WNSDEA, 2000). In Kenya, the company has put proposals to put power plants for Nakuru and Eldoret.

Further, the funding of the 74MW diesel powered Kipevu II station has been finalised. The Kenyan government signed up for the project with Wartsila NSD Corporation in 1998 and state owned Kenya Power and Lighting Company agreed to buy electricity from the station for 20 years, while Caltex Oil Company agreed to supply the station regularly with diesel fuel for five years. It is noted that Kipevu II will be built and managed under a 'Build, Own and Operate' formula by Tsavo Power Company Limited. With Wartsila, Commonwealth Development Corporation, energy global Power Limited and industrial promotion services (K) as partners.

2.1 Theoretical Framework.

2.11 Introduction

Debates and Theories surrounding the deregulatory of electricity generation and supply industry and the introduction of competition have become topical almost worldwide. Therefore, the question, which arises, is whether restructuring and deregulation of the industry will lead to cheaper and reliable electricity for all consumers. This means that deregulation of power sector will result in regulators exercising less control over generation choices and an opportunity, therefore for the private sector or small scale independent power producers to make significant impact on the industry with generation facilities situated closer to the source of the demand.

Morse (1997) outlines regulatory policy regarding distributed generation by utilities and the impact of restructuring. A distinction is drawn between distributed generation with generation source on the customer side of the meter (self-generation or single net metering) and distributed generation facilities with the generation source on the utility's side of the meter. Morse argues that in a restructured industry with generation, transmission and distribution and ancillary services largely separated, distributed generation on the supply side of the meter proves problematic from the regulators point of view. The consideration of implications of electricity industry restructuring of distributed generation by utilities is only beginning in some African Countries.

2.12 Planning and Economic Analysis in Power Generation

It is important to note that the utility policy decision relevant to a power plant must depend on the analysis of the utility's system as a whole, considering such factors as:-

- Expected load growth both short term and long term
- Installed generating capacity and availability to meet present and future demands including reserves required to cover scheduled maintenance
- The possibility of purchasing excess or extra power from the nearby generators
- The revenues expected from power sub-sector n future.

According to UN (1993), utility planning groups is the energy sector should review most of these factors continually and report to utility management on the electrical generating capacity required to meet present and projected future demands. Computer analysis of utility power systems is the principal tool of system planners in tracking past performance with respect to demand and projected future demands.

Based on technical and economic considerations, the potentials in power sub-sector investment in developing countries is dictated by certain key factors. These include:-

(i) Availability of Alternative Local Sources of Electricity

In developing countries, electricity is obtained mainly from hydropower. The abundance of hydroelectric resources in a specific country gives impetus to the development of this resource of power. However, its success depends entirely on climatic conditions, particularly adequate and reliable rainfall.

(ii)Trends in Production and Demand of Electricity

Although certain major trends have developed over the last decade that are quite clear, (e.g. electricity production has grown fastest in Asia, followed by Latin America and Africa), there are a number of issues that requires feasibility study (e.g. private power generation, distribution and transmission; and sectoral/ regional use of electricity) in order to forecast where the greatest potential may exist in developing countries.

In general, a predictable growth in the use of electricity by the industrial sector should be an indicator that the private sector involvement in power generation industry among other opportunities should be examined.

(ii) Constraints to be considered

It is important that certain constraints must be considered in planning for the power development by the private sector and should be taken into consideration. Of particular importance are the location of such firms with respect to the available climatic conditions, physiographical analysis, the capital-intensity nature of such projects and the difficulty in obtaining financing and political conditions, which effect the stability of governments in developing countries. All those factors that can encourage or discourage foreign investment, particularly in the energy sector.

Therefore, in terms of policy considerations, it is noted that in developing countries where significant industrial growth is planned (e.g. industrialization by the year 2020 in Kenya), the private and /or non governmental agencies should be encouraged to invest in power sub-sector wherever it is economically employed and what barriers need to be removed to encourage more investment in power sub-sector.

Small-scale power system is sometimes feasible in light industrial applications of the type that would be common in developing countries such as sugar industries, dairy processing, tea industries among others. There may be vast opportunities for this type of encouragement in developing countries. Generation of power by private firms with export of excess electricity to the grid is certainly feasible in developing countries with some industry. However a significant barrier to the involvement of the private sector in power sub-sector in developing countries may be internal politics and policy-oriented constraints. In most of these countries, the electric utility is a branch of the government and is responsible for all the power generation in the country (UN, 1993). Allowing other entities, whether they are private companies or other government branches to generate electricity for retail consumption may foster resistance from the utility. According to UN report on energy (1993), political obstacles such as these are often the ones that are the most difficult to overcome.

According to UN (1993), the development of government policies and a legislative and/or regulatory framework to oversee and promote the private sector in power generation requires the alternation of various issues, which includes regulatory provisions, tax and investment credits, fuel use issues and environmental issues. Regulatory provisions include topics such as ownership restrictions, interconnection requirements and monetary incentives applicable to the production of power by the private sub-sector.

Currently, utilities and electricity generating plants in many developing countries are government owned and/ or subsidized. Legislation concerning power generation by non-government entities and private producers (industrial or independent cogeneration projects) have not been developed. Once this initial barrier is overcome, markets for excess power must be available for the sub-sector to be attractive (UN, 1993). Connection to the utility grid would be beneficial and would provide this market.

It is noted that in the generation of electricity, the highest efficiency is obtained in hydropower plants - 60 to 70 per cent in smaller units and up to 90 percent in larger, sophisticated plants (UNEP, 1986), Electrical power generation in thermal plant is, however, thermodynamically inefficient with energy loses at over 60 per cent. The average efficiency of stream power plants is between 30 to 40 per cent, gas turbines between 20 to 30 per cent, diesel power plants between 30 to 37 percent and convectional nuclear plants, 30 to 60 per cent (UNEP, 1986).

The optimization of the operation of power plants and use of suitable tariff structures, particularly in the pricing peak loads, has considerable potentials for electricity conservation (Elmahgary, 1976). Many developing countries are responding to the potential for efficiency in the power sub-sector (UNEP, 1986). According to (Hagel III, J, 1976), the field of electric power generation emerges as a crucial focus for research and development programmes in energy efficient technology. This is because electric power plants are responsible for a high and growing share of primary full demand.

2.13 Planning for Power Generation Stations

According to Cope D.R. et al. (1984), establishment of a power generation station goes through four distinct stages of development: Planning, Construction, Operation and Commissioning. The search for sites to put up power station involves a number of phases and criteria: -

(a) Area search:

This involves a comprehensive study thousand square kilometers in order to identify potential sites, its opportunities and constraints. An important criteria used is based on the nature of regional demands relative to the national system (Cope. D. R. et al, 1984). Factors such as the extent of regional self-sufficiency are taken into account. In this respect, trends, which are likely to affect the demand in future such as prospects for future industrial growth, should be considered.

(b) **Site selection/ conflict resolution:**

This stage involves the selection of specific sites for which consent may be applied. According to Cope, D.R (1984) special features may be taken into consideration. These include the local economy, the amenity value of the area and the political implications of developing a power station in that location which may be local or national.

(c) Detailed technical investigations of alternative sites. All stations need a sizeable area of occasionally level and with sub-soil conditions suitable for foundation construction.

2.14 Planning for Small Scale and Unconventional Power Sources.

In view of the environmental advantages of small-scale power sources, particularly hydro, the balance between big and small hydro merits more analysis. It is argued that several smaller hydros may damage the environment and society more than on large project (Goodland, R. 1994).

However, if suitably sited, small-scale and unconventional power sources should be compared with other large-scale power generation alternatives. Privately owned renewable energy generators can sell surplus of the power they produce to the public utility.

The renewable energy generators include:

i) Non-dam (or very low head) axial tube turbines within rivers.

ii) Small generating systems (including water wheels)

iii) Solar elsewhere in the country (includes photovoltaic, tidal, wind, and hydrogen from splitting water molecules).

iv) Biomass energy production (Biomass plantations, alcohol, garbage and sewage).

Many tropical forest countries contain dry sunny or even desert regions where solar powered electric plants can be sited to serve the region. The solar powered plants do occupy 1/10th to the 1/20th the land of even the best hydro chemical and often can put otherwise unproductive land to sustainable use. Similarly, Sahel and other plains and steppe often have steady year-round winds. Such systems are already economical in comparisons with hydro when the value of inundated forests or other land is internalized, even imperfectly. Therefore, small-scale and unconventional privately owned power sources should be among the sources to be considered when planning for increased generation in power sub-sector in order to increase national power supply. (Goodland, 1994)

2.15 Micro-Power Systems at Regional level.

Electrification programs have centred almost exclusively on grid electrification, while this is cost effective for high-density loads, planners have often overlooked the alternatives. The generation and supply costs of electricity can be reduced by working with lower service standards, but other options are available (Munasinghe, 1987).

Decentralized, isolated distribution systems have been common for several decades in remote population centers; and in most developing countries predate the establishment of grids (World Bank,1996).Such systems were serving numerous villages and towns in ,for example ,Northern Ghana a before the grid extensions in the 1980s.

Electricity supply from renewable Energy sources which regions are endowed will provide attractive scenario, which the private sector can venture in the power production. Energy from solar, Wind, Micro-hydro schemes has become attractive in regions where the solar isolation, wind regime, and hydro resources are suitable. Electricity for local distribution can not an also be generated from such fuels as Biomass, depending on local availability of resources(World Bank,1996).

Micro-hydro electric power systems can be one of the cheapest option for providing electricity to regions that are far away from the grid to be connected to it, and can sometimes also supply the grid. Micro-hydro systems privately owned could both serve the local demand and feed into the central grid. Another aspect of micro-hydro is the care needed when selecting a site, given the variation of in stream flows during the year and from river to river. Costs vary significantly depending on the site and terrain.

The development of micro-grids at regional level, whatever their primary source of energy requires a significant level of community consensus and support regarding such factors as billing, service and organization.

Local participation is a key ingredient in planning and designing of such isolated systems, in their implementation, and in their day-to-day operation(World Bank, 1996).This is self-evident in the case of small local systems that are as a result of local self –help or private initiative.

However, even isolated systems put in place by a national program are more efficient if they exist or involve the local consumers and the private sector investors.

Central grid systems can also benefit from the local private participation in regional power generation and distribution .In Bangladesh, for example locally managed rural electric cooperatives are responsible for distributing the power they purchase from a local mini-power system.

2.16 Institutional Reforms in the Power Sub- Sector.

Institutional reforms on the electric power sector are being introduced in many countries (Bacon, 1995). The aim of the reforms is to increase efficiency to their electricity industries and attract more private sector involvement. According to the World Bank (1996) the reforms include :

- Reducing government's role by separating policy making from regulation and operation of utilities.
- Establishing transparent regulatory systems with predictable price –setting rules and procedures.
- Putting power sub-sector on commercial basis, preferably as companies under a commercial code.
- Encouraging direct investment and competition in generation and distribution.

The pace and depth of energy sector reforms have intensified in developing countries In Africa, governments are increasing the need to reform as they come to understand that to discouragereform un the regions could leave them behind and discourage private involvement unless they commit changes (World Bank, 1993 a, b, 1994d and internal reports).

One of the major problems in electric power sub-sector in many countries which have initiated reforms is that private investors have been mainly interested in generation, not distribution .In these circumstances, the power industry will require public involvement for some time; and as with the general institutional reforms, much will depend on the individual country's circumstances. The following are some possibilities in institutional reform programme:

- Public involvement in distribution should continue, with regulations requiring private sector producers of power to expand in ways consistent with achieving satisfactory financial rates of return to investment.
- Joint public-private investments in distribution, with the same regulatory requirement as the first option.
- When the distribution company is privately owned, a regulatory requirement to expand service, coupled with permission to meet financial requirements out of specific tariffs.
- Full price liberalization of the private investors in power distribution, with regulators acting as monitors of the prices and the efficiency of service ,the latter being the expansion of service where it is viable.

- Encouragement of the formation of electricity cooperatives, the private development of micro-grids, or both.

2.17 Liberalization of Power Sub-Sector in Kenya.

The government of Kenya embarked on liberalization of electricity power generation since 1996. The policy paper of 1996/1998 on power sub-sector spells out the roles of the independent power producers in power sub-sector. The paper highlights the major steps to be taken in the power sub-sector. This includes unbundling of KPLC, liberalization of power sub-sector and encouragement of the private sector in power sub-sector.

In Kenya, there are four major independent power producers. These are Ibeafrica (56MW), Westmont Kenya (43.5 MW), Orpower 4 (12 MW) and Tsavo power (75 MW). The entry of these independent producers into the power industry was in the spirit of liberalization of the sub-sector. Further, liberalization and/or privatization of power sub-sector is also highlighted in the national Poverty Eradication plan (1999-2015).

However, a policy, which will allow different players in the industry to operate in different regions; and supply power in those areas, has not been formulated. The government of Kenya is currently undertaking a study to look into the viability of such arrangements.

2.18 Private Participation in the Power Sector: Recent Trends.

It is noted that over the last ten years or so, a growing number of developing countries have opened their electricity industries to the private sector. The new wave of policy reforms designed to promote private participation has been due to three important forces.

a) The need to expand the capacity and / or increase the reliability of the systems.

b) The public sector budget constraints.

c) The positive results of the early experiments with private participation in Chile and the United Kingdom.

Between 1990 and 1997, it is noted that sixty -two developing countries introduced private participation in the power sub-sector to varying degrees (World Bank -FPSIN, 1998) The degrees range from Management contracts for the state -owned utility in Mali to the privatization of most sector operations in Argentina, Bolivia and Hungary. However, before 1990, private participation in power sub-sector in developing countries was limited to Chile (which introduced comprehensive reforms in the 1980s to create a competitive Private market.) and a few isolated cases in other cases in the countries.

With this background the private participation in power sub-sector has grown substantially since 1990, with electricity becoming one of the leading infrastructure sectors in attracting private investment. Although 62 developing countries have made at least some progress in introducing private participation in electricity, the breadth and depth of the private participation remain uneven. The most successful countries have been those that have found the political will to Abandon a long history of subsidized tariffs and to establish regulatory frameworks that offer credible commitments to investors.

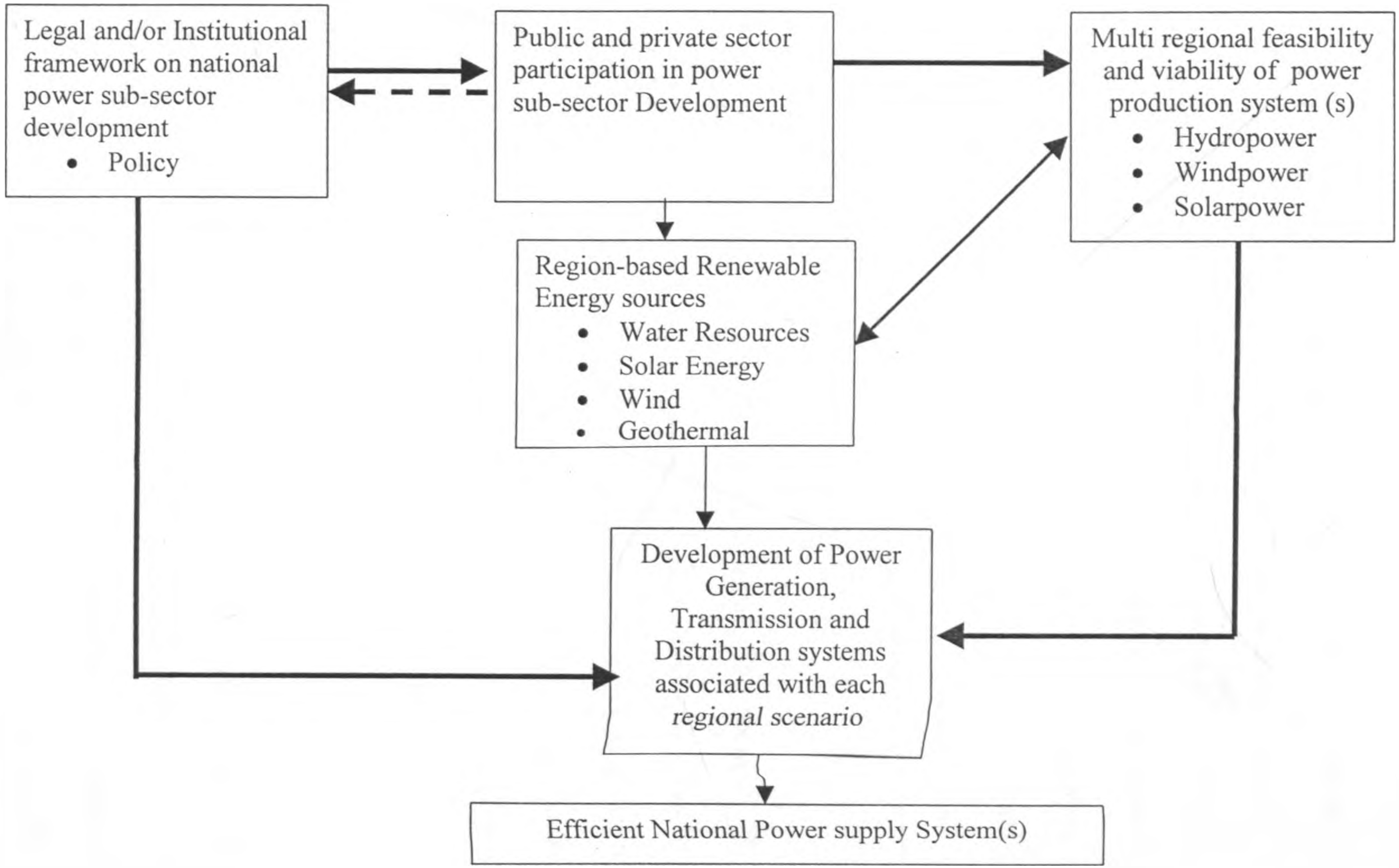
2.19 Towards a Paradigm of Multiregional and Multisectoral approach in Power Generation, Distribution and Transmission.

The rising demand of power has imposes serious strains on power supply systems, and as a result, we have severe tensions in the national economy. One of the possible strategies of coping with this situation could be to promote multi-regional and multi-sectoral power generation, transmission and distribution.

This can be achieved by formulating policies, which fosters this goal; to exploit domestic resources at regional level and actively involve the private participants in power sub-sector. On one hand, generated power can be supplied directly to the consumers at the regional level. On the other hand, various generating power systems can be combined into effective grid.The individual projects associated with such strategies (as in the case with BBK's projects) are usually small in scale. However, existence of such small-scale projects can result in complex system and thus cause large impacts. (Lakshmana, I.R et al 1985:6). At the local level, the project may create new settlements or boomtowns, depending on the nature and location of the activity source.

Other consequences may emerge as the need to invest in services and infrastructure increases such as distribution networks, transportation systems, Housing, Hospitals, Schools, etc; as well as public capital and private and public services.The relationships shown on the model (3.6.1) could play a fundamental role and the analysis is explicitly dynamic. The conceptual model has been designed to aid such development of power sector system. This will ensure that there is no over-reliance on national power generation sources and, therefore, improve efficiency in power sub-sector.

Diagram 2: CONCEPTUAL MODEL.



Source: Modified from Lakshmanan T.R and Johnasson B. (eds.), 1985.

2.3 Summary.

From the literature review, one thing is clear that the growth in the energy sector (particularly the power sub-sector) consumption will be manifested in an increasing demand on energy resources unless a major effort is initiated to develop and apply new technologies capable of improving power supply. The most critical area of accelerated improvement of energy supply is the power generation, distribution and transmission. Other areas of research and development may improve the efficiency of electric power by not only developing new technologies for the generation and the new models for distribution and transmission of electricity, but also involve the private sector in the development initiated in the sub-sector.

Non-governmental and/or private has a role to play in the sub-sector. The potential for generation, distribution and transmission of power by the private sector in developing countries should be looked into. This may be approached not only from the national context but also from the regional perspective. However, there are barriers (both legal and institutional) to power development by the Non-governmental agencies. These barriers have to do with the economics of investments and politics. The barriers need to be addressed in order to open up the sub-sector for significant opportunities to increased participation of the private sector in power industry in the developing countries.

Analysis of the criteria employed in selection of a power generation system has been discussed in this chapter. Therefore, in planning of development of a power generation system in any given region, it is important that the attributes as well as the possible constraints are exhaustively analyzed. This will enable a power planner to come up with a feasible and realistic decision as regard the type of power system to be developed .The power system to be developed will be dictated by the natural resources available in the affected region.

CHAPTER THREE

STUDY METHODOLOGY

3.0 Introduction.

In this chapter, the research methodology used in this study is explained. The study draws both primary and secondary data. The methodology used includes collection of data, analysis and the interpretation of the results obtained. Use of interview schedules and direct observation in the field constitutes primary data. Designed questionnaires and unstructured questionnaires were used.

The designed questionnaires had both open ended and closed-ended questions. Open-ended questions were used in order to elicit incisive information from the respondent(s). This was intended to make them speak more openly and freely. This type of questionnaire(s) had also closed-ended questions and were executed to the business community in the immediate neighbouring towns and residents of adjacent villages. The aim this questionnaire was to know their opinion regarding the supply of power from the state's power utility vis-à-vis the problems they encounter on the supply. The same method was used to get information from various institutions in the area, which uses electricity.

On the other hand the unstructured questionnaire was administered to the officials of the electrical department of the company and the officers of Kenya Power and Lighting Company. This method enabled the respondents to express themselves fully and give comprehensive and detailed information on various issues on the power supply in the area.

Focussed discussions were held with officials from Electricity Regulatory Board, Ministry of Energy and Kenya Electricity Generating Company.

3.1 Sampling Design

The comparative study area (i.e. the area supplied within power from KPLC) was purposively clustered based on villages. From the clusters simple random technique was applied in administering the questionnaires. The number of copies administered to each village was proportional to the relative size of the particular village, population density and, indeed, the number of household supplied with electricity. The reason why clustered and simple random sampling technique was used is to enable the researcher to come up with fairly non-biased data.

3.2 Methods of Data Collection

In this study, two types of data were collected and analyzed i.e. the primary data and the secondary data. In order to obtain this data, various methods and techniques were used.

3.2.1 Primary Data

a) Field Observation

This comprised of field observation of various features that were relevant to the study by the researcher. Observation features were either recorded in the field notebook or take a photograph of any feature relevant to the study.

b)Questionnaires

In administering the questionnaires, the researcher or research assistant asked the question as per the questionnaire and the respondent could answer. The researcher could then record the questionnaire appropriately as per the answer given by the respondent. This method was necessary because some of the respondents were unable to read the questionnaire or could not understand the questions. However, those who could read and understand the questions would fill in the questionnaire on their own. Three types of questionnaires were developed i.e. for the business community, for the households and one for institutions. Institutions comprised of schools and hospitals.

b) Personal Interviews

Unstructured questionnaire was administered to the officials of the electrical engineering department of the company and those of Kenya Power and Lighting Company. However this questionnaire was supplemented by focussed discussed on areas, which could warrant detailed explanation, or those aspects which required detailed explanation. The focussed discussion yielded more information than the use of questionnaires with closed-ended questions. However, for analytical purposes it is often difficult to analyze this data quantitatively due to the varied answers given by the respondent(s). Therefore, qualitative technique of analysis is used in this respect. It is on this basis that the researcher designed more closed-ended questions than open-ended questions ones in the other three sets of questionnaires (i.e. household, institutional and business questionnaires.

3.2.2 Secondary Data

Secondary data was obtained from various relevant sources in order to explain what could not be obtained from the field. The information was used to fill the gaps and also to explain information

CHAPTER FOUR

BACKGROUND OF THE STUDY AREA

4.0 Introduction

This chapter gives the description of the study area in terms of its geographical setting, which favoured directly or indirectly the development of power generation project by BBK. It also covers the position of the district, which the study falls, its topography, Hydrology, Geology, Climate, Land and Soils.

4.1 Position and size of the study area.

The study area is located in Kericho District in western region of Kenya. Kericho District is one of the 18 districts of the Rift Valley province. It lies between Longitude 35 degrees 02' and 35 degrees 40' east and between Equator and Latitude 0 23' S. The District is bordered by Nakuru to the East, Uashi Gishu to the North, Nandi to the Northwest, Koibatek to the NorthEast and Bomet and Bureti to the South. It is also bordered to the west by Nyando, Nyamira and Rachuonyo Districts to the Southwest. The study area borders Kericho Municipality to the east and is adjacent to Kericho-Kisumu road. It covers an area of about 13000Ha and the area shaded in map 2 shows this.

4.2 Topography and Hydrology.

The topography and hydrology of the study area can be understood by describing the topography and hydrology of the entire district .In terms of topography ,the district slopes toards west, and consequently rivers drain in that direction. All the rivers in the district are perennial and have adequate potential for exploitation. Small streams and tributaries join up to form major rivers and this characterizes the central parts of the district. These rivers include Kipchorian, originating from western part of Mau Forest and flowing through Londiani, Kipkelion and Chilchilla divisions to join River Nyando on the Kericho / Kisumu districts border. River Yurith flows through Bureti and Roret divisions of Bomet Districts to join river sondu on Kericho/Homabay border. Rivers Kipturet and Timbilil both flow through Londiani and Chilchila Division from Tindiret Forest before joining River Nyando which flows along the Kericho / Kisumu border. Other rivers include Kiptaret, Timbilil, Maramara and Malaget.

The area is characterized by various tributaries which merge to form larger rivers The north eastern part of the study area forms the catchments area of many rivers in the entire district The area is densely forest and it slopes gently towards the south and the southwest part of the study area. The rivers are characterized by rapid falls of which some have been harnessed by Brooke Bond (K) Ltd for hydroelectric power generation.

4.3 Geology

Between the Mau-Escarpment, and the lowlands of Kisumu District, a hilly shelf is formed. The central part of the district rises eastwards towards 3000M high Mau Ridge. The district is endowed with volcanic as well as igneous and metamorphic rocks. This is because it lies in Lake Victoria basin and the Rift Valley.

4.4 Soils

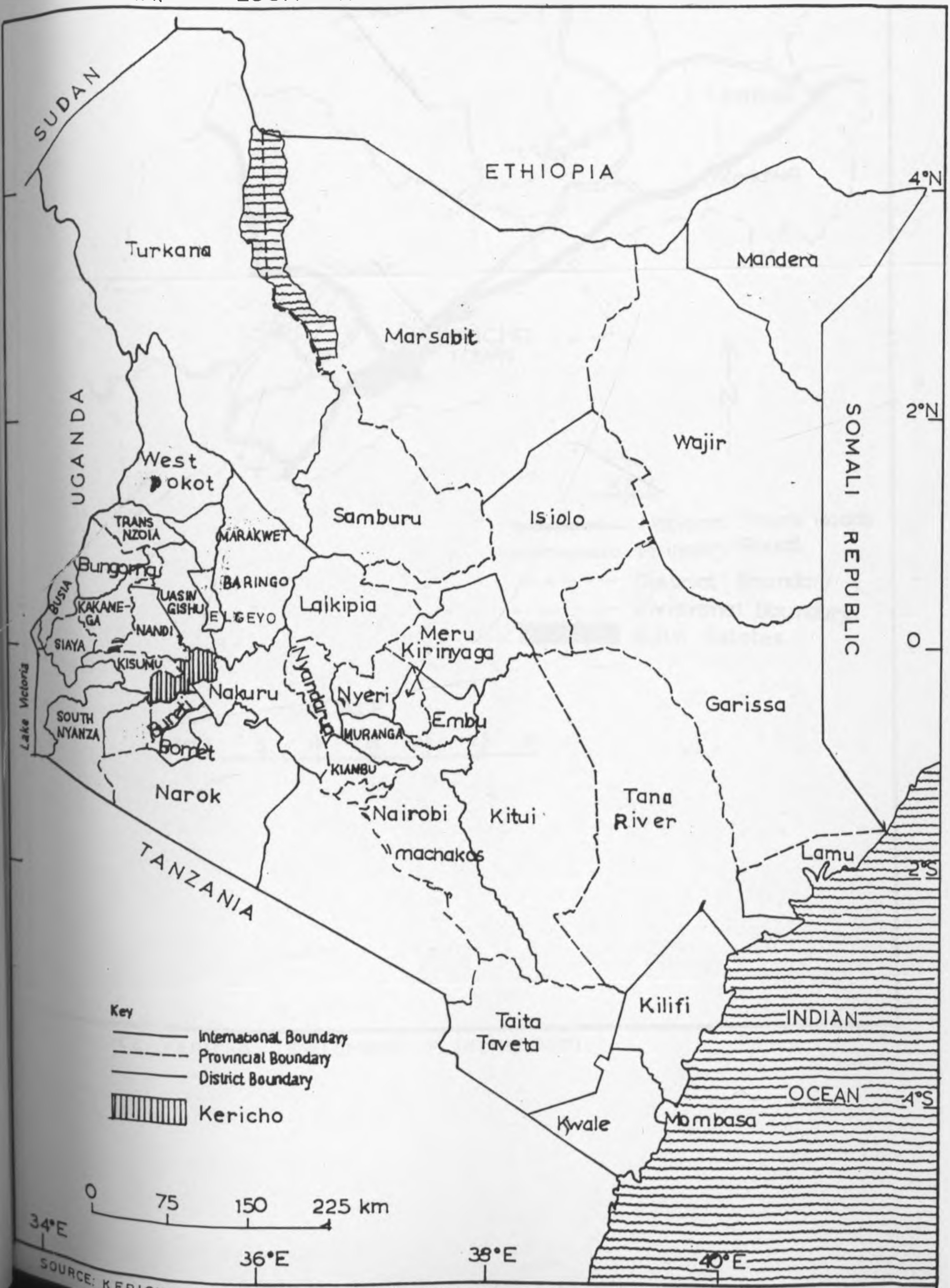
More than 90 percent of soils in the district are developed on basic igneous rocks or on ashes and other Pyroclastic rocks of relatively young volcanoes. The soil type found in the district is mainly clay and loam soils. These are well-drained, deep, dark reddish brown of moderate to high fertility with acid Humic topsoil. There are also soils which are developed on 'poorer' rock but which are enriched by volcanic ashes.

Mountain and hill units in the northern parts of the district have shallow to moderate deep Ando-eutric and Humic Cambisols. Volcanic foot ridges, south and east of Kericho, have Mollic Andosols and Ando-humic and Humic Nitisols, which are extremely deep. West of Kipkelion has soils which do not differ significantly from the soils of the mountain and hill units having shallow to moderate deep Humic Cambisols. Soils of the uplands on the basic igneous rocks are extremely deep. Clay soils occupy about 47 percent of the district. They are mainly found in the central part of the district.

4.5 Climate.

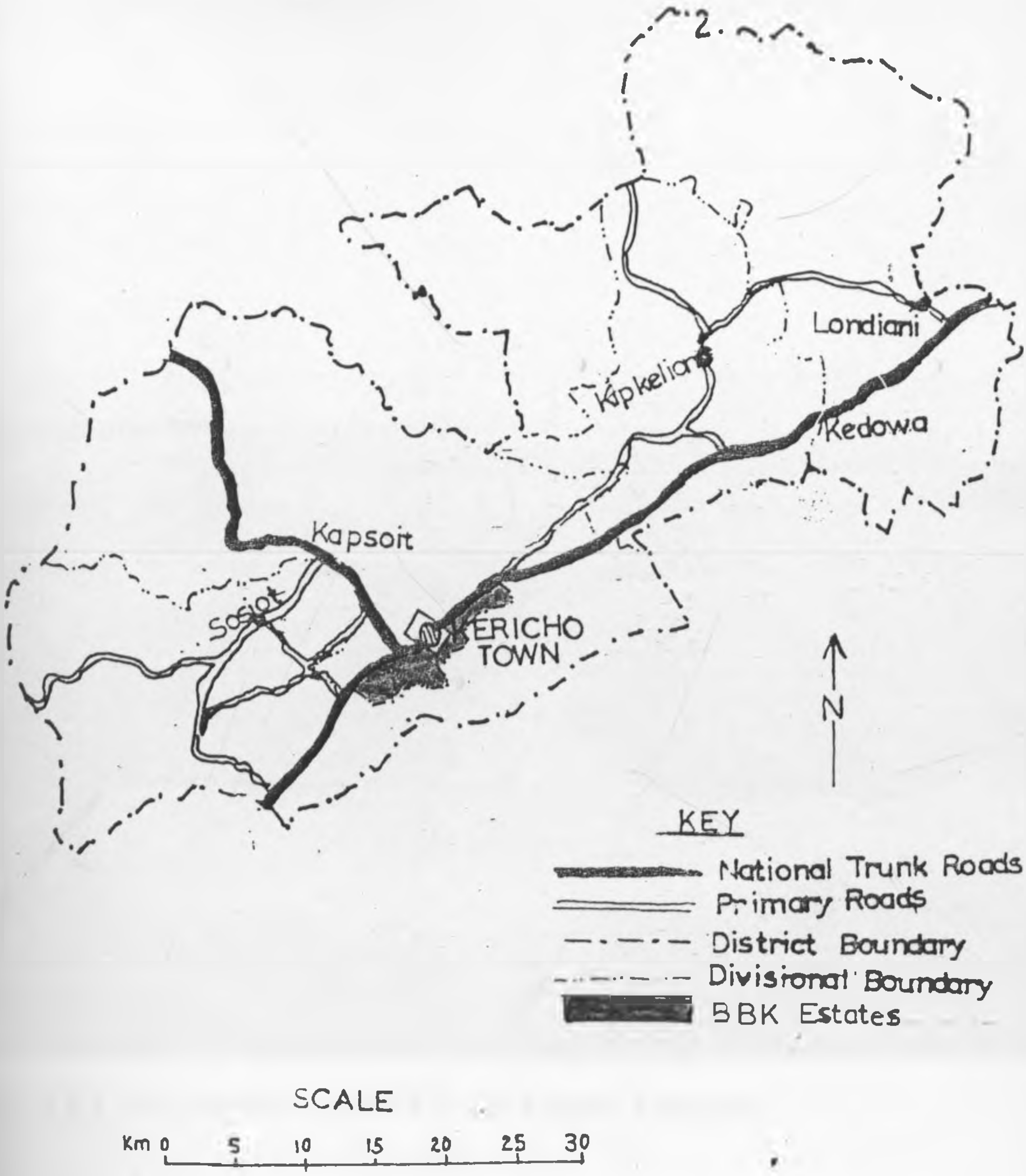
The climate of Kericho District can be described as highland sub-tropical climate with moderate temperatures, low evaporation rates and relatively high rainfall in the lower highland areas, particularly in the tea growing zones. At the upper highland areas, the temperatures are high with high evaporation and low rainfall. Rainfall is highest in the lower highland zone of Ainamoi and Belgut Divisions while the upper highland covering Kipkelion and Londiani is drier and receives low rainfall. Tables 6, 7b and 7c show climatic data taken at a weather station within the tea zone of the district.

MAP 1 LOCATION OF KERICHO DISTRICT IN KENYA



SOURCE: KERICHO DEVELOPMENT PLAN (1997-2001)

MAP 2 LOCATION OF BROOKE BOND IN THE DISTRICT



SOURCE KERICHO DEVELOPMENT PLAN (1997-2001)

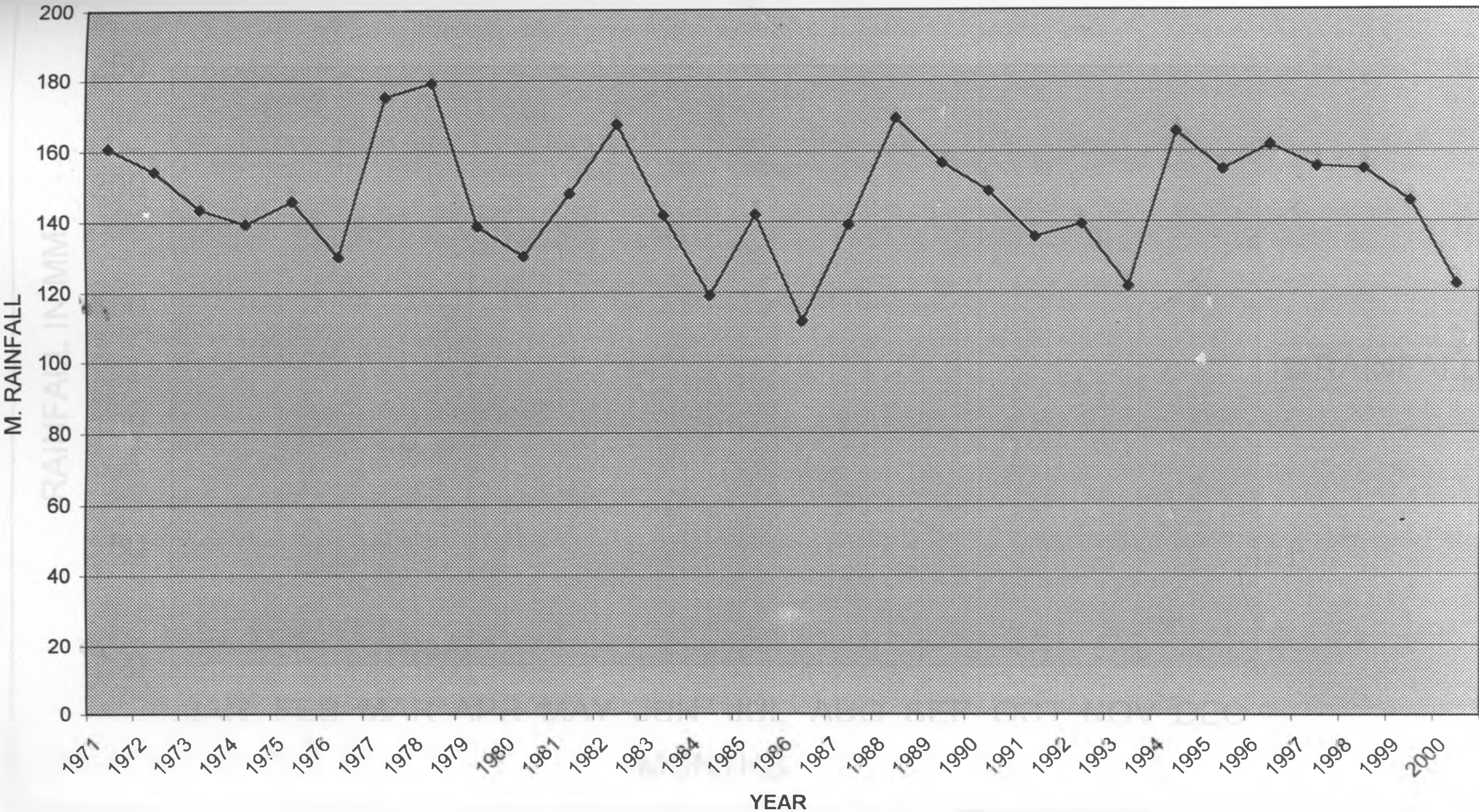
PLATE 1: An overview of BBK's Tea Estates/ Plantation.

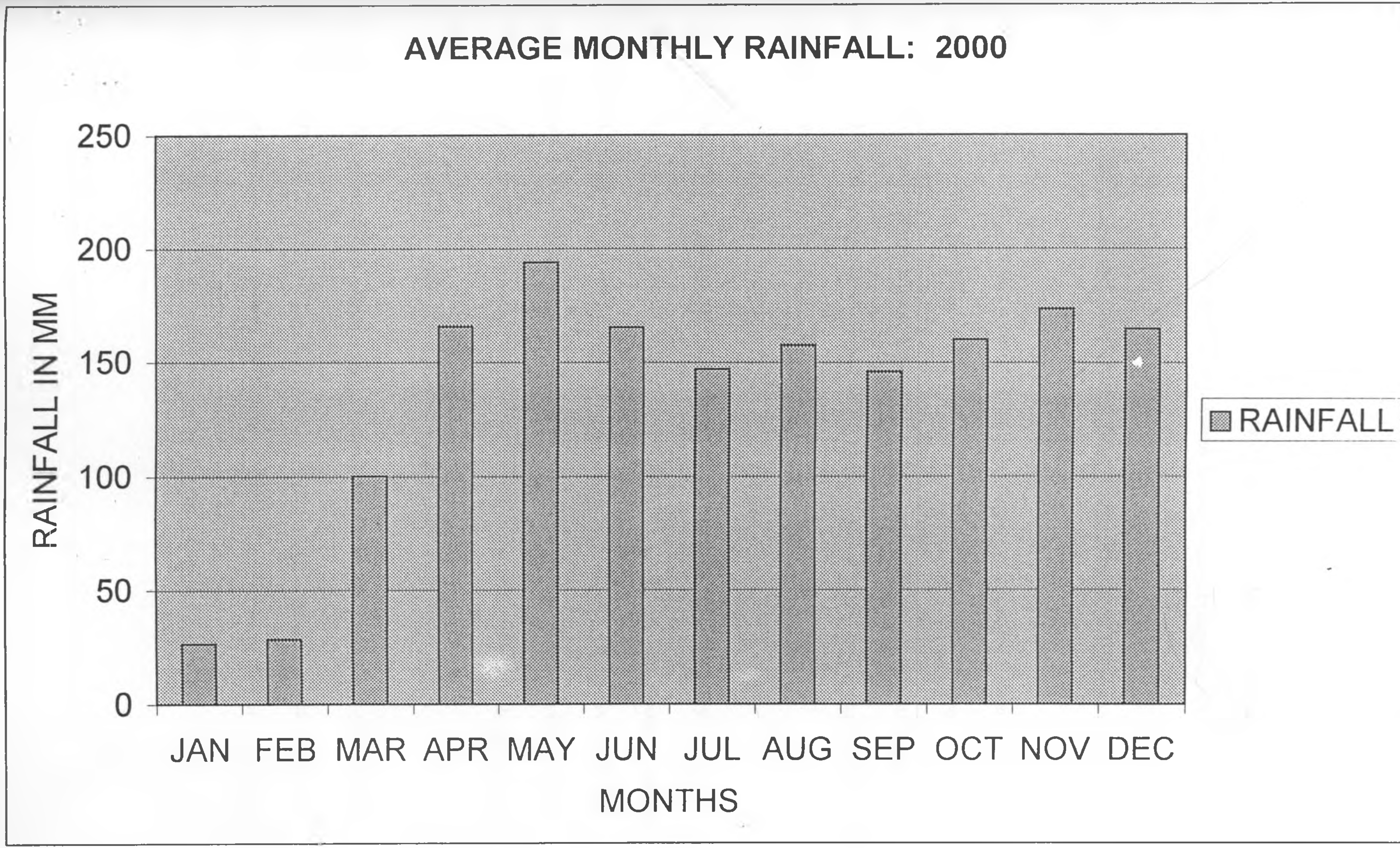
KERICHO DIVISION: RAINFALL (mm) - 1971 TO 2000

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	MEAN
1971	94.3	14.4	36.4	270.2	278.8	227.5	175.3	370	152.6	116.4	87.1	105.6	1929	160.7
1972	91.9	167.1	109.3	128.3	236.6	217.4	119.5	149.9	105.3	109.7	217.5	97.6	1850	154.2
1973	179.1	183.1	39.1	168.8	241.6	191.7	90	180.7	166	118.5	132.2	32.8	1724	143.6
1974	48.5	32.8	211.1	285.6	239.2	153.9	209.7	101.9	165.2	116.4	62.7	45.4	1672	139.4
1975	11.6	56.5	183.2	275	217.5	97.6	147.3	267.1	228.6	150.7	55.8	59.6	1751	145.9
1976	32.9	86.5	79.5	181.1	280.4	178.8	153	204.9	114.1	47.7	125.9	76.1	1561	130.1
1977	204.4	95.7	139.6	275.4	243.9	227.2	148.7	129.9	124.5	166.8	270.6	78.6	2105	175.4
1978	104.7	200.4	306.9	303.3	178.6	171.2	106.7	178.4	176.7	187.6	89.7	146.9	2151	179.3
1979	110.6	190.4	129.6	184.9	255.1	201.2	100.7	157.9	94.9	38.3	117.1	84.2	1665	138.7
1980	70.4	39.3	155.1	217.2	291.1	139.1	113.5	141.2	137.4	80.4	139.4	39.3	1563	130.3
1981	34.1	74.6	254.3	299.8	225.6	114.7	173.3	145.1	220.4	108.2	72.7	53.7	1777	148
1982	46.2	63.1	94.6	241.4	372.2	129.6	105.3	205.2	125.5	186.2	288.9	152.4	2011	167.6
1983	67.4	54.6	62.5	250.9	181.9	183.2	131.4	184	172.1	238.8	107.5	67.8	1702	141.8
1984	82.6	52.1	39.8	244.8	138.7	97.6	152.7	180.5	89.1	130.1	137.8	83.4	1429	119.1
1985	69.6	104.6	170	324.5	217.7	97.8	184	153.8	128.9	51.2	145.8	56.5	1704	142
1986	33.6	80.1	98.9	239.1	234.1	109.8	108.4	91	103.1	69.7	69	103.8	1341	111.7
1987	74.2	93.8	189.6	185.1	243.5	225.7	98.1	109.9	94	96.7	217.8	41.3	1670	139.1
1988	173.9	76.4	167.7	343.9	226.2	139.4	147.7	236	182	188.5	106.1	42.5	2030	169.2
1989	36.4	122.1	257.6	237.6	220.4	80	119.8	150.5	193.6	178.7	109.5	172.4	1879	156.6
1990	77.1	196.9	278.1	283.8	196.2	85.9	98.6	141.6	112.8	115.1	112.6	84.3	1783	148.6
1991	163.3	54.3	136.7	194.6	220.4	175.4	97.4	196.1	114.7	151.1	77.3	46	1627	135.6
1992	21.1	88.3	79.4	211.9	199	186.5	178.2	181.2	140.7	194	86.8	104.9	1672	139.3
1993	148.3	125.6	67	123.8	269.8	179.4	92.1	91.7	86.6	106	97.2	71.4	1459	121.6
1994	39.2	98.6	200.3	266.2	328	172	146.9	173	131.5	1231	266.7	41.7	1985	165.4
1995	33.7	118.6	169.2	234.5	248.7	190.1	112.2	116	189.3	175	189	79.8	1856	154.7
1996	112.9	171.2	201.7	256.9	227.7	109.6	178.1	129.4	198.7	126	168.3	59.8	1940	161.7
1997	81.1	1.6	74.6	321.6	120	119.4	154	147.8	29.5	213.6	359.3	243.4	1867	155.6
1998	201.2	121	64.3	260	230.5	167.1	116.3	136.3	144.1	254.2	138.4	25.3	1859	154.9
1999	128	22	282.2	206.1	207.8	123.3	112.8	171.1	149.9	179.1	106	61.2	1750	145.8
2000	26.5	28.8	100.1	165.8	194.1	165.4	147.2	157.6	146.1	160	173.8	164.9	1465	122.1
TOTAL	2573	2785.7	4278.3	7016.3	6771.2	4492.1	3871.7	4822.1	4071.8	4115.7	4154.7	2357.7	43895	152.4
29 YR MEAN 1971-2000	88.7	96.1	147.5	241.9	233.5	154.9	133.5	166.3	140.4	141.9	143.3	81.3	1769.3	147.4
10 YR MEAN 1990-2000	100.7	99.8	155.4	235.9	224.8	150.9	128.7	148.4	129.8	163.5	160.2	81.8		
25 YR MEAN 1975-2000	86.4	95.5	155.3	246.5	231	148.1	131.1	160.8	139.3	142.2	146.2	83.1		

Source: BBK,2000

Fig 1: **MEAN ANNUAL RAINFALL: 1971 - 2000**





Source: BBK, 2000

Generally, the district receives rainfall and it is influenced by altitude. The rainfall is well distributed except for the short dry season between January and February. April and May are the wettest months. However, there is no real break between short and long rains in the whole district. The total annual rainfall ranges from 1700MM to 2020MM per annum.

The temperatures of the district range from about 16 degrees centigrade to about 20 degrees centigrade. The coldest month is usually July with an average about 16 degrees centigrade while the hot season starts around December to February with temperature ranging from about 16.9 degrees centigrade to 18.6 degrees centigrade. Altitude is the main cause of temperature variation in the district.

The study area receives an average annual rainfall of 1800mm.Table 5 shows the rainfall amount received in the area for 29 years (1971-2000).The lowest amount recorded during this period in 1986,when the area received about 1300mm of rainfall. There has never been much variation in the amount received, but there has been a gradual decline over the years. Figure is a graph showing the annual rainfall pattern of the amount received in the study area from 1971 to 2000.

Monthly rainfall received in the study area is about 152 mm. Figure 2 shows the monthly rainfall patterns for the year 2000The area receives rainfall throughout the year (unmodal pattern). However, amount received usually drops during the months of January, February and March every year.

4.6 Forestry.

Forests play an important role in the maintenance of water catchment areas. In 1996, the total area covered by gazetted forest in Kericho District was 67,941.8 ha of which indigenous (natural forest) occupied 53,004.79 ha. The area has reduced due to deforestation, which has taken in the recent past. The government, tea estates and Telcom Kenya own the forest plantations (Kericho District Development Plan, 1997-2001).

The study area is adjacent to one of the large forest in the region –Mau forest. It borders this forest to the east .The forest extends towards the south where it borders the Nyayo Tea zones. However, the company has its own forests and/or woodlots, which it harvests for wood fuel used in the tea factories. Woodlots owned by the company constitute about 2400Ha of the total land coverage of the land it owns. The woodlots exists in pockets of forest within the tea plantations (see plate 1)

4.7 Historical Development of Brooke Bond Kenya Limited.

The history of Brooke Bond Kenya Limited (BBK) starts from 1869 when Arthur Brooke, then only 24 years, having saved $ 400 opened a shop in Manchester, United Kingdom. His main aim was to sell tea over the counter for cash. Other items he sold in his shop were Coffee and Sugar. Emphasizing Quality, Reliability and Economy, Arthur Brooke opened more shops in Liverpool, Leeds and Bradford. In 1892, he formed a company and took it to market to become "Brooke Bond and Company Limited". By 1925, the company had grown rapidly and set up its own branches in Egypt and East Africa.

The coming of Brooke Bond to Kenya is linked with Tom Rutter's hunting safari in 1914. Tom was in-charge of Brooke Bond in Calcutta, India. During the hunting mission, he found out that East Africa was a potential market for Indian teas. 1n 1922, a sales office for Brooke Bond India was opened in Mombasa. By 1924, the group realized that there was considerable potential for growing tea in Kenya. During the same year, the company acquired approximately 400 hectares of land at Limuru and built a Factory. Acquisition of Kericho Estates followed almost immediately.

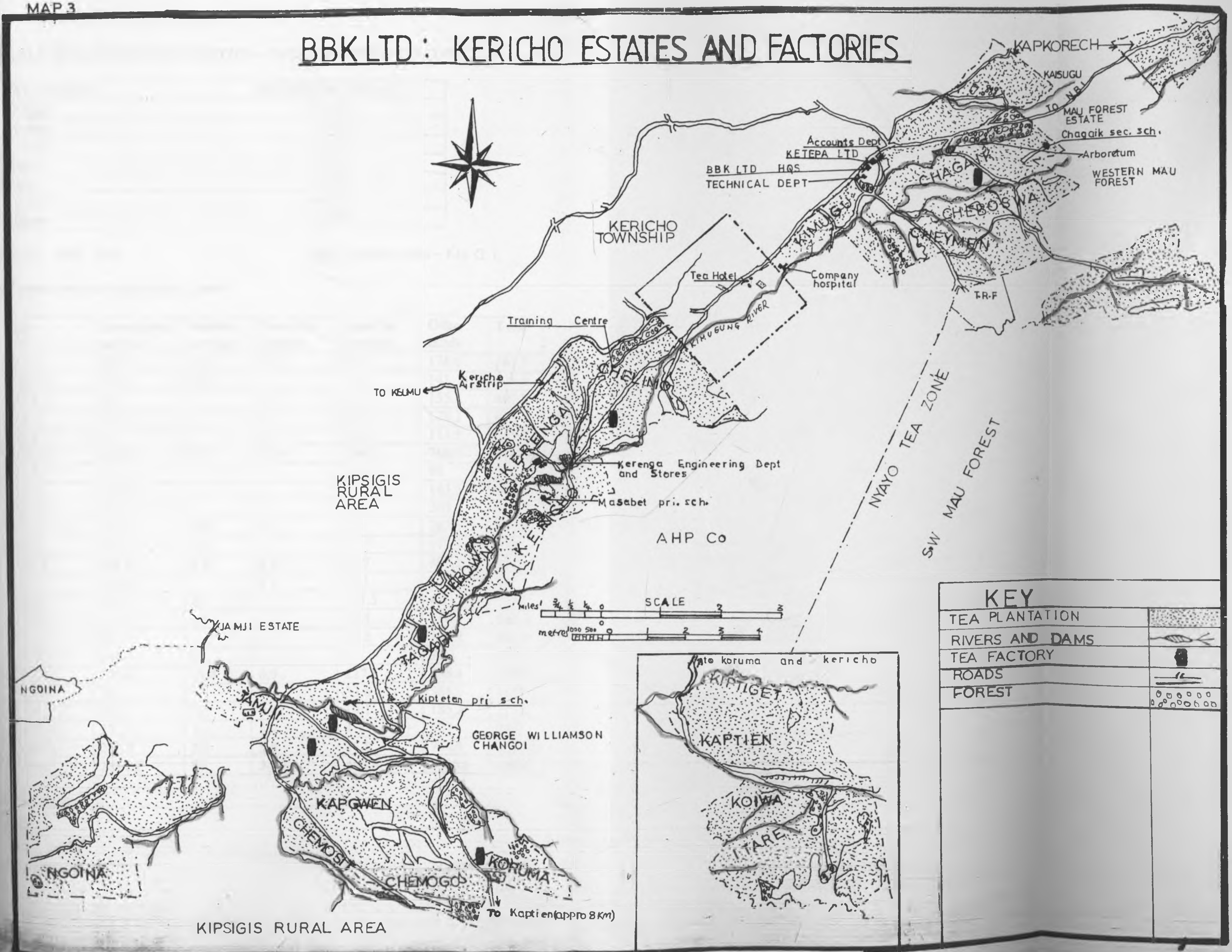
In 1927, BBK's first major Tea Factory was completed at Kerenga. By 1928, the company stopped importation of tea into Kenya. In 1938, Associated Tea Growers of East Africa (ATGEA) was formed and Brooke Bond appointed Blenders, Packers and Distributors for ATGEA. In 1941 and 1944, Brooke Bond Tanganyika Branch and Uganda Branch, respectively, were established. In 1970, the activities of Brooke Bond East Africa were officially divisionalized into Brooke Bond Liebig Kenya Limited (previously Kenya Tea Company). In 1971, the group acquired Buret Tea Company, which comprised of Chemogo, Chemosit and Kaptien Estates. Kituamba Coffee Estate in Central province was also acquired by the company. In 1982, the company became Brooke Bond (Kenya) limited after the sell of "liebig" by Brooke Bond Group in United Kingdom.

It is important to note that today BBK is one of the largest commercial enterprises in Kenya providing employment to more than 20,000 people. The company is a significant foreign exchange earner for Kenya having risen from Kshs 0.25 million in 1972 to Kshs 1 billion in 1984. Today, foreign exchange stands at about Ksh.5.5 billion p.a.

4.8 Estates and Factories.

Estates and factories of BBK are grouped in two divisions i.e Kericho division and Central division. Kericho Division land holding is 13,085 hectares and Central division covers a land size of 1016.2 hectares. The total land holdings of Brooke Bond stands at 14,101.2 hectares. BBK owns 20 Tea Estates plus 8 factories (seven are in Kericho division) manufacturing an average of 32 million kilograms of made tea per annum. Table 7 and Table 8 show the statistics for the factories and estates respectively, for the company in Kericho.

MAP 3



SOURCE: BBK(2000)

TABLE 7: FACTORIES STATISTICS - KERICHO DIVISION (1997)

FACTORIES	MAXIMUM INTAKE
Chagaik	123,200
Kimugu	70,400
Kericho	115,500
Tagabi	66,000
Jamji	11,000
Koruma	66,000
Kimari	151,800

Source: BBK, 2000 **NB:** Factories units – KG. G. L

TABLE 8: ESTATES STATISTICS – 1997

Tea	Eucalyptus for fuel	Wattle for fuel	Trees for Timber	Land to develop	Other lands	Total
371.6	100.1	7.2	15.4	8.6	178.6	681.5
370	130.3	25.8		7.1	141	674.9
324.5	5.4	-	1.8	-	155.5	487.2
478	79.5	-	2.7	87.5	179.3	827
362.4	67		2.5	35.1	114.3	581.3
1907.2	**382.3**	**33**	**22.4**	**138.3**	**768.7**	**3251.9**
374.8	51.1	-	-	51.7	93	570.6
334.7	106.4	-	-	-	165.5	606.6
371.2	52.6	-	-	-	209.7	633.5
383.5	191.1	308	5.5		263.5	847.4
310.5	67.4	2.6	-	-	171.5	552
1774.7	**468.6**	**6.4**	**5.5**	**51.7**	**903.2**	**3210.1**
494.3	180.6		0.9	18.1	167.1	861
494.2	334.7	4.5	-	111.5	45.1	1350
377.1	31.8	4.9	-	38.4	116	568.2
421.4	76.1	-	-	59.5	123.9	680.9
420.4	114.4	3	-	-	76.3	614.1
2207.4	**737.6**	**12.4**	**0.9**	**227.5**	**888.4**	**4074.2**
691.3	99.2	-	-	33.6	365.1	1189.2
416.5	99.2	2.2	0.4	10.1	185.2	713.6
398.7	27.2	3	5.4	4.1	207.6	646
1506.5	**225.5**	**5.2**	**5.8**	**47.8**	**757.9**	**2548.8**
7395.8	**1814.1**	**57**	**34.6**	**465.3**	**3318.2**	**13085**

Source: BBK, 2000

4.9 Development of Power Generation Projects by Brooke Bond Company

It is noted that the development of power generation projects by BBK dates back to 1924, the time when Brooke Bond acquired Kericho Estate. Immediately after the acquisition of Kericho Estate, bush clearing, road construction, building of houses and power stations and planting of tea were undertaken. Among the power stations, which were developed by Brooke Bond, include Jamji (hydro and generators), Kerenga (hydro), Kimugu and Tagabi (hydro). Chemosit Station (hydro) was acquired as part of Buret Tea Factory, which Brooke Bond bought in 1971. Buret Tea Company comprised of Chemogo, Chemosit and Kaptien Estates. Kimugu Power station was set up as a standby station as well as boosting the other power stations during peak periods.

The table below shows the year of development of each station and the amount of power it produces: -

Table 9. Development of Power Generation Stations by BBK.

Station	Year of Establishment	Source of Power	No. of Generators	No. of Turbines	Capacity of Power generated	Water head
Jamji	1928	Diesel generators	2	-	700KVA	N/A
		Hydropower	-	2	224KVA	70M
Chemosit	1919	Hydropower	-	1	112KVA	
Tagabi	1928 (rehabilitated 1990)	Hydropower	-	1	1000KVA	50M
Kimugu	1954		2		828 KVA	
Kerenga	1932	Hydropower	-	2	500KVA	

Source: BBK, 2000

4.10 BBK`S Power Generation Sytem: The Case of Jamji Power Station.

For illustration purposes, hydropower generation data for Jamji station for 1998, 1999 and 2000 are used. In 1998,hydropower units generate at Jamji station were about 4 million KWH, and about 3.5 million KWH and 2.9KWH in 1999 and 2000 respectively. From these figures it is evident that the amount of power generated from hydro for the last three years have been declining. This can be explained by two important factors. First, deforestation has been undertaken in the forests around the study area and in the neighboring regions. This has had implications on the amount of rainfall received in the area. Secondly, the hydro dams were constructed many years ago (see table 9) and therefore siltation and eutrophicaton has taken place over time. Therefore the water holding capacity of the dams has declined.

4.11 Summary.

From the background information, it is observed that the study area is suitable for hydropower generation. This argument is supported by the fact that the area receives adequate and reliable rainfall throughout the year. There have been insignificant rainfall fluctuation of amount received in the area as is indicate by the rainfall data for the last 29 years .In addition, the area receives reliable and well distributed rainfall throughout the year with only a short period of two months with relatively low rainfall.

Forests play an important role in maintenance and/or conservation of water catchments areas .The study area is well surrounded with forests (both natural and exotic), which explains the reason why the area receives adequate and reliable rainfall throughout year. In addition tea plantation do influence the climate of the area.

Temperatures are relatively low hence there is not any acute evaporation in the dams. Therefore the physiological characteristics of the study area can enable construction of hydropower generation system s of any scale. However, it is beyond the scope of this study to establish the geological requirements, which favours the construction of a hydropower dam.

CHAPTER FIVE

POWER GENERATION ,DISTRIBUTION AND TRANSMISSION BY BBK.

5.0 Introduction

It is observed that out of the seven factories in Kericho Division, the company supplies six factories with its own generated power. It is only one estate, which is supplied with power from the national grid (KPLC). According to the Company's Electrical Engineer, the power they generate is sufficient for smooth operation of the factories. The company generates about 82 percent of which 2% constitutes the back up power from diesel power generation used when power outage occurs in the national grid supply system. Nevertheless, the company is supplied with 18 per cent of its total power requirements from KPLC.The company has potentials of expanding its power generation systems to produce surplus power. However, according to the Engineer in-charge, the company is not interested in expanding its power generation systems because the power it generates at the moment is adequate for its consumption.

5.1 Power Generation by the Company vis-à-vis Power Import from KPLC

In order to relate the power generated by the company and the power it imported from the national grid, statistics for 1998, 1999 and 2000 have been used deliberately. This is because during this period, there was severe shortage of power supply in the country. Therefore, the analysis of the company-generated power in relation to the imports from the national grid would give a clear picture of the role the private sector can play in power sub-sector, particularly when there is national power deficit.

PLATE 2: A picture showing one of BBK's Hydroelectric Dams.

PLATE 3: One of BBK's Hydroelectric Power stations. There are three other Similar ones.

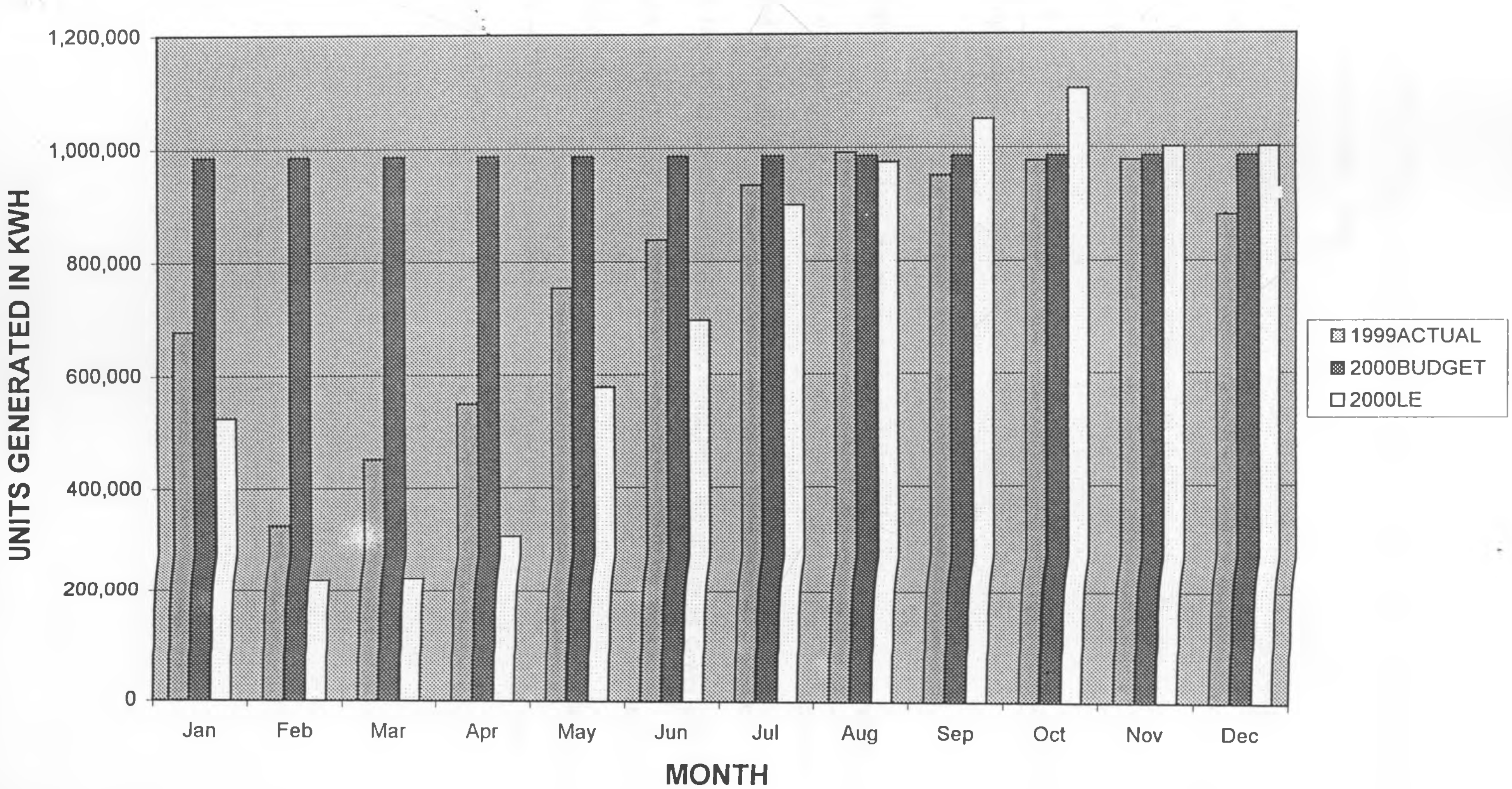
5.1.1 Hydropower Generation by BBK {1998 – 2000}

It is noted that from 1998, hydropower generation declined and this is attributed to the persistence of drought upto the year 2000. In 1998, the company was able to generate about 10,800,000 KWH from its hydropower stations. This consequently dropped to about 9,300,000 KWH and 8,750,000 KWH in 1999 and 2000 respectively.

On monthly basis, January 1998 recorded the highest figure of about 1,000,000 KWH. This gradually declined to about 680,000 KWH in April because of the dry spell between January and April. The amount of power generated gradually increased from May upto October and started to decline again. (See table 10). This corresponds with the amount of rainfall received during that year.

It can be noted that the amount of rainfall received annually dictates the level of power generated from the hydropower stations. In 1999, the highest amount generated was in the month of August and the least amount was on the month of February. Similarly, in the year 2000, the highest figure was recorded in October; about 1,100,600 KWH and the least amount of power generated was about 220,000 KWH in February.Figure 3a and 3b shows graphical representation of power generation for 1999 and 2000. From these graphs, it is noted that when the area received adequate rainfall, hydropower generated was over and above the budgeted target. However, if the rainfall is insufficient or when there is drought, hydropower generated is lower than the budgeted. In this case, the company has to supplement it with diesel power generation.

Fig 3: HYDROPOWER GENERATION - 1999/2000



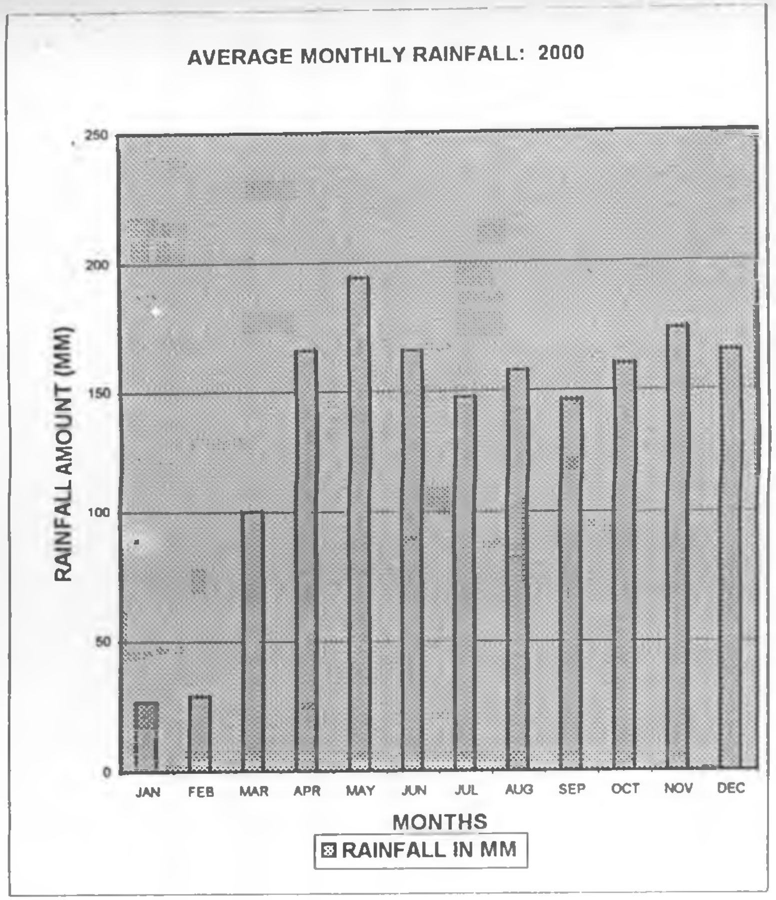
Source: BBK,2000

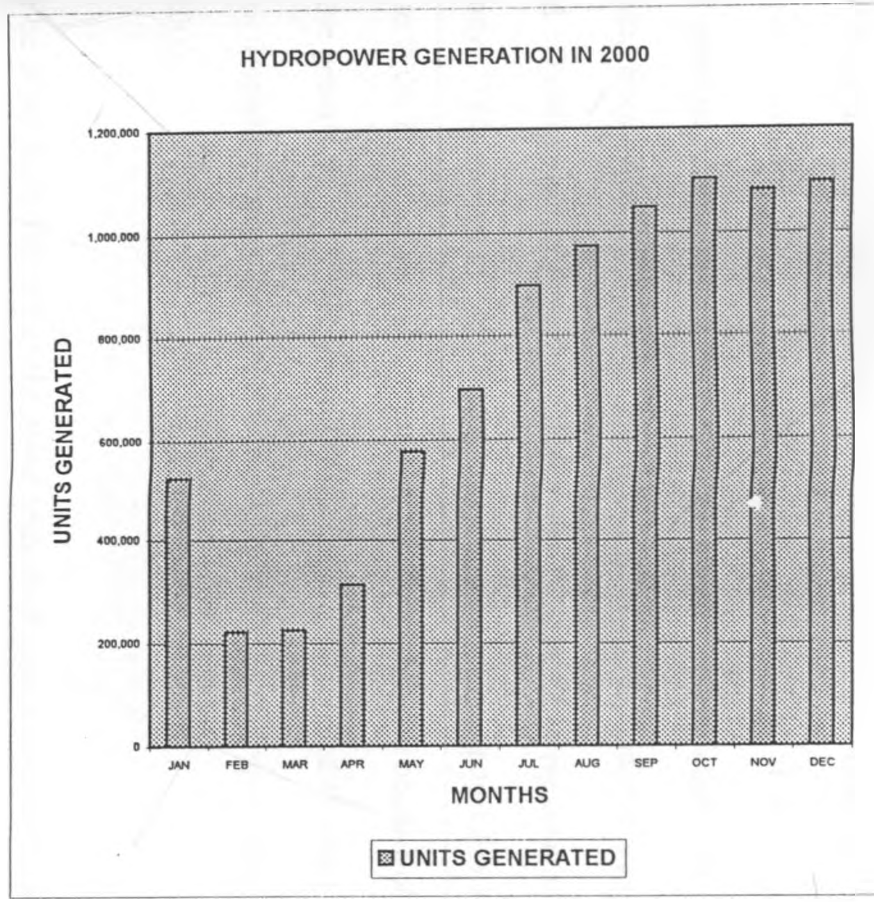
5.1.2 Relationship between Hydropower Generation and the amount of Rainfall received in the area (1998 – 2000)

Figures 2a, 2b and 2c show the monthly average amount of rainfall received at the study area in 1998,1999 and 2000. From these statistics, it can be noted that during the months when rainfall is high, the amount of hydropower generated in the proceeding months is high. On the other hand, if the amount of rainfall declines, there would be a corresponding decline in hydropower within 2 to 4 months. Figure 4 shows the relationship between rainfall amount and the amount of hydropower generated in 2000.

It is important to note that the amount of rainfall received in the area corresponds with the amount of power generated from hydros in 2000. The amount of rainfall received in the area increased gradually from the month of March upto the end of the year. The area received annual average rainfall of about 1465mm in 2000.Relatively, the amount of power generated in 2000 increased gradually from the month of April upto December. Between the months of April upto December, the company generated over the budget. This is attributed to high amount of rainfall received in the area during these months. Therefore it is important to note that rainfall is the key to economical power generation by the company.

RELATIONSHIP BETWEEN RAINFALL RECEIVED AND HYDROPOWER GENERATED IN 2000





Source: BBK,2000

5.2 Diesel Power Generation: 1998 – 2000

As mentioned earlier, the company generates power from diesel generators to supplement hydropower and the KPLC'S imported power. The amount of power generated using diesel power generators is, therefore, expected to correspond in variation with the amount of power generated from hydro and imports from KPLC. This correspondence is expected to be inversely related. Diesel power generated constitutes about 2 percent of the total power consumed by the company. The amount of power generated using diesel generators has been on the rise from 1998 to 2000. However, in 1999, the amount generated dropped because of mechanical problems with the generators. In 1998, Diesel generated power amounted to about 282,000 KWH. This amount dropped to about 266,000 KWH in 1999 and then shot up to about 682,000 KWH in the year 2000.

It can be noted from Fig. 4 that the actual amount of power generated was below the budgeted level and this was between the months of January and May in the year 2000. During this period, power rationing had not been effected by KenGen. In Fig 6, it is observed that the actual power imports from KPLC were between 500,000 KWH and 650,000 KWH in the months of January and May.

In the year 2000, diesel power generation was highest in the monbth of June and this amounted to about 15000KWH.During the same month ,power imports from KPLC dropped from about 530000KWH to about 250000KWH.The imports gradually dropped below the budgeted level of about 220000KWH ,in the preceeding months (June to November).In 1999 there was less generation of power from the diesel generators except for the month of March and April. In the same months, the amount of power imported from KPLC was relatively high. This is attributed to low hydropower generation capacity in the same period.

The company had budgeted to generate upto 40,000 KWH on monthly basis for the year 2000. However, it generated over and above the planned budget from June to December. From the month of June, there was scheduled power rationing by KPLC hence diesel generators operated for long hours to generate supplementary power to add to the little power the company imported from KPLC. During the same period, there was increased tea production due to sufficient rainfall received in the area. Figure 5 gives a graphical summary of the amount of power generated using diesel for 1999 and 2000. The graph shows the actual power generated for the two years and the planned budget for the year 2000.

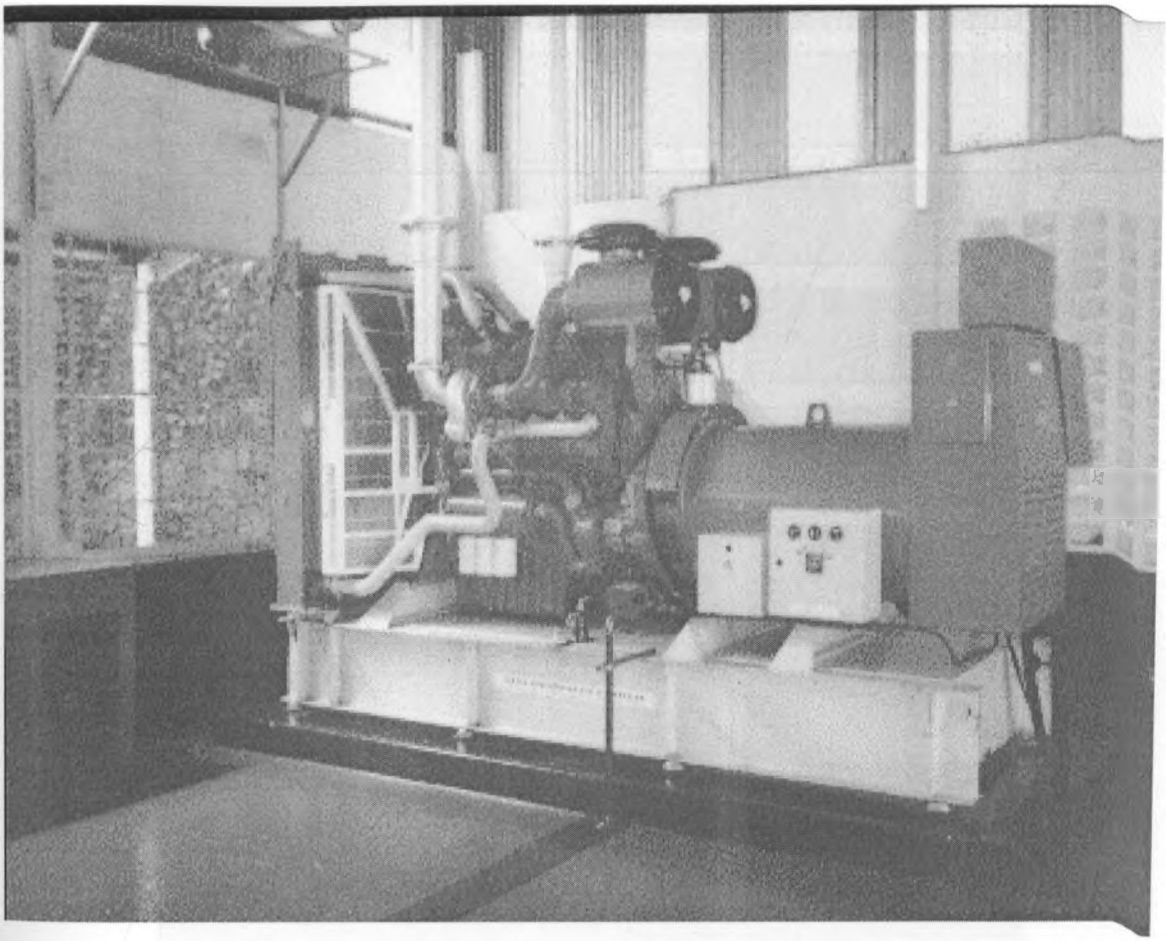
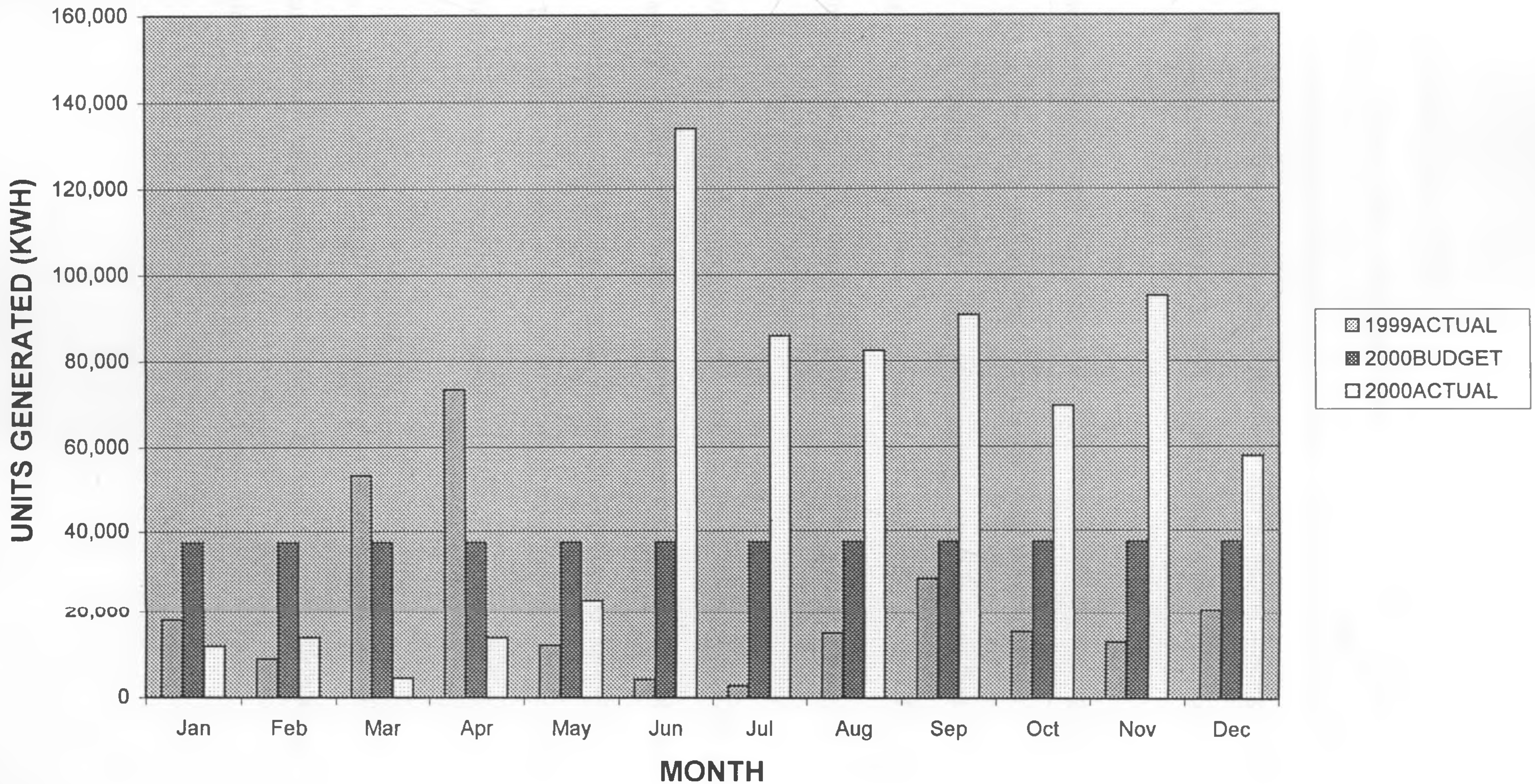


PLATE 4:A Diesel Generator: The company uses Diesel Generators to generate Power when there is Power failure from KPLC.

Fig 5 : DIESEL POWER GENERATION - 1999/2000



Source: BBK,2000

5.3 KPLC Power Import: 1998 – 2000

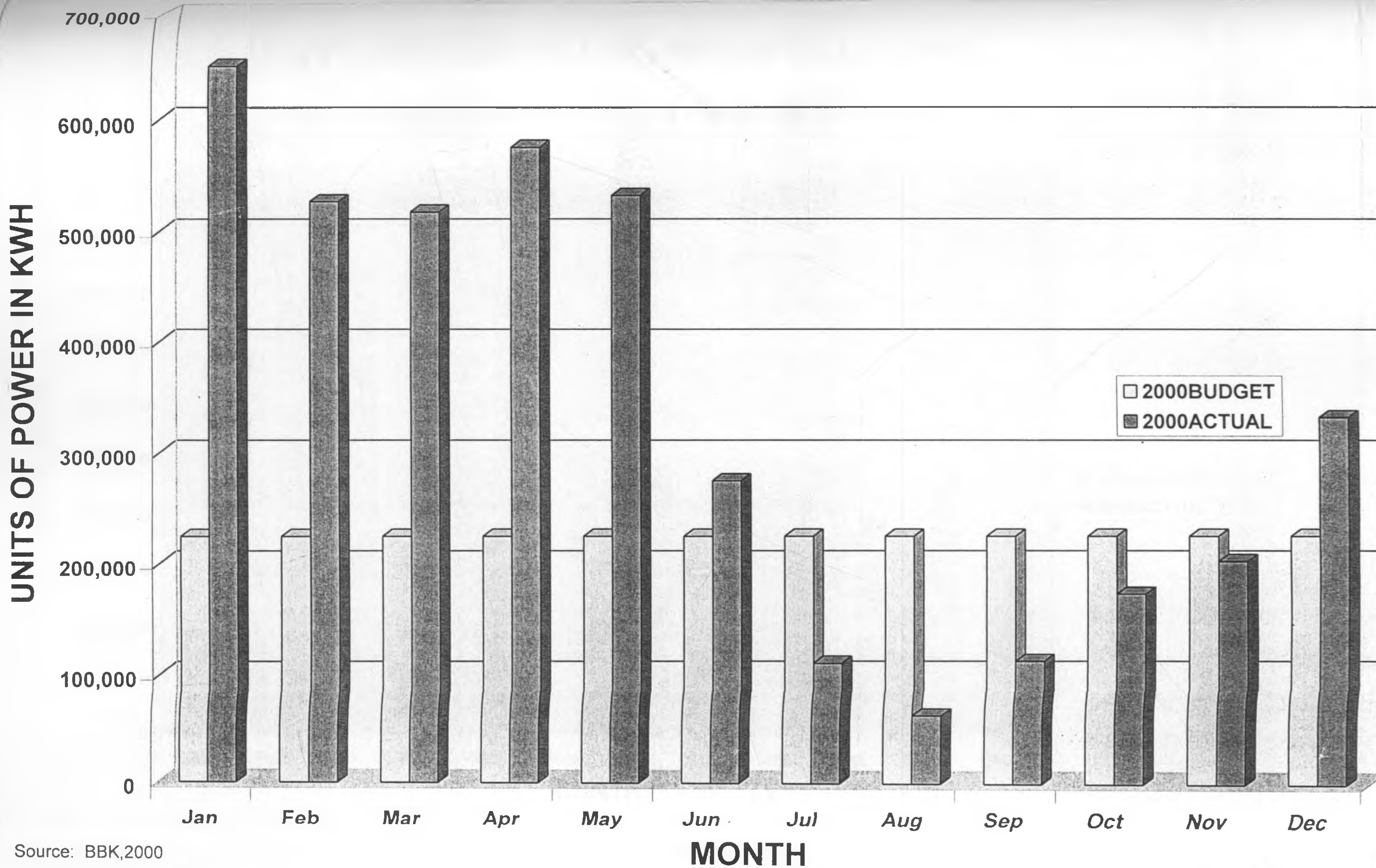
In 1998, the company imported about 2,370,000 KWH from KPLC. The highest amount of power imports was in April. During this month, the amount of power generated from the hydros was the lowest (see table 11). This corresponds to relatively high amount of diesel generation in the same month. The lowest figure recorded for KPLC power import was in November.

In 1999, the lowest amount of power import from KPLC was in June and the highest was in April (see table 18). There was a gradual increase in the amount of power imported from KPLC from January to April. In the year 2000, the lowest amount of power imported from KPLC was in August (67,160 KWH). The highest was in the month of January (575,630 KWH). The rains had reduced from December to April and therefore less hydropower was generated.

In the year 2000, it is noted that the company spent over and above the budgeted KPLC Import bills between January and June. The company had planned to spend a maximum of about Kshs 1.5 million on monthly basis on power imports. However, from January upto June, it spent between Kshs 1.5 million and Kshs 5 million on monthly basis (see figure 7). During this period, the hydropower generation was below the planned budget (Figure 3b).

From July upto September, the company was operating within its budget scope. However, the cost of electricity shot up and this made the company to spent more than the planned budget between the month of October and December.

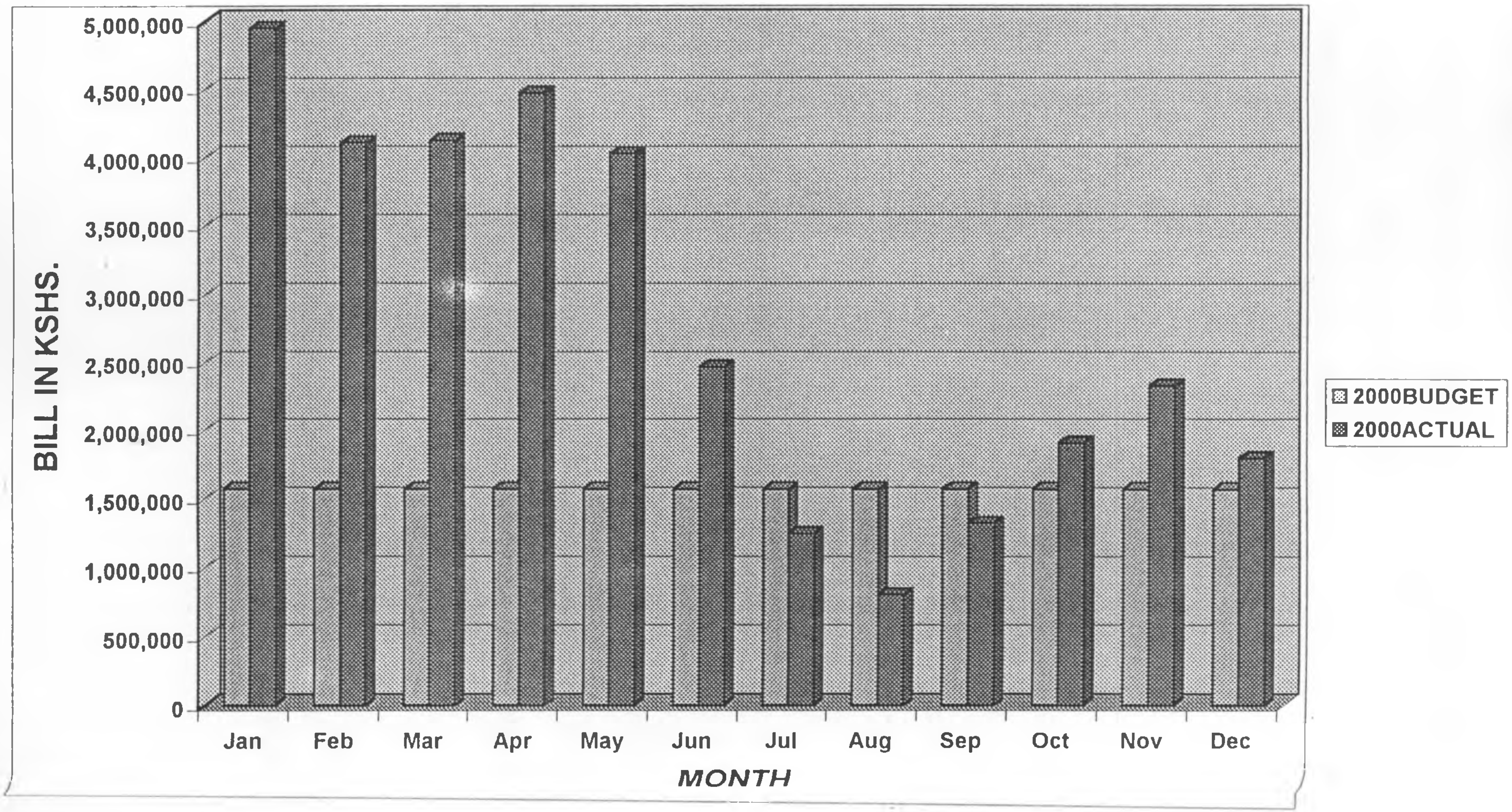
Fig 6: FORECAST KP&L POWER IMPORT - 2000



Source: BBK,2000

Fig 7 INCREASE IN KP&L IMPORT BILLS - 2000

TOP PORTION SHOWS MONEY SPENT OVER & ABOVE BUDGET



Source: BBK,2000

5.4 Summary: Power Generation by Source

From the statistics given, it is important to note that hydropower has played an important role in generating power to the company. It constitutes a higher percentage of power generation. Diesel generation constitutes the least amount of power generated.

The Table below summarizes the percentage power generation for the last three years:

Table 10:

YEAR	HYDRO (%)	DIESEL (%)	KPLC (%)
1998	80.2	2.1	17.3
1999	94.2	2.7	3.1
2000	65.4	5.1	29.5

Source: BBK, 2000

5.5 Electricity Distribution by BBK and KPLC

5.5.1 Electricity Distribution by BBK

Map 5 and 6 shows the 11KV distribution and transmission network of power generated by BBK. The transmission lines, the transformers and all other electrical accessories within its distribution system belong to the company. It also transmits and distributes power extensively within its jurisdiction without seeking permission from KPLC or Ministry of Energy.

The power is supplied to the factories and estates. The amount consumed at specific points are shown on the maps. A total of about 8025 KVA is distributed within the company's network.

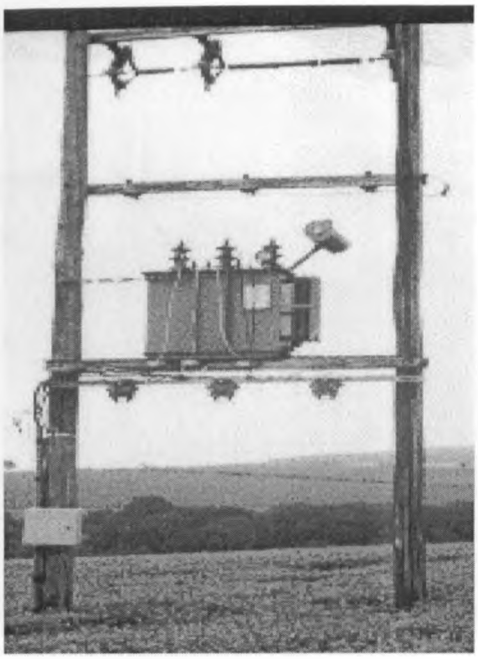


PLATE 5a: A Transformer.

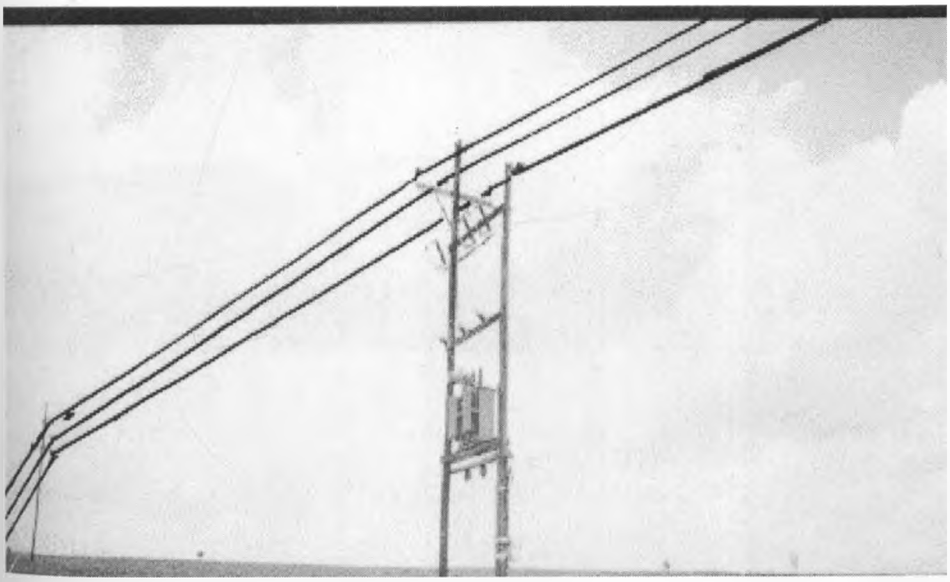
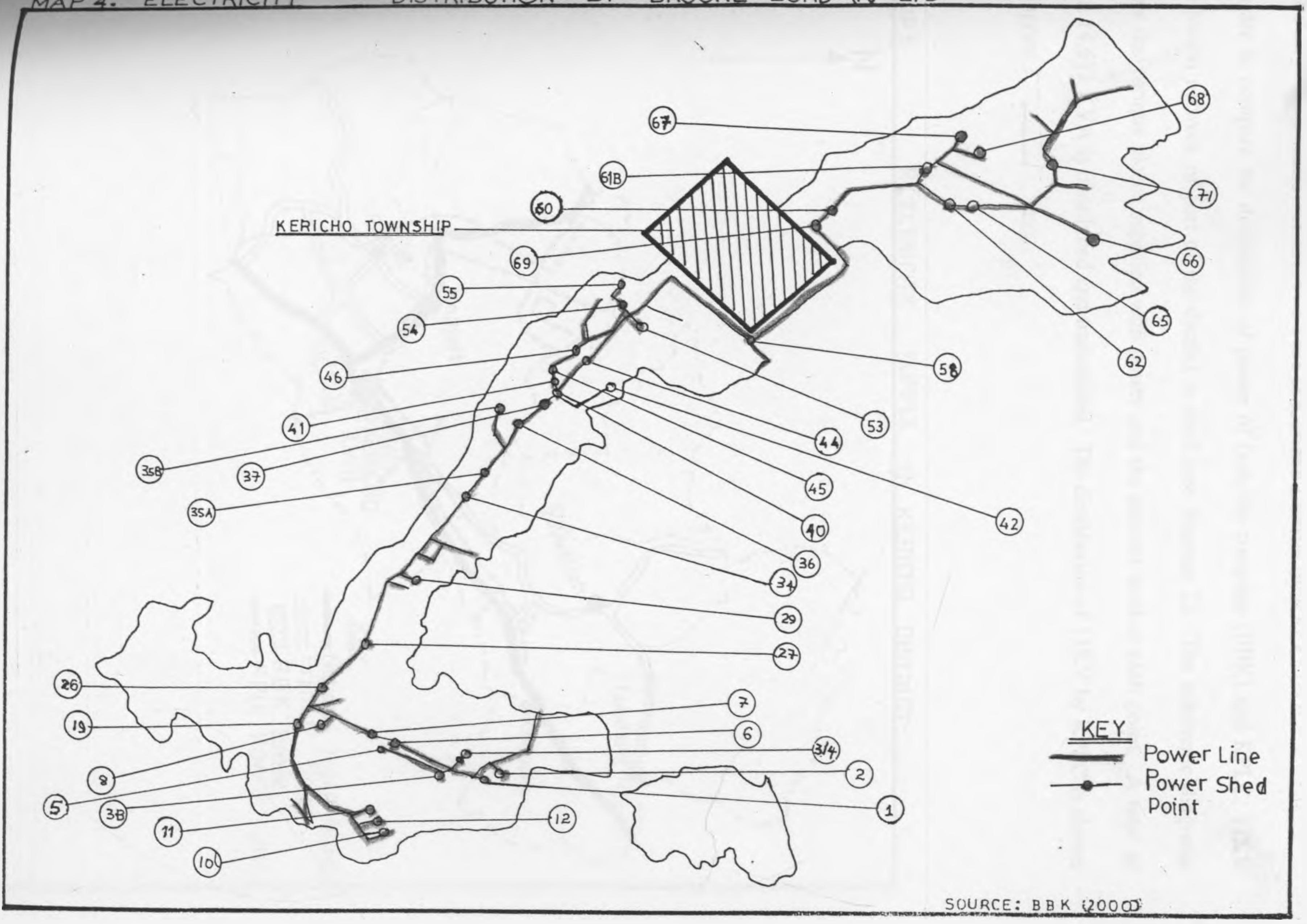


PLATE 5b: Distribution and Transmission lines: The Company generates, distributes and transmits power to all its Estates and Factories. It owns the entire electrical system including the cables and transformers.

PLATE 6: One of the Tea factories the company supplies its own Generated power.

PLATE 7: One of the Housing Estate: The company supplies Electricity to all its housing Estates.

MAP 4. ELECTRICITY DISTRIBUTION BY BROOKE BOND (K) LTD.



LEGEND

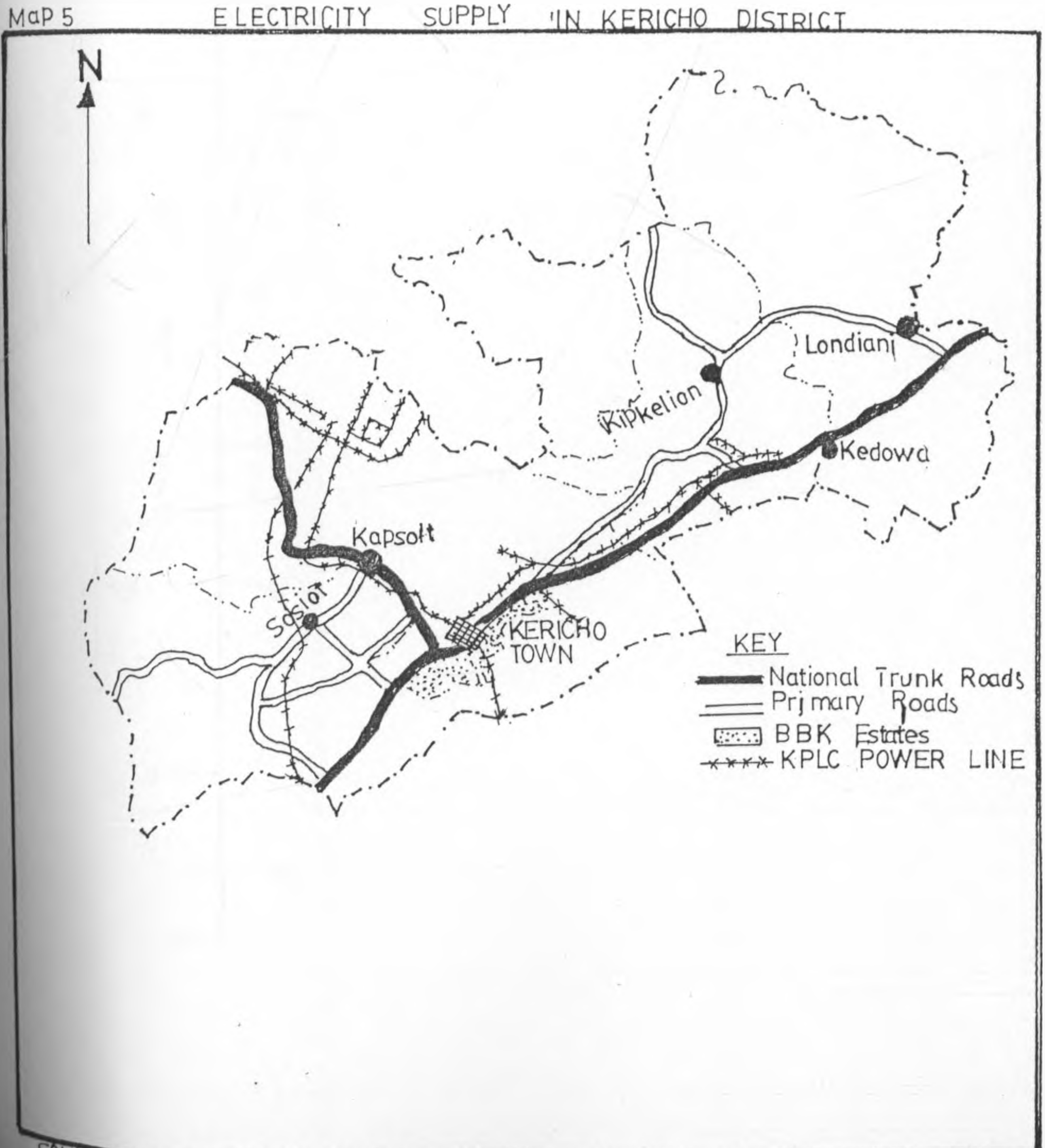
ESTATE/FACTORY		POWER
Koruma		
1.	Koruma Water Pump	50 KVA
2.	Koruma Dispensary	10 KVA
3.	Koruma Factory	500 KVA
Kapkwen Estate		
5.	Kapkwen Manager's house	5 KVA
6.	Kapkwen Office	5 KVA
Jamji		
7.	Jamji nursery	100 KVA
8.	Jamji K.I.T Co.	100 KVA
9.	Spare line - Koruma line	20 KVA
Chemogo		
10.	General Manager, Chemogo	5 KVA
Chemosit		
11.	Chemosit Club	20 KVA
12.	Chemosit Store	50 KVA
13.	Chemosit step-up	100 KVA
14.	Chemosit power house	11KV/415
Jamji		
15 - 17	Jamji Factory	2(300) KVA
18	Jamji Estates Clerk House	15 KVA
Jamji Power House and Dams		
19/20	Jamji power house	630 KVA
21	Spare Jamji Power House	315 KVA
22	Jamji Power House	350 KVA
23	Jamji Power House	500 KVA
24	Jamji Power House	50 KVA
25	Jamji Power House	750 KVA
Tagabi Estate and Factory		
26	Lower Tagabi Staff Houses	50 KVA
27	Lower Tagabi Canteen	5 KVA
28	Tagabi Factory Manager's House	5 KVA
29	Tagabi Estate Office	25 KVA
30/31	Tagabi Factory	300 KVA
32	Tagabi Hydro	1000KVA
33	Tagabi Water Pump	25 KVA
Chebown Estate		
34	Chebown Manager's House	5 KVA
35A/36	Chebown offices	10 KVA
35B	Chebown Special Hall	50 KVA
Kerenga Power House and Dam		
37	Kerenga Power House	50 KVA
38/39	Kerenga Power House	250 KVA

Kerenga Engineering Department		
40	Lower Camp – Kerenga	30 KVA
41	Main Engineering Staff Houses	50 KVA
Masabet Estate		
42	Masabet Staff Houses	20 KVA
43	Masabet Canteen	5 KVA
Kerenga		
44.- 45	Engineering and Quarry	200 KVA
Kerenga Estate		
46	Kerenga Senior Management House	20 KVA
47	Kapndege Office	25 KVA
Kericho Estate		
49 - 52	Kericho Factory	200 KVA
Kericho Estate		
53	Kericho Water Pump	100 KVA
54	Manager's House	25 KVA
55	Training Centre	50 KVA
56/57	Chelimo Office and Water Pump	50/20
56	Manager's House	5 KVA
Accounts		
58	Accounts Department	50 KVA
59	Accounts Camp	25 KVA
60	Central Hospital	100 KVA
Kimugu		
61	Kimugu AVR	2 units
62	Kimugu Water Pump	25 KVA
63/64	Power House	410 KVA
65	Factory	500 KVA
66	Ex Dr. Rotich's House	25 KVA
67	BBK Head Office	200 KVA
Chagaik Estates		
70	AVR	2 Units
71	Houses	10 KVA
Kapkorech Estate		
72	Fence	10 KVA
73	Factory	25 KVA
Chagaik		
74	Pump House	30 KVA
75	Chagaik Housing	75 KVA
76/77	Factory	200 KVA

5.5.2 Power Distribution of 11KV in Part of Kericho District by KPLC.

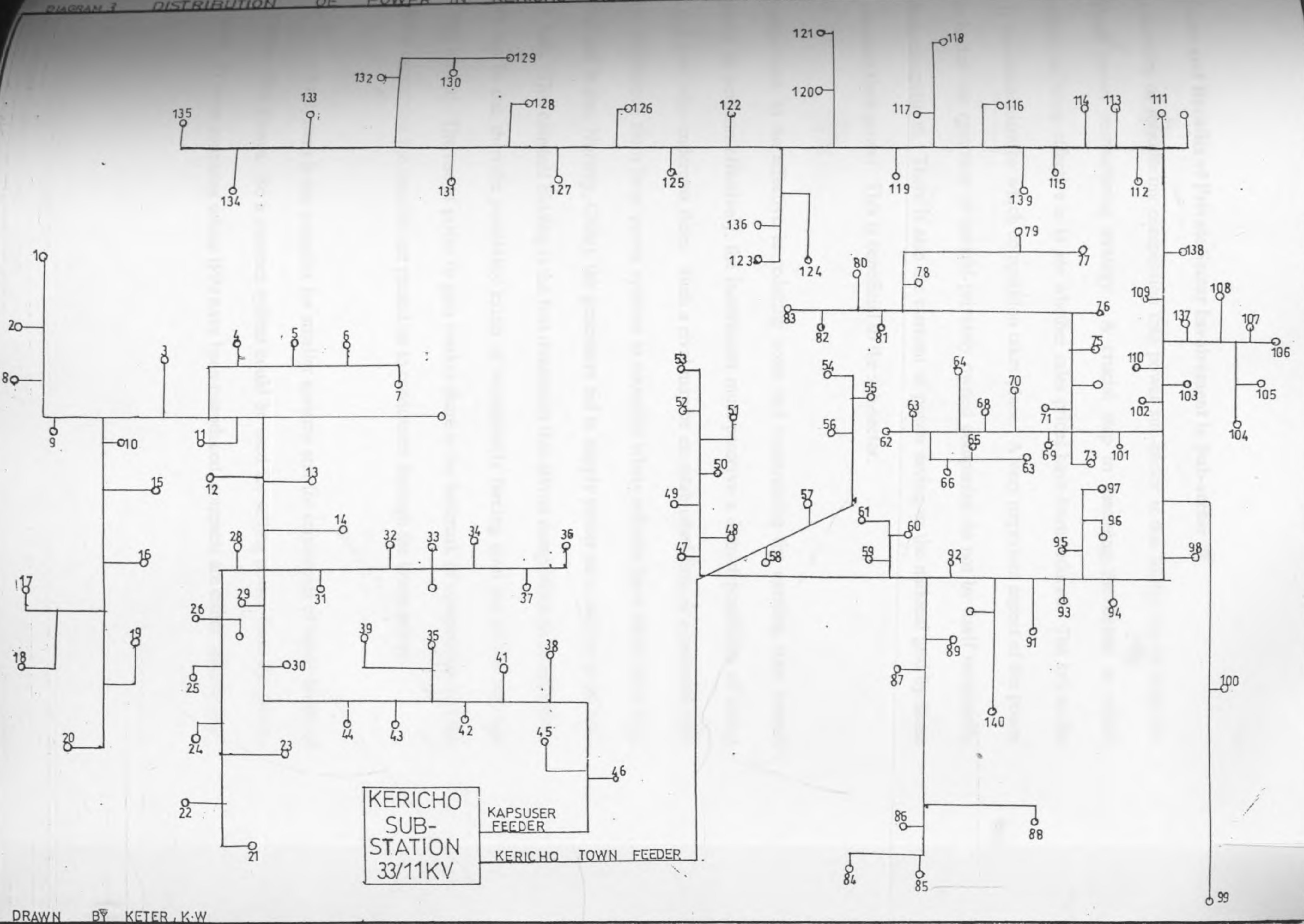
In order to compare the distribution of power of both the company (BBK) and KPLC, 11KV distribution network of part of the district is used (see diagram 2). The schematic diagrams shows the various places supplied with power and the amount shed at each point. A total of about 14,613 KVA is distributed and transmitted. The distribution of 11KV by KPLC is shown in diagram 3.

MaP 5 ELECTRICITY SUPPLY IN KERICHO DISTRICT



SOURCE Kericho DDP (1997)

DIAGRAM 3 DISTRIBUTION OF POWER IN KERICHO DISTRICT BY KPLC (PART)



LEGEND

	AREA SERVED	POWER SUPPLIED
1	Sosiot Market	315KVA
2	Sosiot G.School	50KVA
3	Itanda -	50 KVA
4	Sosiot Water supply	50 KVA
5	Rebecca Soi & Others	15 KVA
6	Loice Mitei & Others	15 KVA
7	Z.Bengat & Others	15 KVA
8	Cheptenye B.School	15 KVA
9	Koskey's Family	5 KVA
10	Kebenet Applicants	50 KVA
11	Tegat Water Pump-	50 KVA
12	D.O Ngetich-	15 KVA
13	Kipkoiyan-	15 KVA
14	Tegat Tea Factory-	630 KVA
15	Kebenet Applicants	25 KVA
16	Kebenet Applicants 3	50 KVA
17	Chereres Applicants 1	50 KVA
18	Chereres Applicants 2	50 KVA
19	Chereres Applicants 3	50 KVA
20	Chereres Applicants 4	50 KVA
21	Kipsolu Sec. School	50 KVA
22	Kipsolu Village-	15 KVA
23	Kipsolu Happy Church	15 KVA
24	S.Chepkwony-	15 KVA
25	J.K.Cheruiyot-	50 KVA
26	Simon Too (8385)	50 KVA
27	Kapsimotwa Village	15 KVA
28	Tech-Gaa W.Group	50 KVA
29	Kaptororiet Church	50 KVA
30	D.Chemaigut-	5 KVA
31	Tegat Village-	25 KVA
32	Kaplemeiwet Village	25 KVA
33	Ayub Chepkwony	50 KVA
34	Kapsoiyo School-	50 KVA
35	Susumyet Village	25 KVA
36	Kakiptui Village-	25 KVA
37	Kakiptui Health Centre	50 KVA
38	Kipsigis G.School water pump	25 KVA
39	Simon Too (6335)-	50 KVA
40	John Kauria-	25 KVA
41	Kipsigis Girls School	50 KVA
42	M.O.W Camp-	100 KVA
43	A.Maseri -	15 KVA
44	Kapsuser Market-	100 KVA
45	F.Bett's water pump	50 KVA
46	Kapsirwon W.Group	50 KVA
47	Veterinary Dept.-	200 KVA
48	World G.Mission (KHBC)	100 KVA
49	T.Sambu -	100 KVA
50	Alfania Koech-	50 KVA
51	Moses Sambu-	50 KVA
52	Eli Sigei -	25 KVA
53	Joseph Talam-	25 KVA
54	Belgut Brothers-	200 KVA
55	Somali Village-	200 KVA
56	NHC Houses-	200 KVA
57	NHC Sewage Pump	100 KVA
58	Remand Home-	100 KVA
59	Spencon (K) Ltd-	200 KVA
60	Sewage works-	315 KVA
61	Spencon (K) Ltd water pump	200 KVA
62	Reuben Yegon-	50 KVA
63	Kericho Water supply	200 KVA
64	Keongo W.Group-	50 KVA
65	John Langat-	50 KVA
66	CLLR Koskey-	50 KVA
67	Kapcheptoror Church	50 KVA
68	Keongo Primary School	50 KVA
69	Keongo Village TX1	25 KVA
70	Keongo Village TX2	50 KVA
71	Hon Ngeny-	15 KVA
72	E.F.Sulvan-	50 KVA
73	Kerego Pri. School -	15 KVA
74	Canic Dairy-	315 KVA
75	Cllr Kilel-	15 KVA
76	Kipchimchim Market	50 KVA
77	Ainamoi Market-	200 KVA
78	Ainamoi Health Centre	50 KVA
79	Ainamoi Sec. School	50 KVA
80	Joel Sang -	50 KVA
81	Kipchimchim Sec. School	50 KVA
82	E.Chebelyon-	15 KVA
83	Z.Byegon-	83 KVA
84	Siloam Hospital-	315 KVA
85	Mortgage Housing	100 KVA
86	Derby Avenue (9303)	50 KVA
87	Derby Avenue (9302)	25 KVA
88	Kericho T.Sec. School	15 KVA
89	District Hospital	200 KVA
90	Patronic Service-	100 KVA
91	Kenyatta Road-	315 KVA
92	Wagon Works-	200 KVA
93	Garage -	315 KVA
94	Kenya Beer Agency	100 KVA
95	A.Chepkwony-	200 KVA
96	Sanik Bakery 1-	630 KVA
97	Sanik Bakery 2-	200 KVA
98	Mulembe Hotel-	100 KVA
99	Water works	150 KVA
100	Motor Mart-	315 KVA
101	New Prison-	25 KVA
102	R.C.Mission-	200 KVA
103	Tea Hotel-	100 KVA
104	Tea Research W.Pump	100 KVA
105	Tea Research Houses	15 KVA
106	Tea Research Institute	50 KVA
107	Tea Research Foundation	50 KVA
108	Cheymen/Cheboswa	15 KVA
109	Three House KCO	5 KVA
110	S/Services-	100 KVA
111	S.Kenduiywa-	50 KVA
112	Major Koech-	25 KVA
113	R.Towett -	50 KVA
114	Ketepa Ltd-	630 KVA
115	Kapkugerwet Market	100 KVA
116	Telcom Earth Station	630 KVA
117	Mau Forest Water Pump	50 KVA
118	Mau Forest House-	50 KVA
119	Mau Forest Factory	50 KVA
120	Kaisugu Staff Houses	50 KVA
121	Kaisugu W/Pump-	50 KVA
122	Kaisugu Pri. School	15 KVA
123	John Koech-	15 KVA
124	Kaisugu Tea Factory	630 KVA
125	Kapkatungor Estate	50 KVA
126	Kapkatungor W/Pump	25 KVA
127	Chepsir Pri. School	100 KVA
128	Sogobet Pri School	50 KVA
129	Kipyemit Pri. School	15 KVA
130	Chesinende Pri. School	100 KVA
131	Chepseon Sec. School	50 KVA
132	Chepseon Applicants	100 KVA
133	Chesinende Market 1	315 KVA
134	Chepseon Polytechnic	50 KVA
135	Chesinende Market 2	50 KVA
136	Chesumot Ltd-	200 KVA
137	Kericho T.T.College	100 KVA
138	Timsales -	200 KVA
139	To BBK -	KVA
140	Kericho T. Exchange	630 KVA

5.6 Costs and Benefits of Private Sector Involvement in Sub-sector

The possibility of introducing competition into power sub-sector is due to the crucial steps for the whole power restructuring strategy. A crucial step in assessing the extent to which competition is being effective is to see whether sales prices have been reduced. The key to the issue is the mechanism by which competition takes place. A very important aspect of the power market is that the existence of several privately owned companies do not by itself necessarily introduce competition. There is also the element of power saving to the national grid by those who consume their power. This is beneficial to the sub-sector.

For competition to be effective in reducing costs and constraining the existing state owned companies to perform effectively, the incumbents must perceive a district possibility of losing sales to a rival who undercuts them. Such a rival may be an established firm or a potential new entrant. Experience from large power systems in countries where reforms have taken place (e.g. England and Wales, Norway, Chile), the generators bid to supply power on a daily or even half-hourly basis. This constant bidding is the first dimension that allows competition to be effective. If costs can be cut, then the possibility exists of immediately forcing rival out of the way and supplying instead. The use of prices to gain market share is the hallmark of competition and has the crucial aspect that the benefits are passed on to consumers through the lower prices.

However, such a system is too complex for smaller systems and for economies of lower levels of development like Kenya. So a contract system could be used for selling power from the private generators. In most countries where IPPs have been introduced, contracts are either 'take or pay' or based on dispatching according to the indexed cost formula. But such contracts do not lead to a competition between the IPPs and the existing plants to improve their efficiency of operation.

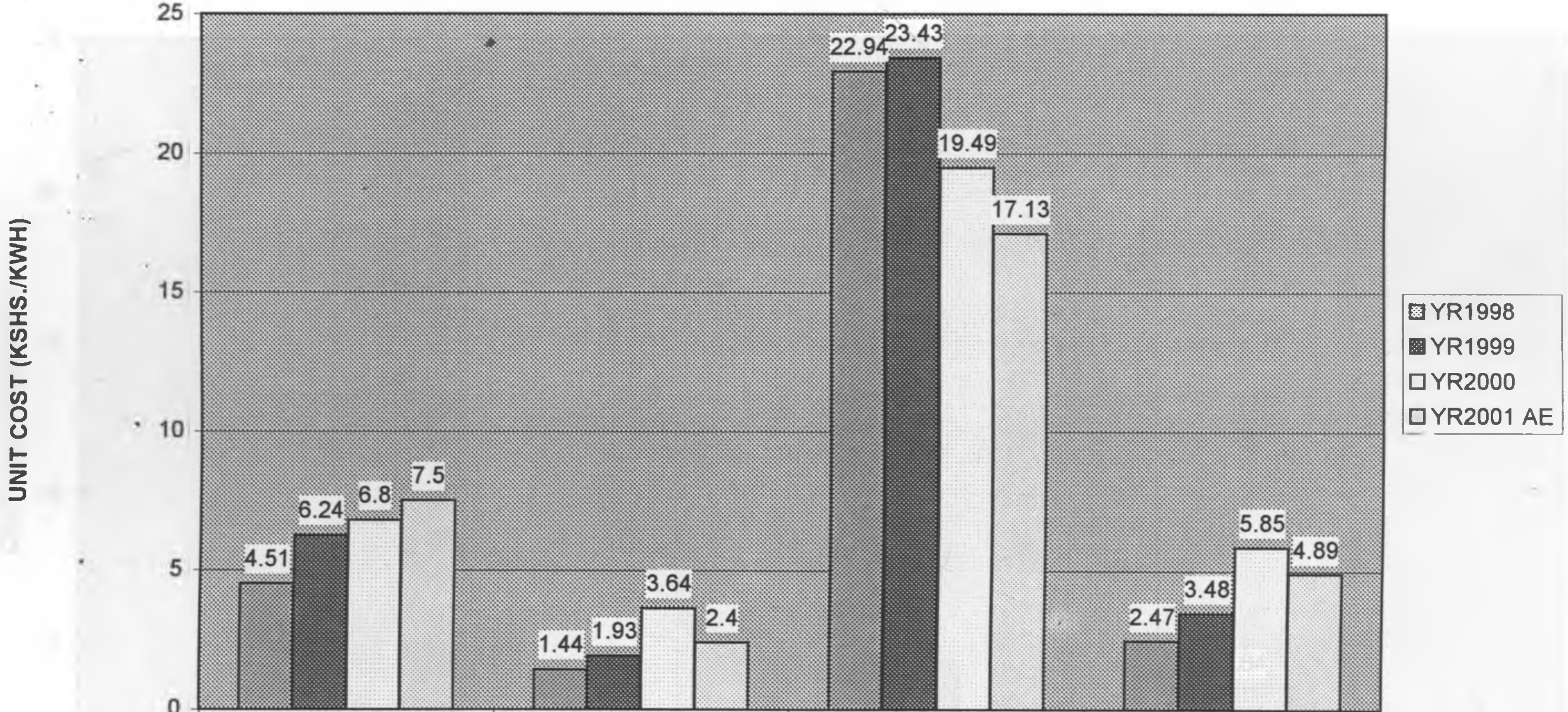
5.7 Cost - Benefits of Own Power Generation by BBK

In terms of generation costs, it is noted that the company has the benefit of low cost in generating power from its plants. The amount they could be paying to the national utility could be enormous had it not have its own power plants. However, the company incurs a lot of expenses when the supply from the national utility is not adequate; and therefore it has to supplement it through diesel power generation.

5.7.1 Power Generation Costs: 1998 – 2000

The company has been enjoying low cost in generating power from its hydros compared to diesel power generation (see Figure 8). Between 1998 and the year 2000, annual generation cost of power from KPLC has been increasing gradually. This is attributed to the low annual rainfall received between this periods which forced the company to import more power to supplement its own-generated power from hydros. Figure 9 on power generation costs indicate that diesel generation is the most costly in terms of power generation. This is attributed to high fuel and parts costs. The fuel costs has been on increase in the past three years. Generally, it is noted that there has been an annual increase in generation costs from 1998 upto 2000.

Fig 8: POWER GENERATION COSTS 1998 TO 2000

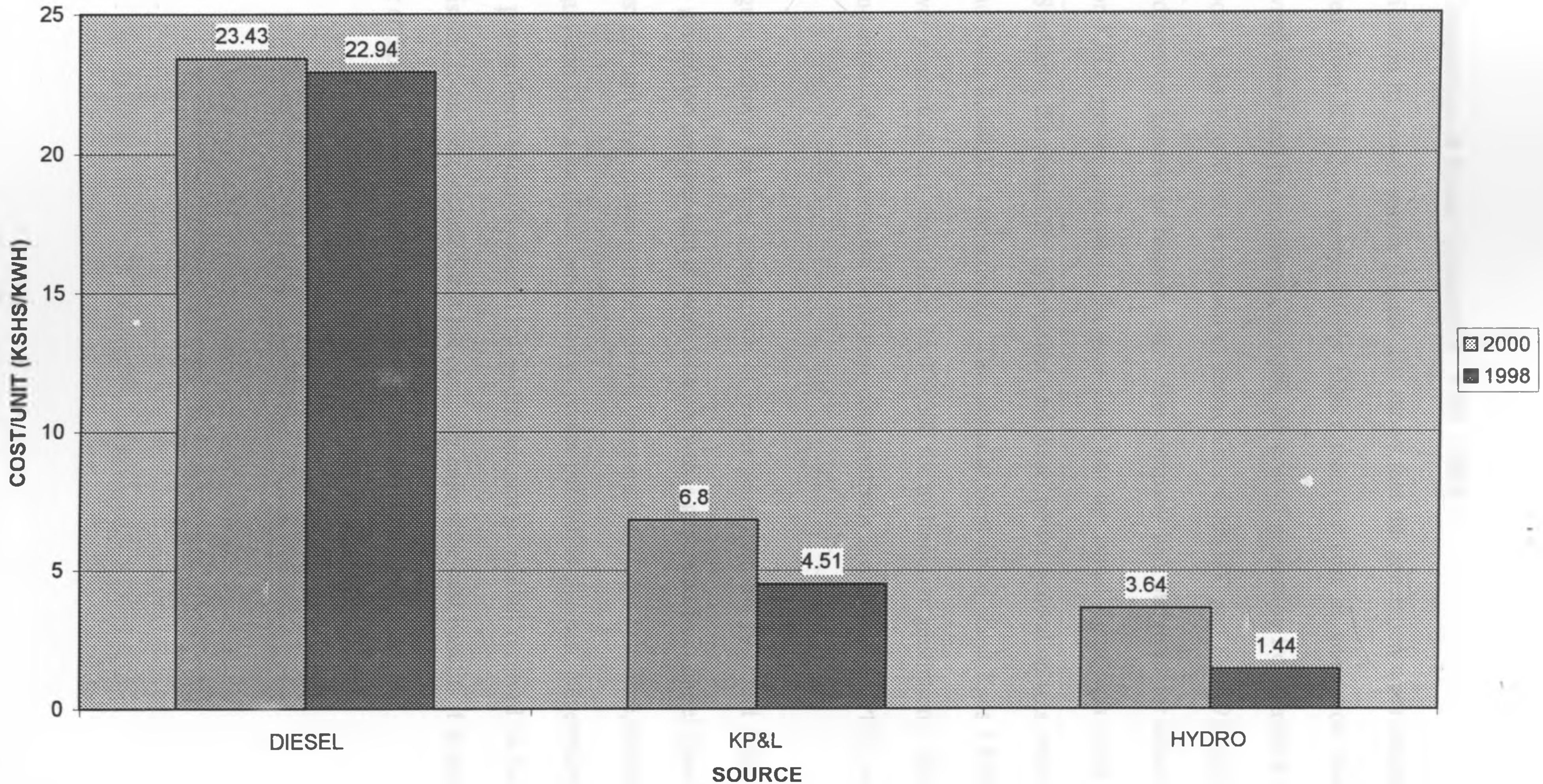


	KP&L	HYDRO	DIESEL	AVERAGE
YR1998	4.51	1.44	22.94	2.47
YR1999	6.24	1.93	23.43	3.48
YR2000	6.8	3.64	19.49	5.85
YR2001 AE	7.5	2.4	17.13	4.89

SOURCE OF POWER

Source: BBK,2000

Fig 9: POWER GENERATION
(COST COMPARISON 1999 & 2000)



Source: BBK,2000

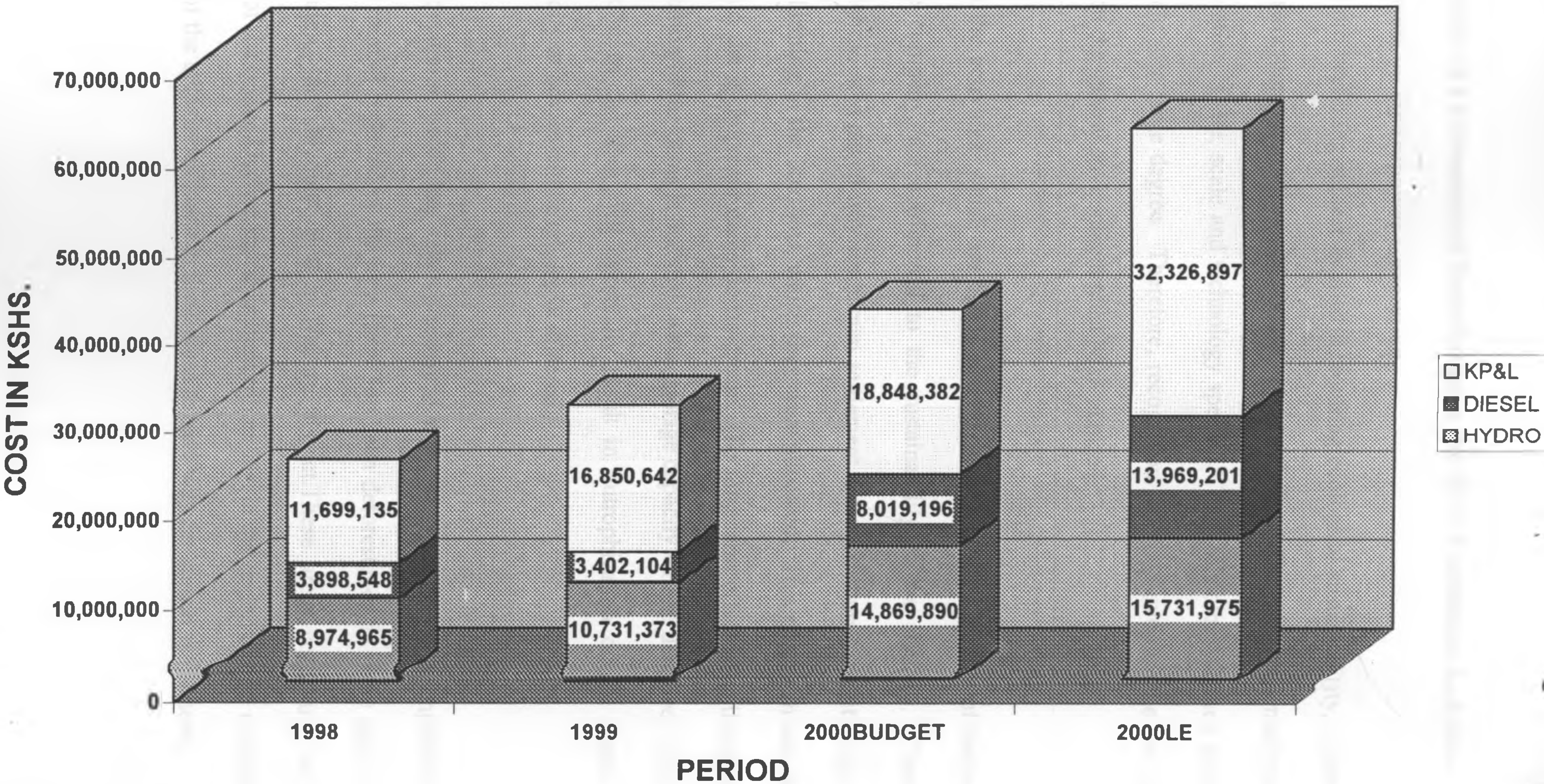
5.7.2 Cost Comparison of Power Generation: 1998 – 2000

The cost distribution by power source (Figure 10) shows that the generation costs incurred on power imported from KPLC is comparatively higher than the cost of generation from the company's owned diesel and hydro plants. In 1998, the cost of generation from national utility power was about Kshs 12,000,000 compared to about Kshs 4,000,000 and Kshs 9,000,000 for diesel and hydropower generation respectively. The company had budgeted for about Kshs 19,000,000 for KPLC power imports in the year 2000 but the actual figure was about Kshs 32,000,000. Similarly, the budget for hydropower and diesel power generation was about Kshs 15,000,000 and Kshs 8,000,000 respectively. This actually went up to about Kshs 14,000,000 for diesel power generation and about Kshs 16,000,000 for hydropower generation. However, hydropower and diesel power generation costs were comparatively lower that the KPLC costs.

Therefore, Figure 9 shows the cost comparison of power generation for 1999 and 2000. It is noted that the generation cost per unit is more when power is generated from diesel generators. Generation cost per unit when power is from hydro is comparatively low. Therefore, this implies that the company can save a lot if the generation of power per unit is cheaper. Nevertheless, the generation of power from hydro is determined by the amount of rainfall received in the area. From the statistics, it can be concluded that the company enjoys the cost benefits if it generates its own power compared to importing power from the national utility.

Fig 10: POWER GENERATION COSTS 1998 TO 2000

COST DISTRIBUTION BY POWER SOURCE



Source: BBK,2000

5.8 The Impacts of Environmental Degradation in the River Catchment and Sub-Catchments on Hydropower Generation

Power projects are becoming subject to criteria requiring ecological sustainability, maintenance of local social structure and a reliance on indigenous knowledge. The environmental impact on electricity generation is site, scale and technology specific. The technology chosen determines the scale and site to a large degree. Therefore, recognition is being given to the fact that the human impact on the natural environment must be minimized.

It is noted that the activities, which are taking place upstream of the location of hydropower stations by the company, are detrimental to the sustainability of the stations. The forest clearance at Chelimo area paved way for human settlement and agricultural activities (see plate 8). People do farming in the land lots, which they were allocated. This results in soil erosion, which drains into the hydropower dams down-stream. The long-term effect of soil erosion and the eventual siltation of the dams is that their water storage capacity will be depleted. Moreover, continued siltation of the dam will eventually result in eutrophication of the dams. The generation capacity of power will be adversely affected.

In addition ,deforestation which has taken place outside the study area has had implications on thee amount of rainfall received in the area.There has been deforestation in there part of Mau forest ,Olenguruoni and Ndoinet area in Nakuru district.These areas constitute the main catchment area of the region.Decline in the amount of rainfall in the region can be explaineb by the defostation of the indeginous forest in these areas to pave way for human settlement.

PLATE 8: Human settlement at the catchment areas of the rivers draining into the Hydro Dams might have long term effects on performance of the Hydro Dams due to Siltation.

PLATE 9: A river draining into one of the Hydro Dams.

5.9 Local Area Power Supply.

The research sort to find out from the business community, households and institutions their opinion(s) on a number of issues on power supply and demand. Questionnaires were administered to 40 different businesses in the towns adjacent to the company. These were Kericho town, Kapkugerwet and Kapsuser. Fifteen questionnaires were administered to households and institutions.

Businesses were grouped into two broad categories: Non-Engineering related and Engineering related businesses. Non-Engineering related businesses constituted 52.5% and the Engineering related businesses constitute 47.5% of the total number of respondents. Each business enterprise had about 10 employees.

The entrepreneurs were asked to state the days when their business does well. Out of the total respondents; 27.5% stated that they make good business during weekdays and 12.5% stated that they make good business during the weekends. However, 60% of the respondents stated that they make good business during both weekdays and weekends.

In addition, 75% of all the businesses and 93% of households were supplied with power by KPLC and they relied wholly on this source. However, 25% of business community were supplied with power by KPLC; and in case of power outage, they generated their own power. This category comprise of 6.3% of households interviewed. Those who stated that they generated their own power complained of high cot of own-generation due to high cost of fuel.

The respondents were asked to state the duration of power utilization and 95% of the business community stated that they utilized power for more than 5 hours per day. This group comprised of 93.8% of household respondents.

Power cuts and/or blackouts

A question was asked on the frequency of power cuts/blackouts. All the respondents stated that they experience power cuts/blackouts. But 90% of the business community respondent's stated that power cuts/blackouts do occur during weekdays with 70% stating that power cuts occur during the afternoons.

The findings from the question show that the business persons experience power cuts/blackout when the business is expected to be good. The data collected indicates that business is good during the weekdays and weekends and this is the time when they experience power cuts/blackout. The research sort to find out the best possible source of power which can be harnessed in the region. Their responses were as shown in the table below:-

Table 11: Alternative Power Source in the Area

POWER SOURCE	NO. OF RESPONDENTS	PERCENTAGE	TOTAL
Hydropower	23	57.5	23
Solar Power	7	17.5	7
Wind	1	2.5	1
Others	9	22.5	9
TOTAL	**40**	**100**	**40**

Source:Field Study,2000.

A question was asked to inquire the adequacy of power supply. It is noted that 16 household respondents answered this question with 87.5% stating that the supply is not satisfactory. The reason they gave is that power cuts often occur when power is most

Table12 Sufficiency of Power Supply

Do you think the current supply of power is adequate?	No. of Household respondents	Percentage	Total
Yes	1	6.7	1
No	14	93.3	14
Total	**15**	**100**	**15**

It is also noted that among the schools and hospitals interviewed, 100 per cent of those supplied with electricity from KPLC complained of power outages. But the company hospital, dispensaries, schools and residential estates have never experience any power outages.

The company sponsored schools have never loss time due to power black out whereas those supplied by KPLC stated that they loose more than one hour in case of power black out occurrence.

6.10 The Possibility of Local Area Power Supply by BBK

The study revealed that with the appropriate legal and institutional framework, it is possible to have local area supply (localized power generation, distribution and transmission). As mentioned earlier, such a system will enjoy the economies of scale in terms of minimization of power loss as a result of long distant power transmission.

It is noted that BBK, as an example, sheds about 8025 KVA to various consumption points. If this power was to be supplied to, for instance, households with consumption rating of 5 KVA each, then approximately 1600 neighbouring households could be supplied with power. This is an ideal scenario where power is assumed to be for household consumption only. But in a mixed settlement (urban and rural economy); the supply could serve about 3 heavy industries of 630KVA each, 10 medium size factories and small enterprises of 25 KVA each; about 40 institutions (schools, hospitals, etc) of 15 KVA each; and about 600 households of 5 KVA each. This is an illustrative scenario of the possibility of a power generator serving a local area.

Diagram 4 shows the possible area(s) the company can supply power at local area. There are two power feeders, Kapsuser feeder and Kericho town feeder. The Kapsuser feeder constitutes KVA and Kericho town feeders constitutes about KVA. If BBK's generated power was to be distributed and transmitted to the area shown on the diagram, it is noted that it could supply upto 55 per cent of the area shown in the schematic diagram of Kericho District.

5.11 Summary.

In this chapter comparative advantage, which the company enjoys in generating, distributing and transmitting its own electricity have been discussed. From the analysis it is evident that the company spends less costs in generation of power from its own hydropower systems compared to generation cost from diesel or imports from KPLC .The possibility of local area power supply has been highlighted .For example, a hydropower generation system which has the same capacity has the ones owned by BBK at the moment can supply electricity to the entire municipality and its surrounding environs. This indicates that with a larger power generating system, the whole district and even the neighbouring districts can be supplied with locally generated electricity.

Environmental conservation and management is key to sustainable power generation from natural resources, particularly hydropower system. Environmental degradation in the river catchments and sub-catchments of the study area ha been pointed out to be a major constraint now and in future in the development and management of power systems by the company .In the study, however, river discharge analysis could not be done to asses the river flows. This was because of lack of data on river discharges of the area.

CHAPTER SIX

PLANNING IMPLICATIONS AND RECOMMENDATIONS

6.0 Introduction

This chapter discusses how proper planning and use of appropriate technology can help to reduce power supply / demand imbalances, especially by the private sector. The government can borrow these experiences in order to foster development in the power sub-sector. For example, an alluminium smelter, consume large amounts of electricity. Others, for example a Sugar Mill may be electrically self - reliant (or even produce surplus). Hence, in between lies a range of industrial and service sector users, all of who influence the demand for electricity and, thereby, the needed supply. The illustrations will form the basis of the way forward in the power sector in Kenya, and, therefore, will highlight some of the possible proposals.

Agriculture, for which this study was based, represents one area of comparative advantage for many developing countries for power generation. For instance, Mumias Sugar Company has undertaken a project on co-generation of power generation in Kenya. Therefore, generation of power by the private organizations would be an important development in the power sub-sector. The positive impacts of such an arrangement could be realized if many of the organizations are in their electricity needs. If well developed with more efficient generation equipment, there can be sufficient electricity production to even allow the organizations to sell electricity offsite

The tea sector is another area, which can be involved in power generation. It is noted that tea is grown in areas of relatively high and reliable rainfall throughout the year, ranging between

1800mm upto 2200mm per annum. The crop does well in highland areas characterized by undulating land. These characteristics are favourable for the development of hydroelectric power generation, as is the case with Brooke Bond (K) Ltd in Kericho. In this case, the amount of rainfall received throughout the year becomes significant.

Cement industry is another important industrial sector, which requires large amounts of energy mostly in the form of heat, but also some electricity, which is used to drive motors. While great strides have been made in reducing the amount of energy required to produce cement, further gains in the form of electricity co-generation are possible. A cogeneration equipment can be installed which would allow the industry to utilize waste heat in order to produce a certain percentage of its total electricity needs. Such a project has been undertaken in Korea and it has been quite successful and, indeed, economically attractive. Similar technology may be considered in Kenya in future in order to address electricity demand.

Although Kenya has considerable power generation potential, private developers have not been involved in sizeable power generation projects, particularly hydropower projects. The private sector tends to take cautious approach to involvement in these kinds of projects. It is noted that large power projects are capital-intensive and often require more than one source of funding. Private companies usually prefer to utilize non-recourse financing, since their aim is to produce power for their own consumption and, therefore, enhance production.

In order to address the problem of power deficit in Kenya comprehensively, both national and regional (or multi-regional) perspectives are generally needed. The regional, multi-regional perspectives are generally needed. The regional, multi-regional and national considerations should be complied with multi-sectoral approach in power generation and / or provision. This

means that providing them with the necessary incentives should encourage other players in the sector, other than the government.

Although previously, attempts in this direction have not met, immediate acceptance, especially in developing countries, continued efforts might eventually indicate whether or not the current policies in the power sector are supported by efficiency and / or distribution arguments.

There are a number of factors that could influence on the participation of the private sector in power generation in Kenya. These include, among others: -

- Market opportunity, which indicates that there is a clear need for additional capacity if the country is to industrialize fast.
- Enormous amounts of capital will be needed by the government to meet expected future electricity demand.
- Inability of the government to fund all the electricity need(s) and, therefore, the private sector will begin to play an important role in at least the generation aspects of the sector.
- The state agency, which regulates power utility in Kenya - Electricity Regulatory Board of Kenya, has clearly encouraged private power participation.

6.1 Recommendations

The study has been carried out in order to highlight the potentials and the constraints that impede development and / or participation of private sector in power generation. It is clear from the study that the private sector can be an important player in power generation, a factor that is especially relevant for the financially pressed public sectors in Kenya today. Private power producers also tend to operate more efficiently than publicly owned facilities, since they normally accept responsibility for project risks, such as construction cost overrun ;and efficient operation of the plant(s).

However, the macroeconomic, legal and regulatory environments in Kenya do not encourage competitive proposals for investment in private generation of power. This research therefore has come up with recommendations, which cultivate the requisite investment environment, and in developing the mechanisms and procedures that need to solicit and evaluate internationally competitive proposals for an orderly private power development and / or participation.

It is emphasized that the success or failure of participation of the private sector in power industry in Kenya will depend on the stability of macroeconomic environment. In particular, the policy makers and political leaders must agree on the role that the private sector should have in the electric power industry, and, therefore, they must develop laws, regulations and mechanisms to facilitate private power projects. If encouragement of private power development is to be realized, the sector should be structured to create competition. This is an issue, which it is hoped that the current reforms towards privatization of the power sub-sector in Kenya will address.

In the initial stage, competition can be established without restructuring but by permitting existing public utility to purchase surplus power from local private producer(s) on a competitive basis. Further, since power generation activities can be competitive, it could be possible to reduce the need for regulation. On the other hand, power transmission, which is considered to retain the characteristics of a monopoly, should be subject to regulation. For example, a separate transmission company can be responsible for purchasing power on a competitive basis from diverse generators, for operating the grid and for the load dispatch.

Regulatory process should be institutionalized in order to reduce the number of conditions that need to be incorporated in the contractual agreements for private power producers. Therefore, published procedures should be provided; including the specific steps and approvals needed for private power development. Professional management, institutional independence and predictable pricing mechanisms are essential to an effective regulatory function. This means that the regulatory structure should ensure that the financial viability and creditworthiness of utilities.

6.1.1 Private sector involvement in power sector in Kenya: The way forward.

It is noted that with the exceptions, the power utilities in Kenya are government owned integrated monopolies responsible for generation, transmission and /or distribution of all electricity that they produce. Varying degrees of competition already exist in the running of even the most integrated power utilities, as for instance to construct facilities, to contract out certain functions and so on.

One of the tenets policy of the restructuring of the power sub-sector in Kenya should embrace is that exposure to markets and competition should be increased in order to enhance sector performance. In particular, recognition that not all of the activities involved in the privation of the infrastructure services is a national monopoly to achieving greater efficiency. For greater efficiency in the power sub-sector the following tenets of a new policy should be fostered.

a) Competition in Generation.

It is important to note that the small size of the power systems and the weakness of the regulatory frameworks in Kenya make it difficult to recommend their break up (unbundling). Unbundling generations from transmission and wholesale competition for generation are complex affairs. Therefore the fragmentation of the generation systems into several prices for competition should emerge, and a trend toward smaller plants and less capital-intensive generation, should be encouraged.

This model assumes that the economies of sale in the generation can be obtained in the spirit of sub-sector fragmentation or are less important than the efficiency brought by competition. In this respect, independent power producers might be able to compete with utility-based generation in specific circumstances. So there is need to review the barriers to their entry in the power industry and the rules for pricing their outfit.

b) Decentralization of Generation and Distribution

The weaknesses that prevail at the national level in the formal govemance system of the power sub-sector in Kenya suggest less sophisticated decentralized community based supply. Whether in education, health, water supply and sanitation, rehabilitation, or supply of new housing, this mode of service delivery has elicited responsible behavior and good cost recovery from beneficiaries and responsive supply by producers.

Decentralized community based low Voltage power supply is worth exploring, but it should exclude most traditional generation technologies except mini-hydro, wind power and solar power. However, decentralization has one draw back in the eyes of many, it often translates into markedly different power prices from one area to the next; significant departure from the prevailing practice of natural tariff for small consumers. This is an issue, which should be addressed by the electricity a regulatory Board, as a sole regulator in the power sector.

6.1.2 Purchasing Power from Private Producers

Another very important issue for commercial viability of power projects is the tariffs structure. The most common pricing approach followed in private power agreements (as in China) is the two-part tariff, comprising a capacity charge, which is designed to recover the capital or fixed costs of the plant, and an energy charge, which varies with the net amount of energy in Kilowatts Hours actually delivered by the power producer to the purchasing utility. The government can adjust these rates by providing various incentives and penalties and through indexation, which provides the producer, operations and maintenance operator, and the projects debt and equity sponsors with greater certainty that their costs and earnings will not erode during the life of the project because of factors beyond their control.

Power generation projects involve risks for all parties - the power purchaser, the project developer, and the tenders. The development of private projects can go on successfully only with an appropriate allocation of risks. One of the main reasons many private power projects in developing countries have not progressed has been an inability to meet the requirements of tenders, notably the provision of guarantees from government covering the power purchasers' obligations, foreign exchange risk and so on. Therefore, if the private power projects have to succeed, the ability of the parties to agree on how risks will be shared is often the key to initiating a successful participation of the private sector in power sub-sector.

It is noted that availability of a bulk power market, in addition, to the market from sales to the existing public utility, can provide additional economic benefits and incentives to private power producer and retail consumers. The private producer can have an opportunity to obtain additional revenues through sales and other bulk users. Private participation in a bulk power market also requires the following authorities and conditions: -

- Legislative authority for sale of electricity by the private sectors to consumers other than a utility power purchaser.
- Legislative authority for private access to transmission and distribution systems.
- Establishment of conditions under which power utility or other owners of bulk transmission systems wheel power from private generators.
- Establishment of a clear transmission pricing mechanism.
- Legislative Authority for generation, transmission and distribution of power at Regional level by Private Producers.

From the study, it can be realized that the argument based on the economies of scale in power projects may not be valid, therefore, it is important to provide additional motivation for power generation by the private sector. If there is to be a role of the private sector in power sector, its justification must be based on the three roles: - Mobilization of private capital for power development, Development of new sources of power generation, or Improved economic efficiency.

CHAPTER SEVEN

SUMMARY AND CONCLUSION

7.0 Summary.

There are various advantages of private sector involvement in power sub-sector. One of the advantages is that, given the desperate need for investments by the governments in the energy sector and the shortage of public capital, the idea of private capital flowing into the sector is attractive. However, such an investment must have an element of additionality involved.

Another possible advantage of private sector involvement in power sub-sector is the possible new sources of power that can be opened up. For instance, some power projects may be considered too small (as the case with power projects for BBK) to be developed effectively by a large public utility. Alternatively, Industry or Agriculture may be able to employ cogeneration technologies that are not available for traditional power plants.

A case in mind is, for example, Mumias Sugar Company in Kenya, which generates power using cane by-products (burgass). In this case, private sector involvement can bring additional capacity into production of power from sources, which are economically efficient, but not readily available to publicly owned utilities.

It is pointed out that power generated by a private enterprise need not necessarily be distributed to the national grid; but if it is able to serve itself with power sufficiently, it will have saved power to the national grid and, therefore the saved power can be consumed in other sectors of the economy.

Perhaps the most persuasive argument in favour of private participation in power sub-sector is that of the improved economic efficiencies. Such efficiencies might come about, when improved maintenance results in physical capital being more efficient or long- lived. Besides this, overheads may be somewhat lower in the private sector. Whichever way, to the extent that profit motive induces, the private sector to improve efficiency, the economy of a country benefits in the long run.

It is worth noting that since the establishment of the Electricity Regulatory Board, the government has embarked on a new wave of reform decisions aimed at creating the necessary structures to apply the law and key principles of market orientation such as efficiency and competition in the power sub-sector.

These decisions include the separation of generation from transmission operations and establishment of competition in generation of power. This gives the private sector a chance in the power sub-sector to not only generate but also diversify power sources. This is an important aspect, particularly in Kenya where hydropower generation constitutes 75% of the total installed capacity. This has been (as mentioned earlier) subject to climatic conditions particularly rainfall.

The serious power shortages of 1999/2000 in Kenya, worsened by the declining economic development should spark the government's interest in tapping the potential private sector in the power sub-sector development. However, the main problem that should be addressed is the need for long-term market and tariff commitments due to sector's capital-intensive nature.

7.01 Power Savings to the National Power Utility.

It is important to note that the concept of 'participation' in this study do not necessarily mean that a power producer generates power that is supplied to the national grid. In this context, a private generator who generates power for own consumption will have participated in the power industry. This means that the private producer will have saved a certain amount of power to the national grid. That power can then be supplied to other needy areas by the national utility.

Brooke Bond (K) Ltd distributes about 8025 KVA of power to all its estates and factories. This amount of power is generated from its own power generation stations. This implies that the company saves upto 8025 KVA to the national grid (which it could have, otherwise imported for its use).As indicated earlier, if the company was allowed to transmit and distribute power it could supply a portion in any given region(based on its current capacity). The company has the potentials to expand the generating systems. Therefore this implies that it can supply a relatively large area in a region.

7.1 Conclusion.

The case study has revealed important issues that call for planning in the power sub-sector. It is important to note that every power source or system has unique characteristics, which favours its development. For instance, in planning for hydropower generation systems, various factors are taken into consideration. These factors dictate the siting of power stations. Factors considered include topography, rainfall amount, temperature, river catchments and sub-catchments, quantities of water in rivers and their tributaries in the proposed site, river discharges and so on. The same applies to other power generation sources.

Therefore, it is important that potential sources of power peculiar to different regions should be identified. These sources can therefore be harnessed to generate power to be utilised in these areas or to be supplied to the national grid. Wind and solar power, for example, can be best suited in arid areas in the tropics. This is because these areas receive long hours of sunshine and sufficient wind blow to run turbines to generate power. A multitude of such small-scale sources of power can sum up to substantial amount of power.

Kericho District, where the case study is based, enjoys adequate and reliable rainfall throughout the year. The rainfall data reveals that the area received more than 1300mm of rainfall annually for the last 29 years. The area is characterised by valleys and hills, some of which provide suitable sites for hydropower generating stations. Private power investors can harness these characteristics with a bias towards hydropower generation.

Another aspect, which is important in planning for the location power system, based on existing natural resources, is the economies of scale in power supply. It is noted that the further the consumer of power from the source, the higher the amount of power lost through distribution and transmission. Therefore, more power is lost in supplying a dispersed settlement than a concentrated settlement. Regional power generation, distribution and transmission would ensure that less power is lost.The private sector can establish power generation systems at regional level and supply power within that region. For instance, financially able Municipal Councils can develop a power system to supply power within the municipality or township.

In conclusion, various concerns have been discussed as pertains to the role of the private sector in power generation. The findings and the discussions highlighted that the participation of the private sector in power generation can make an important contribution to development of power sector infrastructure in Kenya. This can be either directly or indirectly. It is important to stress that Kenya's power sector would remain attractive to private developers/investors as long as there is:-

(i) The initiation and or implementation of power sector reform in a transparent process, where potential investors in the Kenyan power sector can assess the scope, direction and schedule of reforms.

(ii) Clarification and streamlining of the process of obtaining power project and tariff approvals particularly for the power investors who want to venture into commercial power generation.

(iii) Development of mechanisms for and increased access to financial assistance for all power projects by the local investors.

(iv) Commercialization of various power companies and / or power generators that will be off-takers from private power projects, and

Provision of power developers to direct access to customers so that they are able to bear more market risk in the future. This could be debatable in a developing country. However, it is one of the ways of encouraging the private sector participation in power sector.

However, Covarrubias, A.J. (1996) argues that as with other infrastructure sectors, ownership of power sector assets by private entrepreneurs (assuming their interest could be elicited) may be a political and economic issue in many developing countries. Nevertheless, privatisation of some segments of the operations appears possible, especially power generation. Private operators can be expected to invest in almost any country if they succeed in hedging their perceived risks.

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UNIVERSITY OF NAIROBI

FACULTY OF ARCHITECTURE, DESIGN AND DEVELOPMENT.

DEPT. OF URBAN AND REGIONAL PLANNING

BUSINESS COMMUNITY QUESTIONNAIRE

Questionnaire No.................................. ....

Name of Interviewer ....

Date of Interview...

Name of the Village/Sub-Location ....

Name of Respondent ....

Position of Respondent..

1. What type of business do you run?
2. When do you experience good business?
   (i) Weekdays (ii) Weekends (iii) Public holidays
3. How many people are employed in your business? ....
4. How much do you incur in terms of their wages/salaries? Ksh ....
5. What source(s) of power do you utilize in your business.................................
   (i) Own solar power
   (ii) Own generation
   (iii) Commercial power
   (iv) Others (specify)
6. Where do you get the power from?
   (i) States commercial power
   (ii) Private producer
   (iii) Own generation

   (If (i) and/or (ii) go to 6 and if (iii) go to 7)
7. How much do you pay for the power consumed? Ksh..... ....per month.

8. How much do you spend to generate own power? Ksh……... …………… per month.

9. For what purpose do you consume power?

   (i) Cooking

   (ii) Lighting

   (iii) Industrial production

   (iv) Appliances/equipment

   (v) Others (specify)

10. How many hours per day do you utilize the power?

   (i) Less than 2 hours

   (ii) Between 2-5 hours

   (iii) More than 5 hours

11. What power conservation measures do you employ in your business to save the amount of power consumed?

   (i) ……………………………………………………………………………..

   (ii) ……………………………………………………………………………..

   (iii) ……………………………………………………………………………..

   (iv) ……………………………………………………………………………..

12. Do you experience power cuts/blackouts?

   Yes ☐ No ☐

13. If yes, when do power cuts/blackouts occur most frequently?

   (i) Mornings

   (ii) Afternoons

   (iii) Evenings/nights

14. Which days do you experience power cuts/blackouts

   (i) Week-day(s)

   (ii) Week-end(s)

   (iii) Public Holidays

15. How many times do you experience power cuts/blackouts per week? ………..times

16. Can you describe the problems that occur in your business when you have power cut/blackouts……………………………………………………………………………

   ………………………………………………………………………………………………

   ………………………………………………………………………………

   ………………………………………………………………………………………

17. Can you approximately state how much useful time you lose because of power cuts/blackouts? For example, do you have to close down the business temporarily? Etc……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………

18. Can you explain briefly the long term consequences of power cuts/blackouts in your business?……………………………………………………………………………..

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………

19. What other alternative sources of power can be harnessed in this area?

Hydro ☐ Solar ☐ Thermal ☐

Wind ☐

other (specify) ………………………………

UNIVERSITY OF NAIROBI

FACULTY OF ARCHITECTURE – DESIGN AND DEVELOPMENT

DEPARTMENT OF URBAN AND REGIONAL PLANING

HOUSEHOLD QUESTIONNAIRE

Questionnaire No.:……………………………Date of Interview:……………………..

Name of Interviewer:……………………………………………………………………

Name of Village/Estate:…………………………………………………………………

Name of Sub-Location/Ward:……………………………………………………………

A PERSONAL INFORMATION

1. Name of the respondent:……………………………………………………………
2. Sex (Male/Female):…………………………………………………………………
3. Age:…………………………………………………………………………………
4. Marital Status:………………………………………………………………………
5. Household Size:……………………………………………………………………
6. Occupation:…………………………………………………………………………
7. Household Head Income:……………………………………………………………...
8. What are the other sources of income in the family?………………………………

   ………………………………………………………………………………………………

   ……………………………………………………………………………………

9. Record the household characteristics in the table below using the codes given:

HA11	HA22	HA33	HA44	HA55	HA66	HA77	HA88	HA99
Name	Sex M/F	Household Status	Age	Marital Status	Educational Level	Where born	Occupation	Where working

HA33 – household Status

01 – Household Head

02 – Spouse of Household Head

03 – Child of Household Head

04 – Others

HA55 – Marital Status

05 – Married

06 – Unmarried

07 – Separated

08 – Divorced

09 – Widowed

10 – Polygamous

HA66 – Educational Level

11 – None

12 – Primary

13 – Secondary

14 – Higher Education

HA77 – Where born

15 – Within the Division

16 – Within the District

17 – Outside the District

HA88 – Occupation

– Farmer   20 – Employee   22 – Unemployed   24 – Others (Specify)

10 What is the type of house?

a) Permanent (Stone/Brick + Corrugated iron sheets or Tiles)

b) Semi-permanent (Mud-walls + Corrugated iron sheets)

c) Temporary (Mud-wall + Grass Thatch)

B. LAND AND LAND-USE

11. Is your land (i) Bought?

    (ii) Inherited?

    (iii) Rented?

    (iv) Squatted?

12. Do you have a title deed?

    Yes ☐ No ☐

13. What is the size of your land?..acres

C. ELECTRICITY SUPPLY AND CONSUMPTION

14. What sources of power do you use?

    (i) Solar

    (ii) Own generator

    (iii) Commercial power

    (iv) Other (Specify)

    If (iii) go to 16.

15. When did electricity first reached your house?...

16. Where do you get the electricity from

    (i) State's commercial power (KPLC)

    (ii) Private producer

    (iii) Own generator

    (iv) Others (Specify)If (i) or (ii) go to 17 and if (iii) go to 18

17. How much do you pay for electricity?................................Ksh. per month

18. How much do you spent generate own power?.................................Ksh

19. What activities do you carry out using electricity in your house/farm?

Irrigation ☐

Welding ☐

Cooking ☐

Lighting/Security ☐

Others (Specify) ☐

20. How many hours per day do you utilize electricity?

(i) Less than 2 hours

(ii) Between 2 – 5 hours

(iii) More than 5 hours

21. What conservation measures do you undertake to save on the amount of power consumed?..

....

....

22. Do you experience power cuts/blackouts

Yes ☐ No ☐

23. If yes, when do power cuts/blackouts occur most frequently

(i) Mornings (ii) Afternoons (iii) Evening/nights

24. How many times do you experience power cuts/blackouts?..........times per week

25. Can you describe the problems that you experience when you have power-cuts / blackouts?...
....
....

26. Can you approximately state how much useful time you lose because of power cuts/blackouts? For instance, do you have to change your activity programme?

27. In the case of power cut/blackout how much extra costs do you incur for alternative source of lighting or power source? Ksh...................................

28. Do you think the current supply of power is adequate?

Yes ☐ No ☐

29. What other alternative sources of power can be used in this area?

Hydro ☐ Solar ☐ Thermal ☐

Wind ☐ Other ☐

UNIVERSITY OF NAIROBI
FACULTY OF ARCHITECTURE, DESIGN AND DEVELOPMENT
DEPT. OF URBAN AND REGIONAL PLANNING.

INSTITUTIONAL QUESTIONNAIRE
{SCHOOLS}

Questionnaire No ....Date of interview ....
Name of the Interviewer ....
Name of the Village/Sub-Location ....
Name of Institution.. ....
Name of the respondent .... Position ....

(1) Who sponsors this institutions?

(i) Government ☐
(ii) Religious organization ☐
(iii) Company ☐
(iv) Others (specify) ☐

2. How many people does the institution cater for?
   (a) Teachers ....
   (b) Students ....
   (c) Others ....

3. Does the students reside in the institution?
   Yes ☐ No ☐

4. What sources of power does the institution use? (Tick where appropriate)
   (i) Commercial power ☐
   (ii) Own solar power ☐

(iii) Own generators ☐

(iv) Other (Specify) ☐

5.Where do you get the power from?

(i) State Commercial Power (ii) Private producer (iii) Own generation

(if (I) and./or (ii) go to 5 and if (iii) go to 6)

6. How much do you pay for the power? Ksh. ……….. …… ……………..per month.
7. How much do you spend to generate own power? Kshs……… ………… per month.
8. or what purpose do you consume the power?

(i) Cooking ☐

(ii) Lighting/Security ☐

(iii) Industrial ☐

(iv) Others specify ☐

How many hours per day do you utilize the power?

(i) Less than 2 hours ☐

(ii) Between 2 - 5 hours ☐

(iii) More than 5 hours ☐

9. What power conservation measures does the institution employ to save on the amount of power consumed?

……………………………………………………………………………………

……………………………………………………………………………………

…………………………………………………………………………

10. Do you experience power cuts/blackouts?

Yes ☐ No ☐

11. If yes, when do power cuts/blackouts occur most frequently

(i) Mornings ☐ (ii) Afternoons ☐ (iii) Evenings and nights ☐

12. How many times to do you experience power cuts/blackouts? ………..times per week
13. Can you describe the problems that occur when you have power cuts/blackouts

……………………………………………………………………………………

…………………………………………………………………………

14. Can you approximately state how much useful time is lost because of power/cuts blackouts? For instance do you have change institutions programme etc…………..hours.
15. In the case of power cuts/ blackouts how much extra costs do you incur for alternative source of power or lighting? Ksh ………………………………………..

16. Can you explain briefly the consequences of power cuts/blackouts in your institutions...

....

17. What alternative sources of power can be used in this area?

Hydro ☐ Solar ☐ Thermal ☐

Wind ☐ Other specify ☐

UNIVERSITY OF NAIROBI
FACULTY OF ARCHITECTURE, DESIGN AND DEVELOPMENT
DEPT. OF URBAN AND REGIONAL PLANNING.

INSTITUTIONAL QUESTIONNAIRE
{HOSPITALS}

Questionnaire No .... Date of interview ....

Name of the Interviewer ....

Name of the Village/Sub-Location ....

Name of Institution. ....

Name of the respondent .... Position ....

1. Who sponsors this hospital?

   (a) Government ☐

   (b) Religious organization ☐

   (c) Company ☐

   (d) Others (specify) ☐

2. How many patients does the hospital cater for? (on average/day)

   (a) In-Patients...

   (b) Out-Patients ....

3. What sources of power does the hospital use? (Tick where appropriate)

   (a) Commercial power ☐

   (b) Own solar power ☐

   (c) Own generators ☐

   (d) Other (specify) ☐

4. Where do you get the power?

(i) State Commercial Power (ii) Private producer (iii) Own generation

(if (i) and./or (ii) go to 6 and if (iii) go to 7)

5 How much do you pay for the power? Ksh.. ……….. …… ……………..per month.

6 How much do you spend to generate own power? Ksh………. ………… per month.

7 For what purpose do you consume the power?

(a) cooking ☐

(b) Lighting/security ☐

(c) Equipment/Apparatus ☐

(d) Others (specify) ☐

8 How many hours per day do you utilize the power?

(a) Less than 2 hours ☐

(b) Between 2-5 hours ☐

(c) More than 5 hours ☐

9 What power conservation measures does the institutions employ to save on the amount of power consumed?……………………………………………………..

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………………

10 Do you experience power cuts/blackouts?

Yes ☐ No ☐

11 If yes, when do power cuts/blackouts occur most frequently

(i) Mornings ☐ (ii) Afternoons ☐ (iii) Evenings and nights ☐

12. How many times to do you experience power cuts/blackouts? ……….times per week.

13. Can you describe the problems that occur when you have power cuts/blackouts

……………………………………………………………………………………………

…………………………………………………………………………

14 Do some equipment/apparatus in your hospital use power?

Yes ☐ No ☐

15 If yes, what do you do incase of power cut/blackouts?

……………………………………………………………………………………………

……………………………………………………………………………………………

…………………………………………………………………

16. Can you explain briefly the consequences of power cuts/blackouts in your hospital?

....

....

17. What alternative sources of power can be used in this area?

Hydro ☐ Solar ☐ Thermal ☐

Wind ☐ Other specify ☐

RESEARCH & DEVELOPMENT DEPARTMENT

BBK TEA DIVISION: MEAN TEMPERATURE DEG. C - JANUARY / DECEMBER 2000

2000	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		MEAN	
ESTATE	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
R & D DEPT.	5	34	6	35	7	34	8	32	8	31	8	31	9	30	7	31	8	32	7	31	9	31	8	31	8	32
KAPKORECH	11	26	11	26	11	26	11	25	11	24	11	24	11	24	10	23	11	24	10	24	11	25	11	25	11	25
CHAGAIK	8	27	9	29	7	30	8	29	8	29	8	29	7	25	8	26	7	27	8	28	10	26	9	26	8	28
SAMBRET	8	22	8	23	8	22	8	23	8	22	8	22	8	24	8	22	8	26	8	24	8	22	7	22	8	23
CHEYMEN	11	26	8	28	9	27	10	26	9	24	10	23	10	22	9	23	10	25	9	25	9	25	9	26	9	25
KIMUGU	8	27	9	27	10	29	9	28	10	29	12	26	10	24	9	24	10	25	12	22	11	23	10	25	10	26
ZONE 1	**9**	**27**	**9**	**28**	**9**	**28**	**9**	**27**	**9**	**27**	**10**	**26**	**9**	**25**	**9**	**25**	**9**	**27**	**9**	**26**	**10**	**25**	**9**	**26**	**9**	**26**
CHELIMO	7	27	7	27	7	27	7	26	6	26	6	27	7	27	7	26	7	27	6	26	7	26	7	27	7	27
KERICHO	7	27	5	29	6	28	7	27	10	25	10	25	10	24	9	27	8	27	9	25	10	25	10	25	8	26
KERENGA	11	27	11	27	11	26	10	26	10	27	10	26	11	26	9	26	8	26	8	26	9	28	10	28	10	27
CHEBOWN	9	27	9	27	10	27	10	25	10	26	10	24	11	24	9	24	10	26	9	26	10	26	10	26	10	26
TAGABI	8	28	8	28	9	27	11	26	10	26	10	24	10	24	9	24	10	25	9	25	10	24	11	25	10	26
ZONE 2	**8**	**27**	**8**	**28**	**9**	**27**	**9**	**26**	**9**	**26**	**9**	**25**	**10**	**25**	**9**	**25**	**9**	**26**	**8**	**26**	**9**	**26**	**10**	**26**	**9**	**26**
JAMJI	9	30	9	30	10	29	11	29	10	31	10	29	10	29	10	29	10	29	10	30	10	30	10	30	10	30
NGOINA	10	31	11	29	13	30	15	30	15	29	13	28	13	27	14	28	14	28	14	30	13	28	14	28	13	29
KAPGWEN	9	30	9	31	10	29	10	27	10	27	11	27	10	26	9	27	9	27	10	27	10	27	11	28	10	28
CHEMOGO	11	31	11	32	12	30	11	28	11	29	12	28	11	27	10	28	11	29	12	29	12	28	12	28	11	29
CHEMOSIT	11	30	11	31	11	30	11	29	11	28	11	28	10	26	10	27	10	28	10	28	10	26	10	27	11	28
ZONE 3	**10**	**30**	**10**	**31**	**11**	**30**	**12**	**29**	**11**	**29**	**11**	**28**	**11**	**27**	**11**	**28**	**11**	**28**	**11**	**29**	**11**	**28**	**11**	**28**	**11**	**29**
KAPTIEN	9	28	9	30	10	30	10	28	10	28	10	27	10	27	10	28	9	29	10	28	11	26	11	26	10	28
KOIWA	13	25	13	27	12	26	11	24	11	24	11	22	11	21	10	21	11	20	11	22	10	21	11	21	11	23
KIMARI	10	28	9	28	10	28	10	28	10	26	10	26	10	26	10	25	9	28	8	29	10	28	10	28	10	27
ZONE 4	**11**	**27**	**10**	**28**	**11**	**28**	**10**	**27**	**10**	**26**	**10**	**25**	**10**	**25**	**10**	**25**	**10**	**26**	**10**	**26**	**10**	**25**	**11**	**25**	**10**	**26**
KERICHO DIV.	**9**	**28**	**9**	**29**	**10**	**28**	**10**	**27**	**10**	**27**	**10**	**26**	**10**	**25**	**9**	**26**	**9**	**27**	**9**	**27**	**10**	**26**	**10**	**26**	**10**	**27**
MABROUKIE	9	22	11	22	11	23	10	21	11	20	9	19	8	19	8	19	8	20	10	22	11	21	10	21	10	21
LIMURU TEA	9	22	11	22	11	23	10	21	11	20	9	19	8	19	8	19	8	20	10	22	11	21	10	21	10	21
CENTRAL DIV.	**9**	**22**	**11**	**22**	**11**	**23**	**10**	**21**	**11**	**20**	**9**	**19**	**8**	**19**	**8**	**19**	**8**	**20**	**10**	**22**	**11**	**21**	**10**	**21**	**10**	**21**
BBK ESTATES	**9**	**27**	**9**	**28**	**10**	**28**	**10**	**27**	**10**	**26**	**10**	**25**	**10**	**25**	**9**	**25**	**9**	**26**	**10**	**26**	**10**	**26**	**10**	**26**	**10**	**26**

RESEARCH & DEVELOPMENT DEPARTMENT

BBK TEA DIVISION: MEAN TEMPERATURE DEG. C - JANUARY / DECEMBER 1999

1999	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		MEAN	
ESTATE	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	**Min**	**Max**
R & D DEPT.	6	33	6	35	7	32	7	31	6	31	6	31	6	30	7	30	7	31	8	30	9	31	7	31	**7**	**31**
KAPKORECH	11	24	11	25	11	25	11	25	11	25	10	23	11	23	11	23	11	24	11	24	12	24	11	24	**11**	**24**
CHAGAIK	10	26	9	27	10	27	10	26	10	26	10	26	10	25	9	25	10	25	10	26	10	28	9	26	**10**	**26**
SAMBRET	8	24	8	24	8	24	8	23	8	22	8	22	8	22	8	22	7	22	7	24	7	23	7	22	**8**	**23**
CHEYMEN	13	25	13	26	13	25	12	24	11	25	11	25	11	22	12	23	11	24	12	24	11	24	12	25	**12**	**24**
KIMUGU	10	27	9	29	11	28	11	27	10	26	10	26	10	26	11	26	10	25	10	25	10	26	10	25	**10**	**26**
ZONE 1	**10**	**27**	**9**	**28**	**10**	**27**	**10**	**26**	**9**	**26**	**9**	**26**	**9**	**25**	**10**	**25**	**9**	**25**	**10**	**26**	**10**	**26**	**9**	**26**	**10**	**26**
CHELIMO	7	27	8	27	7	26	6	25	4	25	5	26	6	26	6	26	6	26	7	26	7	26	7	26	**6**	**26**
KERICHO	9	26	7	28	7	28	7	27	9	25	7	27	7	25	8	26	8	27	7	27	7	27	7	26	**8**	**27**
KERENGA	7	30	7	32	7	32	7	32	7	27	7	26	7	26	11	27	11	26	11	26	11	27	11	28	**9**	**28**
CHEBOWN	10	28	9	30	11	25	10	25	10	24	10	24	9	24	10	24	10	25	10	25	10	25	10	25	**10**	**25**
TAGABI	9	27	9	29	11	25	10	25	9	25	8	25	9	24	9	24	9	25	10	25	10	25	9	25	**9**	**25**
ZONE 2	**8**	**28**	**8**	**29**	**9**	**27**	**8**	**27**	**8**	**25**	**7**	**26**	**8**	**25**	**9**	**25**	**9**	**26**	**9**	**26**	**9**	**26**	**9**	**26**	**8**	**26**
JAMJI	10	29	9	31	12	27	11	26	11	26	10	26	10	26	11	26	11	26	11	26	11	26	10	27	**11**	**27**
NGOINA	13	32	13	34	14	28	14	28	12	28	13	28	12	26	14	29	13	26	13	28	14	29	11	23	**13**	**28**
KAPGWEN	11	28	11	29	11	27	9	27	9	26	9	26	9	26	10	27	9	27	9	26	10	27	11	27	**10**	**27**
CHEMOGO	11	27	13	25	13	25	13	24	15	27	15	26	12	26	11	26	11	28	12	26	12	26	12	27	**13**	**26**
CHEMOSIT	10	30	10	31	10	28	10	27	10	27	11	28	10	30	11	27	11	29	11	27	11	27	11	28	**11**	**28**
ZONE 3	**11**	**29**	**11**	**30**	**12**	**27**	**11**	**26**	**11**	**27**	**12**	**27**	**11**	**27**	**11**	**27**	**11**	**27**	**11**	**27**	**12**	**27**	**11**	**26**	**11**	**27**
KAPTIEN	9	29	10	30	11	28	10	27	10	26	10	22	9	26	10	27	10	27	10	26	10	27	9	26	**10**	**27**
KOIWA	11	23	11	32	10	21	11	22	11	22	11	23	11	22	11	21	11	22	11	22	11	22	11	22	**11**	**23**
KIMARI	9	28	9	29	10	25	10	25	10	23	11	20	10	24	10	24	9	24	10	26	11	24	10	25	**10**	**25**
ZONE 4	**10**	**27**	**10**	**30**	**10**	**25**	**10**	**25**	**10**	**24**	**11**	**22**	**10**	**24**	**10**	**24**	**10**	**24**	**10**	**25**	**11**	**24**	**10**	**24**	**10**	**25**
KERICHO DIV.	**10**	**28**	**10**	**29**	**10**	**27**	**10**	**26**	**10**	**26**	**10**	**25**	**9**	**25**	**10**	**25**	**10**	**26**	**10**	**26**	**10**	**26**	**10**	**26**	**10**	**26**
MABROUKIE	10	25	10	25	11	23	11	21	10	20	9	25	8	16	9	18	9	20	10	21	9	18	11	20	**10**	**21**
LIMURU TEA	10	25	10	25	11	23	11	21	10	20	9	25	8	16	9	18	9	20	10	21	9	18	11	20	**10**	**21**
CENTRAL DIV.	**10**	**25**	**10**	**25**	**11**	**23**	**11**	**21**	**10**	**20**	**9**	**25**	**8**	**16**	**9**	**18**	**9**	**20**	**10**	**21**	**9**	**18**	**11**	**20**	**10**	**21**
BBK ESTATES	**10**	**27**	**10**	**29**	**10**	**26**	**10**	**26**	**10**	**25**	**10**	**25**	**9**	**24**	**10**	**25**	**10**	**25**	**10**	**25**	**10**	**25**	**10**	**25**	**10**	**26**

BBK TEA DIVISION: MEAN TEMPERATURE DEG. C - JANUARY / DECEMBER 1998

1998	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		MEAN	
ESTATE	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	**Min**	**Max**
R & D DEPT.	13	27	8	32	7	34	8	32	8	31	6	31	7	30	7	30	6	31	8	31	8	31	6	33	**8**	**31**
KAPKORECH	12	23	11	24	12	24	12	25	12	24	11	24	11	23	11	24	11	25	11	24	11	25	10	25	**11**	**24**
CHAGAIK	10	26	10	28	9	29	9	27	9	28	11	26	10	25	9	26	10	26	10	27	10	26	10	26	**10**	**27**
SAMBRET	9	23	9	24	9	22	10	23	9	23	9	24	8	25	8	26	8	21	8	24	8	27	8	28	**9**	**24**
CHEYMEN	11	25	13	26	12	26	14	26	12	25	12	25	11	24	11	23	13	24	12	26	11	25	12	24	**12**	**25**
KIMUGU	12	25	11	27	11	29	12	29	11	28	10	24	12	24	10	25	10	26	10	25	10	26	9	27	**11**	**26**
ZONE 1	**11**	**25**	**10**	**27**	**10**	**27**	**11**	**27**	**10**	**27**	**10**	**26**	**10**	**25**	**9**	**26**	**10**	**26**	**10**	**26**	**10**	**27**	**9**	**27**	**10**	**26**
CHELIMO	10	30	11	31	11	30	10	30	10	30	11	31	11	31	11	30	8	29	8	28	8	28	8	27	**10**	**30**
KERICHO	9	25	7	27	7	28	7	27	8	26	10	24	9	24	9	26	9	25	9	25	10	25	10	25	**9**	**26**
KERENGA	11	24	10	23	10	23	13	25	12	25	11	25	11	25	12	26	10	26	11	28	7	29	7	30	**10**	**26**
CHEBOWN	9	28	11	27	10	29	12	26	12	25	11	24	10	23	10	24	10	26	11	26	9	26	9	28	**10**	**26**
TAGABI	11	25	12	25	11	27	11	26	12	25	10	25	10	24	10	25	10	26	10	26	9	24	8	28	**10**	**26**
ZONE 2	**10**	**26**	**10**	**27**	**10**	**27**	**11**	**27**	**11**	**26**	**11**	**26**	**10**	**25**	**10**	**26**	**9**	**26**	**10**	**27**	**9**	**26**	**8**	**28**	**10**	**26**
JAMJI	12	27	12	28	11	30	13	27	14	26	12	27	12	24	12	26	11	26	11	26	11	26	10	29	**12**	**27**
NGOINA	13	28	14	29	14	31	16	29	15	29	14	27	14	27	14	28	14	29	14	29	13	29	12	30	**14**	**29**
KAPGWEN	13	27	10	31	11	30	13	29	13	28	13	28	10	27	9	27	10	27	10	27	11	27	11	28	**11**	**28**
CHEMOGO	10	28	12	28	14	29	15	27	16	28	12	26	11	26	11	27	13	26	13	28	11	25	12	26	**13**	**27**
CHEMOSIT	10	29	10	29	10	31	11	29	10	29	10	28	11	32	10	29	10	29	10	30	11	30	10	31	**10**	**30**
ZONE 3	**12**	**28**	**12**	**29**	**12**	**30**	**14**	**28**	**14**	**28**	**12**	**27**	**12**	**27**	**11**	**27**	**12**	**27**	**12**	**28**	**11**	**27**	**11**	**29**	**12**	**28**
KAPTIEN	11	26	11	26	11	25	11	27	11	27	10	25	10	25	10	27	10	27	14	27	9	26	9	29	**11**	**26**
KOIWA	11	23	12	23	12	23	11	23	11	23	11	22	11	21	11	22	11	23	11	22	11	22	11	22	**11**	**22**
KIMARI	10	25	11	26	10	28	10	27	11	26	11	25	11	25	8	27	9	28	10	27	10	26	10	29	**10**	**27**
ZONE 4	**11**	**25**	**11**	**25**	**11**	**25**	**11**	**26**	**11**	**25**	**11**	**24**	**11**	**24**	**10**	**25**	**10**	**26**	**12**	**25**	**10**	**25**	**10**	**27**	**11**	**25**
KERICHO DIV.	**11**	**26**	**11**	**27**	**11**	**28**	**11**	**27**	**11**	**27**	**11**	**26**	**11**	**26**	**10**	**26**	**10**	**26**	**11**	**27**	**10**	**26**	**10**	**28**	**11**	**27**
MABROUKIE	12	20	12	20	12	20	12	20	12	20	12	20	11	19	11	19	11	19	11	19	11	19	11	19	**12**	**20**
LIMURU TEA	10	20	10	22	10	21	12	22	12	21	10	19	9	16	9	16	9	21	10	22	10	20	10	21	**10**	**20**
CENTRAL DIV.	**11**	**20**	**11**	**21**	**11**	**21**	**12**	**21**	**12**	**21**	**11**	**20**	**10**	**18**	**10**	**18**	**10**	**20**	**11**	**21**	**11**	**20**	**11**	**20**	**11**	**20**
BBK ESTATES	**11**	**25**	**11**	**26**	**11**	**27**	**12**	**26**	**11**	**26**	**11**	**25**	**10**	**25**	**10**	**25**	**10**	**26**	**11**	**26**	**10**	**26**	**10**	**27**	**11**	**26**

ELECTRICAL GENERATION ANALYSIS (Statistical Summary)
Hydro Units: 1998

STATIONS	JAMJI				KERENGA		CHEMOSIT	TAGABI	TOTAL
	1	2	3	4	1	2	1	1	
JANUARY	60,018	48,828	153,800	79,330	129,260	74,040	0	483,400	**1,028,676**
FEBRUARY	51,555	42,108	136,420	141,945	113,675	64,585	0	399,700	**949,988**
MARCH	32,331	25,881	148,190	152,370	52,695	22,805	0	335,600	**769,872**
APRIL	18,039	14,703	119,350	143,145	36,620	39,965	0	303,700	**675,522**
MAY	8,145	51,288	160,460	168,700	126,595	69,260	0	376,600	**961,048**
JUNE	0	47,991	149,035	156,920	121,475	72,305	0	377,100	**924,826**
JULY	0	50,157	154,960	161,310	124,695	75,605	0	406,300	**973,027**
AUGUST	0	48,462	149,695	157,125	123,940	74,425	0	390,500	**944,147**
SEPTEMBER	17,523	42,315	134,815	145,870	116,870	72,880	0	379,600	**909,873**
OCTOBER	46,794	28,893	142,755	151,720	116,995	77,030	0	427,400	**991,587**
NOVEMBER	58,350	32,601	142,360	146,545	2,325	73,700	0	416,100	**871,981**
DECEMBER	56,622	0	138,745	147,310	0	74,360	0	372,700	**789,737**
TOTAL	**349,377**	**433,227**	**1,730,585**	**1,752,290**	**1,065,145**	**790,960**	**0**	**4,668,700**	**10,790,284**

Source: BBK, 2000

ELECTRICAL GENERATION ANALYSIS

Statistical Summary

Hydro Units: 1999

STATIONS	JAMJI				KERENGA		CHEMOSIT	TAGABI	TOTAL
	1	2	3	4	1	2	1	1	
JANUARY	32,304	0	81,660	139,040	0	74,765	0	350,100	**677,869**
FEBRUARY	414	0	56,930	42,370	0	53,300	0	179,900	**332,914**
MARCH	22,968	0	39,600	86,845	0	53,550	0	247,100	**450,063**
APRIL	34,170	147	38,870	133,185	0	27,490	0	314,600	**548,462**
MAY	56,613	0	137,060	136,915	0	46,505	0	375,900	**752,993**
JUNE	49,836	10,737	132,195	133,805	0	60,550	0	450,700	**837,823**
JULY	39,879	27,771	140,515	146,250	53,730	65,770	0	459,100	**933,015**
AUGUST	43,155	32,112	139,560	149,445	123,105	70,780	2,531	430,200	**990,888**
SEPTEMBER	16,950	13,908	157,620	166,785	98,000	71,475	8,961	416,700	**950,399**
OCTOBER	0	47,805	146,275	163,580	129,625	78,970	9,681	400,000	**975,936**
NOVEMBER	0	44,976	149,665	156,680	124,120	72,950	9,712	418,400	**976,503**
DECEMBER	6,888	18,111	141,655	140,600	97,525	54,715	8,296	411,900	**879,690**
TOTAL	**303,177**	**195,567**	**1,361,605**	**1,595,500**	**626,105**	**730,820**	**39,181**	**4,454,600**	**9,306,555**

Source: BBK, 2000

Statistical Summary

Hydro Units: 2000

STATIONS	JAMJI				KERENGA		CHEMOSIT	TAGABI	
	1	2	3	4	1	2	1	1	TOTAL
JANUARY	858	438	109,695	36,480	26,305	47,255	0	302,700	**523,731**
FEBRUARY	0	0	27,415	24,475	19,580	19,030	0	130,300	**220,800**
MARCH	780	558	20,910	32,975	3,030	45	0	166,600	**224,898**
APRIL	0	0	28,285	41,075	37,435	9,525	0	197,200	**313,520**
MAY	102	174	46,900	82,365	67,765	23,185	0	357,100	**577,591**
JUNE	12,765	3,954	68,300	84,830	84,155	23,165	863	416,400	**696,432**
JULY	29,820	25,437	138,850	137,740	74,065	54,645	0	437,800	**898,357**
AUGUST	37,857	31,851	134,740	128,585	103,305	56,470	122	481,000	**973,930**
SEPTEMBER	53,781	42,615	142,305	144,025	119,985	66,490	2,581	477,200	**1,048,982**
OCTOBER	57,180	45,723	155,190	157,465	126,270	61,665	399	498,800	**1,102,692**
NOVEMBER	46,941	36,144	155,590	163,360	123,075	59,795	0	496,900	**1,081,805**
DECEMBER	53,655	42,480	164,260	160,725	119,975	61,200	0	494,500	**1,096,795**
TOTAL	**293,739**	**229,374**	**1,192,440**	**1,194,100**	**904,945**	**482,470**	**3,965**	**4,456,500**	**8,759,533**

Source: BBK, 2000

Diesel Units: 1998

STATION	JAMJI		KIMUGU		TOTAL
	5	6	1	2	
JANUARY	0	0	35,090	30,640	**65,730**
FEBRUARY	0	0	9,820	11,750	**21,570**
MARCH	0	0	14,540	28,090	**42,630**
APRIL	0	0	27,160	36,910	**64,070**
MAY	0	0	8,740	5,020	**13,760**
JUNE	0	0	9,450	6,660	**16,110**
JULY	0	0	5,640	4,490	**10,130**
AUGUST	0	0	4,180	5,470	**9,650**
SEPTEMBER	0	0	1,670	4,260	**5,930**
OCTOBER	0	0	2,310	750	**3,060**
NOVEMBER	0	0	7,420	4,790	**12,210**
DECEMBER	0	0	6,850	10,240	**17,090**
TOTAL	**0**	**0**	**132,870**	**149,070**	**281,940**

Source: BBK, 2000

Diesel Units: 1999

STATION	JAMJI		KIMUGU		TOTAL
	5	6	1	2	
JANUARY	0	0	8,730	9,170	**17,900**
FEBRUARY	0	0	2,100	6,830	**8,930**
MARCH	0	0	22,780	30,680	**53,460**
APRIL	0	0	35,640	37,610	**73,250**
MAY	0	0	6,730	5,370	**12,100**
JUNE	0	0	2,300	1,970	**4,270**
JULY	0	0	1,280	1,610	**2,890**
AUGUST	0	0	5,690	9,310	**15,000**
SEPTEMBER	0	0	13,090	15,800	**28,890**
OCTOBER	0	0	0	15,340	**15,340**
NOVEMBER	0	0	0	13,020	**13,020**
DECEMBER	870	1,170	0	18,940	**20,980**
TOTAL	**870**	**1,170**	**98,340**	**165,650**	**266,030**

Source: BBK, 2000

Diesel Units: 2000

STATION	JAMJI		KIMUGU		TOTAL
	5	6	1	2	
JANUARY	2,630	1,350	0	7,830	11,810
FEBRUARY	2,530	5,380	0	5,990	13,900
MARCH	0	1,950	0	2,520	4,470
APRIL	4,220	4,910	0	4,780	13,910
MAY	7,340	2,350	0	14,050	23,740
JUNE	60,910	54,060	0	18,820	133,790
JULY	40,570	34,720	10,440	0	85,730
AUGUST	28,510	26,450	27,380	0	82,340
SEPTEMBER	10,760	33,960	45,860	0	90,580
OCTOBER	0	39,350	30,130	0	69,480
NOVEMBER	14,410	44,280	36,410	0	95,100
DECEMBER	12,590	21,240	23,920	0	57,750
TOTAL	**184,470**	**270,000**	**174,140**	**53,990**	**682,600**

Source: BBK, 2000

TABLE

POWER IMPORT FROM KPLC: 1998

	LOW	NORMAL	TOTAL
JANUARY	244,360	149,380	393,740
FEBRUARY	127,950	89,820	217,770
MARCH	183,520	116,850	300,370
APRIL	259,440	172,040	431,480
MAY	149,580	141,100	290,680
JUNE	117,370	114,190	231,560
JULY	85,460	85,340	170,800
AUGUST	79,460	69,290	148,750
SEPTEMBER	71,120	67,710	138,830
OCTOBER	540	12,726	13,266
NOVEMBER	2,361	9,216	11,577
DECEMBER	4,748	21,047	25,795
TOTAL	**1,325,909**	**1,048,709**	**2,374,618**

Source: BBK, 2000

TABLE 17

POWER IMPORT FROM KPLC: 1999

	LOW	NORMAL	TOTAL
JANUARY	4,197	23,319	27,516
FEBRUARY	5,919	28,475	34,394
MARCH	6,843	29,786	36,629
APRIL	8,476	41,350	49,826
MAY	2,850	13,080	15,930
JUNE	2,165	7,451	9,616
JULY	3,775	15,416	19,191
AUGUST	5,849	5,167	11,016
SEPTEMBER	11,609	9,618	21,227
OCTOBER	11,220	11,741	22,961
NOVEMBER	12,205	9,964	22,169
DECEMBER	19,616	20,858	40,474
TOTAL	**94,724**	**216,225**	**310,949**

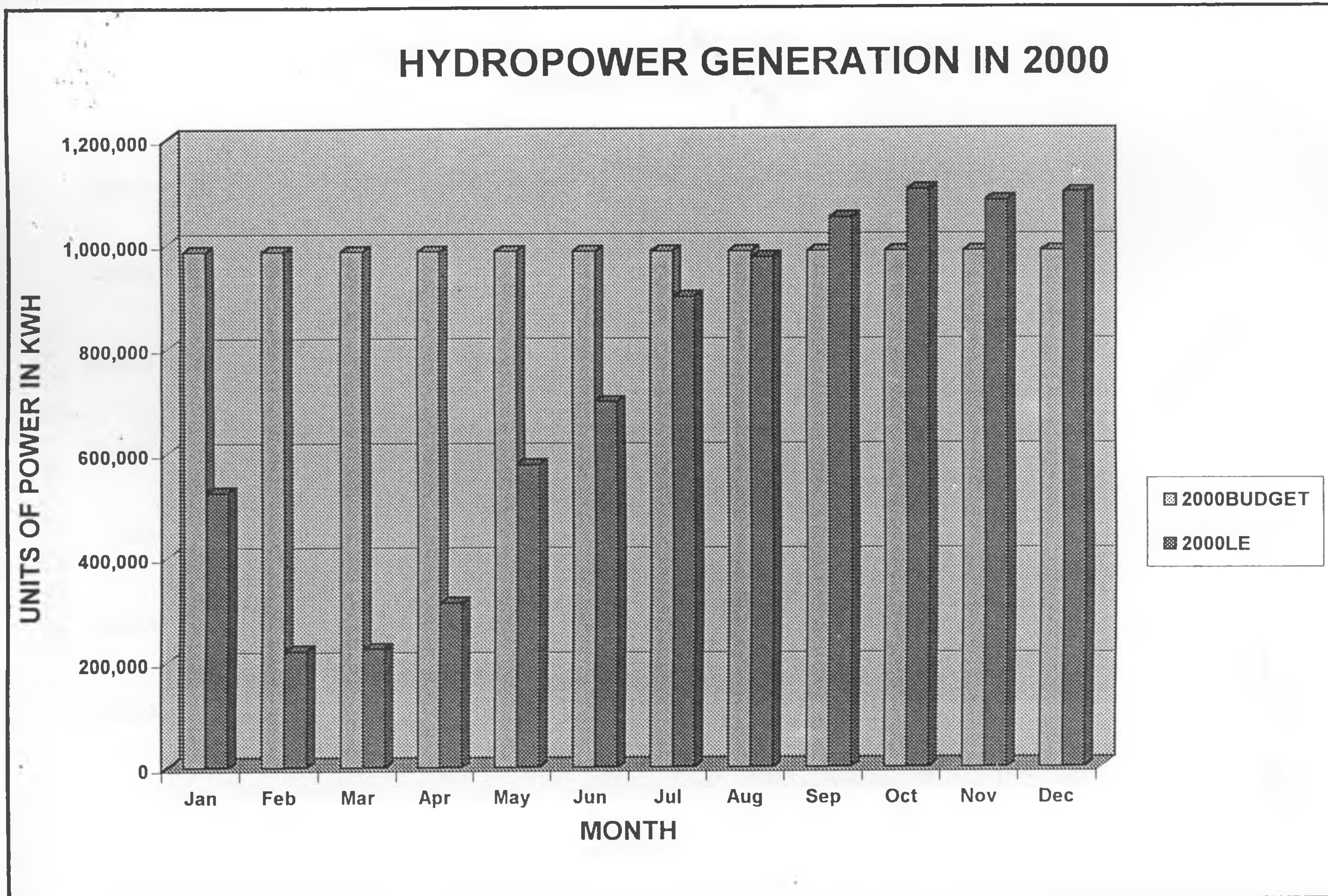
Source: BBK, 2000

TABLE 18

POWER IMPORT FROM KPLC: 2000

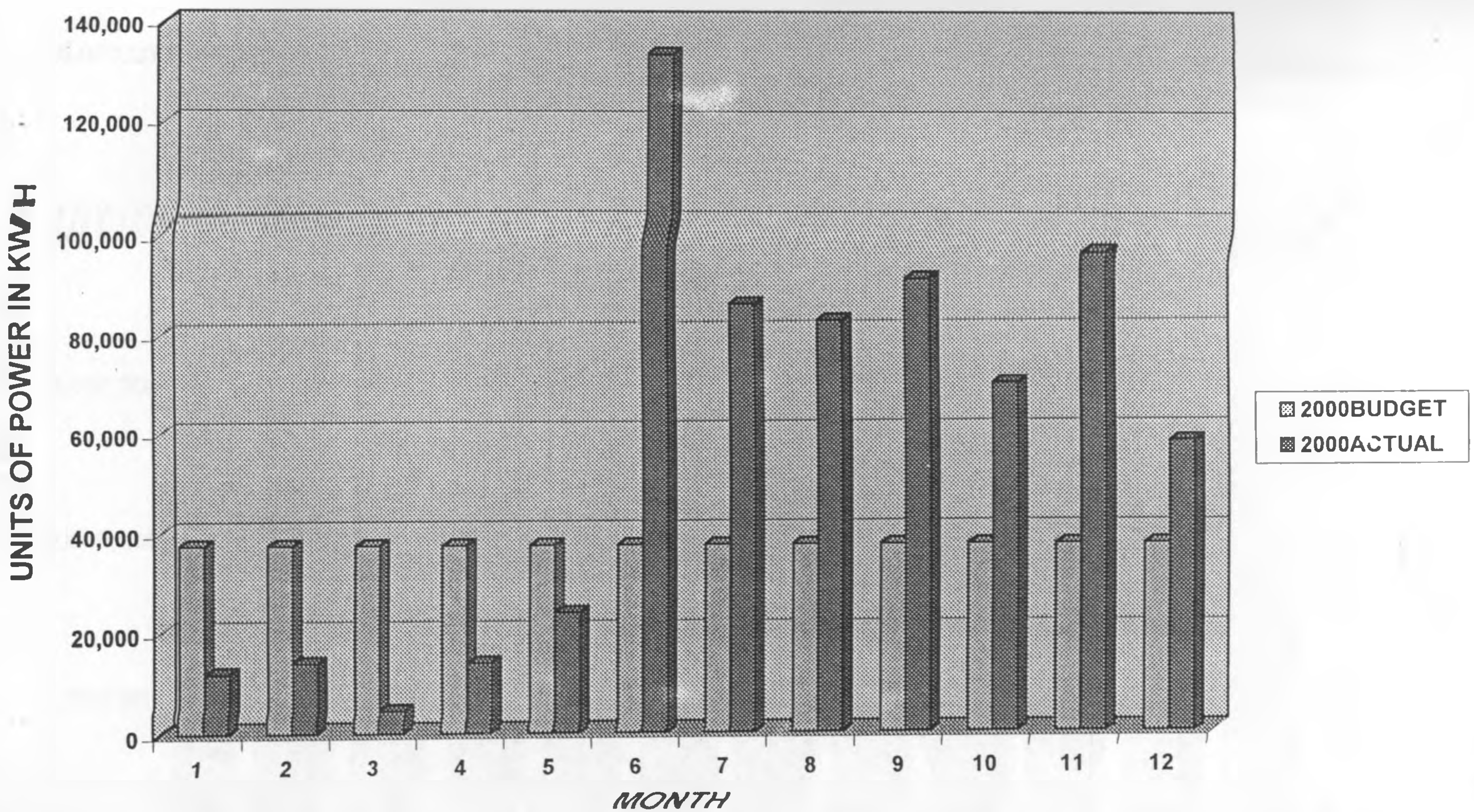
	LOW	NORMAL	TOTAL
JANUARY	269,840	305,790	575,630
FEBRUARY	239,190	253,770	492,960
MARCH	294,130	292,420	586,550
APRIL	256,660	311,430	568,090
MAY	205,170	262,040	467,210
JUNE	76,550	187,490	264,040
JULY	22,180	70,800	92,980
AUGUST	15,440	51,720	67,160
SEPTEMBER	41,670	91,230	132,900
OCTOBER	51,660	104,820	156,480
NOVEMBER	76,830	146,820	223,650
DECEMBER	105,300	226,530	331,830
TOTAL	**1,654,620**	**2,304,860**	**3,959,480**

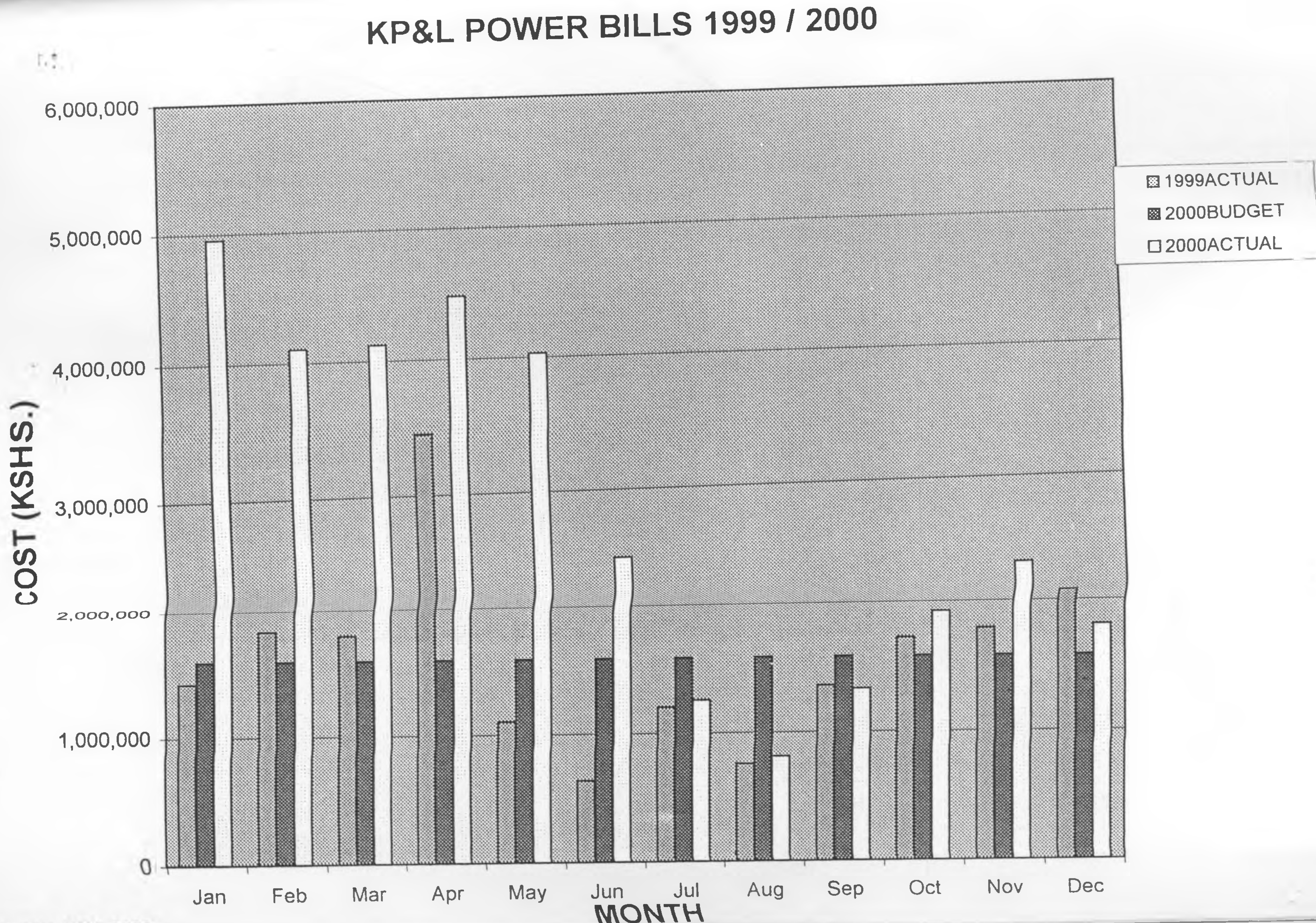
Source: BBK, 2000



Source: BBK,2000

PROJECTED INCREASE (KWH) IN DIESEL POWER GENERATION - 2000





Source: BBK, 2000