

THE SOCIO-ECONOMIC AND ENVIRONMENTAL EFFECTS OF MINING IN KENYA: A CASE STUDY OF FLUORSPAR MINING IN KERIO VALLEY

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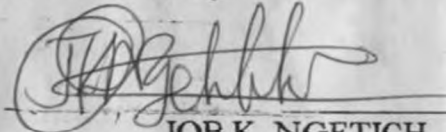
A thesis submitted in part fulfilment for the Degree of Master of Arts in Urban and Regional Planning in the University of Nairobi.

September, 1997

DECLARATION

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

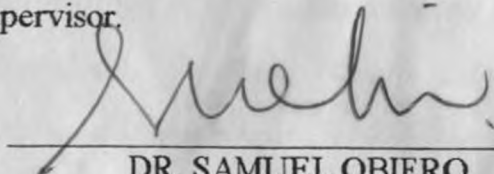
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This thesis has been submitted for examination with my approval as University supervisor.

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DR. SAMUEL OBIERO
(University Supervisor)

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58
258

ABSTRACT

In the past two and half decades mining activities of fluorspar have been operational in the southern part of the Kerio Valley. However very little socio-economic and environmental studies have been conducted to establish the concomitant effects of fluorite mineral development in the Valley. This study, therefore, attempts to identify and quantify these effects of fluorspar mining. The objectives of the study are to examine the production and operations of fluorspar mining as well as to investigate the environmental and socio-economic effects associated with fluorspar mining in Kerio Valley.

The study utilises primary and secondary sources of data. The methodological approach adopted for primary data collection involved mainly the administration of questionnaires and interview schedules. Descriptive, parametric and non-parametric statistics were used to analyse and present the findings.

The study established that fluorspar mining has a role to play in employment creation and revenue generation to the local authority. The correlation result showed that there exists a spurious relationship between the employment and production of fluorspar over the years which indicate that there is a fairly limited potential for intensification of fluorspar production as well as creating additional

employment opportunities, but on the other hand there is a corresponding relationship between export earnings and fluorspar production which indicate that there is a positive but strong association. This implies that there is a bright future for expanding export earnings of fluorspar.

The development of fluorspar production and processing industry have made some environmental degradation. The open cast method of mining involving blasting has contributed to land dereliction. From the survey, 11% of the total respondents interviewed ranked land disfigurement and use of explosives in blasting fluorite as the most critical environmental hazards. Similarly, 70% of the respondents had a perception that fluorspar mining activities in Kerio Valley contribute to contamination of surface water in Kerio river which is a key resource in the Valley's life support system.

The study revealed that fluorspar mining has opened up Kerio Valley south for development. For example 90.1% of the respondents ranked the establishment of good transport network as the most important contribution of mining to development in the Kerio Valley. Several commercial and trading centres have sprung up as a direct consequence of fluorspar mining operations which provide reliable opportunities for the local people to sell their agricultural products and other goods and services to the people living and

working in the mine area. Substantial business development can also be attributed to Fluorspar mining. For example, 55.8% reckoned that all trading and commercial ventures are dependent on fluorspar mining activities.

The location of fluorspar mining concern in the valley has brought about the development of other infrastructural units which the valley community utilises at nominal charges. This include, clean piped water, medical and educational services. Although the provision of electricity and telephone services is the domain of private sector contribution, the adoption of these services for mineral production by KFC have made it possible for the businessmen and other individuals to get access to electricity and telephone services at affordable costs.

However, the most tragic impact of fluorspar mining in Kerio Valley is the unresolved question of the displacement of 1200 households to set aside land for mining, without adequate compensation and alternative place for settlement. The study concludes that there is need for formulation of clear-cut mining policies and regulations which address proper compensation and resettlement strategies as well as providing for greater weight on environmental protection from undesirable effects of mining.

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I would like to express my profound thanks to my University supervisor, Dr. Samuel Obiero, who is also the Chairman of DURP, for making this research project a very stimulating learning process. I am particularly grateful for his tireless efforts in reading my work and making invaluable comments. Through his invaluable advice, guidance and constructive criticism, I was able to organise this work in proper perspective.

I would like to thank all my respondents in Kerio Valley who gave the information asked in questionnaires. They did this willingly and for this I am grateful. It would not have been possible to write this thesis without their co-operation. One research assistant worked tirelessly to administer some of the questionnaires and I would like to extend my special thanks to David Kipkemboi for work well done.

Last but not least, I wish to thank my former schoolmate, Samuel Gachie Mwangi, and Naomi Kihiu-Namachanja, for assisting me in typing of this work. However, I am wholly responsible for writing this thesis and any errors that may be in it should be attributed to me alone.

DEDICATION

This thesis is dedicated to my parents for being a tremendous source of inspiration to me throughout my academic work.

TABLE OF CONTENTS

Declaration	(i)
Abstract	(ii)
Acknowledgements	(v)
Dedication	(vii)
Table of Contents	(viii)
List of Tables	(xiii)
List of Figures	(xiv)
List of Maps	(xv)
List of Appendices	(xvi)
List of Plates	(xvii)
List of Abbreviations	(xviii)

CHAPTER 1: INTRODUCTION

1.1 Overview	1
1.2 Statement of the research problem	3
1.3 Objectives of the study	8
1.4 Hypotheses	8
1.5 Justification of the study	9
1.6 Methodology of investigation	12
1.6.1 Types and sources of data	12
1.6.2 Sampling Methodology	14
1.6.3 Data Analysis	16
1.7 Limitations of the study	19
1.8 Conceptual Framework	21
1.9 Scope of the study and organizational structure	24
1.10 Operational Definitions	26

CHAPTER 2: BACKGROUND INFORMATION ON THE STUDY AREA

2.1	Overview	28
2.2	Location and Extent	28
2.3	Geology of the Study Area	30
2.3.1	Lithology and Stratigraphy	32
2.3.2	Precambrian Rocks	32
2.3.3	Lower Miocene sediments	33
2.3.4	Upper Miocene volcanics	33
2.3.5	Quaternary and Recent Deposits	34
2.3.6	Structural features of rocks	34
2.3.7	Fluorite Mineralisation	36
2.4	Soils	38
2.5	Surface configuration, drainage and climate	39
2.5.1	Surface configuration	39
2.5.2	Drainage and water resources	41
2.5.3	Climate	43
2.6	Vegetation, Wildlife and Tourism	47
2.6.1	Vegetation	47
2.6.2	Wildlife and Tourism Development	48
2.7	Development of Mineral Resources	50
2.8	Demographic profile	50
2.9	Land Tenure and Adjudication	55
2.9.1.	Land Tenure and Agriculture	55
2.9.2.	Agriculture	56
2.9.3.	Animal husbandry	60
2.10	Commercial and Industrial development	64
2.11	Summary	66

CHAPTER 3: MINING POLICIES AND REGULATIONS IN KENYA

3.1 Pre-independence Mining Policies	69
3.1.1 Colonial Mining Regulations	72
3.1.1.1 Prospecting Rights	72
3.1.2 Lawful Mining	75
3.1.3 Possession and Purchase of Minerals	80
3.1.4 Safety Regulations	81
3.1.5 Preparation and Responsibility for Plans	83
3.2 Post-Independence Mining Policies	85
3.3 Role of the Department of Mines and Geology	88
3.4 National Development Plan's Policy Framework	90
3.5 Summary	98

CHAPTER 4: PRODUCTION OPERATIONS OF FLUORSPAR IN KERIO VALLEY

4.1 Overview	100
4.2 History of Fluorspar Mining in Kerio Valley	100
4.3 Mine Planning and Milling Operations	104
4.3.1 Mine Planning	105
4.3.2 Mining Method	105
4.3.3 Processing	106
4.4 Waste water treatment and disposal	109
4.5 Production and Employment situation of Fluorspar Mining.....	110
4.5.1 Production	110
4.5.2 Employment Trends	113
4.5.3 Management Structure and Services	119
4.5.4 Transportation and Marketing of Fluorspar	127

4.5.5	Production operations Expenditure	130
4.6	Relationship between Production, Export Earnings and Employment Trends	132
4.7	Problems of Fluorspar Production in Kerio Valley.....	134
4.8	The Future of Fluorspar Mining in Kerio Valley	137
4.9	Summary	138

**CHAPTER 5: THE SOCIO-ECONOMIC AND
ENVIRONMENTAL EFFECTS OF
FLUORSPAR MINING IN KERIO
VALLEY**

5.1	Overview	140
5.2	Income Generation	140
5.3	Employment Generation	142
5.4	Development of Transport and other infrastructure	145
5.4.1	Development of Transport facilities	145
5.4.2	Health and Educational Facilities	150
5.4.3	Electricity and water supply	156
5.4.4	Recreation facilities	161
5.5	Development of Commercial and Trading Centres	166
5.6	Negative socio-economic impact of Fluorspar Mining.....	178
5.7	Environmental Effects of Fluorspar Mining	182
5.7.1	Aesthetic Degradation	182
5.7.2	Devegetation and soil erosion	188
5.7.3	Depletion of Ground and surface water sources	190
5.7.4	Fluorite contamination	192
5.8	How the model fits Fluorspar mining in Kerio Valley	197

**CHAPTER 6: SUMMARY OF FINDINGS,
CONCLUSIONS AND
RECOMMENDATIONS**

6.1	Overview	203
6.2	Summary of findings	205
6.2.1	Mining Policies and Regulations	205
6.2.2	Production Operations of Fluorspar	206
6.2.3	Environmental Effects of Fluorspar Mining	209
6.2.4	Positive socio-economic concomitants of Fluorspar Mining	211
6.2.5	Negative socio-economic Effects of Fluorspar mining	217
6.3	Conclusions	218
6.4	Recommendations	219
6.4.1	Mining Policies and Regulations	220
6.4.2	Production Operations of Fluorspar	222
6.4.3	Environmental Effects of Fluorspar	224
6.4.4	Socio-economic implications of Fluorite Mineral development	227
6.5	Recommendations to Researchers and Policy Makers	229
	Bibliography	232

LIST OF TABLES

1.1	Distribution of households and sample size	15
2.1	Population Projection of Kerio Valley South	53
2.2	Number of livestock auctioned in Kerio Valley	65
3.1	Mineral Production in Kenya in 1952 - 1954	71
4.1	Monthly Production of Fluorspar	112
4.2	Expenditure of KFC on Production operations	131
5.1	Average Export Prices of Fluorspar and soda ash in 1991 - 1995	141
5.2	Relationship between occupation of the household heads and utilisation of health facilities	152
5.3	Distribution of Primary schools utilised by the Valley residents	155
5.4	Cross tabulated values of household income and water sources	158
5.5	Catchment Population of centres within and outside Kerio Valley	174
5.6	Perception of Environmental problems of Fluorspar Mining according to the Valley residents	196

LIST OF FIGURES

1.1	A conceptualized model of the impacts of mining on development of an area.	23
2.1	Rainfall distribution of Kerio Valley from 1973 to 1996 ...	46
2.2	Problems of Livestock Production	62
4.1	Production of fluorspar from Kerio Valley deposits (in tonnes)	111
4.2	Employment trends at KFC in 1982 to 1996.....	115
4.3	Management structure of KFC	121
4.4	Export Earnings of Fluorspar in 1979 - 1996	130
5.1	Comparative analysis of household heads occupation	143
5.2	Recreational activities and facilities of the Kerio Valley people	163
5.3	Level of utilisation of major infrastructure services by businessmen in Kerio Valley	172
5.4	The Effects of Fluorspar Mining on the Development of Kerio Valley	202

LIST OF MAPS

2.1	Location of Kerio Valley in Kenya	29
2.2	Location of the study area in Kerio Valley	31
2.3	Geological sketch Map of Kerio Valley from Landsat Data	35
2.4	Lithology of Kerio Valley and its Environs	40
2.5	Topography and Drainage of the mine area	45
2.6	Distribution of Fluorite Deposits	52
4.1	Geological Map showing Kimwarer ore body	108
5.1	Major infrastructure units in Kerio Valley	177
5.2	Fluorspar Claim	183
5.3	Environmental problem areas in Kerio Valley	186

LIST OF APPENDICES

I. Household Data Assessment Questionnaire	237
II. Business Data Assessment Questionnaire	242
III. Interview schedule for the Mining Company Management ...	244
IV. Interview schedule for the key informants	247

LIST OF PLATES

4.1 Off-loading and Drying of Fluorspar in Kaptagat	129
4.2 Storage and Protection of Fluorspar from contamination ...	129
5.1 All-Weather KFC Road	148
5.2 All-weather dirt Airstrip for light Aircraft	148
5.3 Waste disposal site in the Mine area	161
5.4 Playing-field at Kimwarer area	165
5.5 Facilities for indoor games at Chebutie area	165
5.6 An upcoming Human settlement near Fluorspar Mill	171
5.7 Periodic Open Air Market within KFC Precincts	176
5.8 Location of the Fluorspar Mill and an abandoned mine site..	187
5.9 Landscape Disfigurement caused by open cast method of mining.....	187
5.10 Effects of Fluorite dust particles on vegetation	189
5.11 Depth of Fluorite Mineral extraction site	189
5.12 Industrial effluent in Tailing Ponds	195

LIST OF ABBREVIATIONS

KFC : Kenya Fluorspar Mining Company

KVDA : Kerio Valley Development Authority

N.G.O. : Non Governmental Organisation

CHAPTER 1: INTRODUCTION

1.1 OVERVIEW

The Countries of the World have been conveniently classified as either developed or developing Countries owing to the differences in the distribution of mineral resource endowment. Minerals have therefore been significant elements in shaping the relationship between the industrialized and developing Countries. Although many developing Countries are well endowed with mineral resources, the full potential has not been realised due to lack of technology and capital among other factors.

The mineral philosophy which featured so well as one of the most critical factors behind the scramble and subsequent partition of Africa reflected the significance of mineral exploitation in development. The mineral resource-based products are useful at individual, societal and at a national levels as sources of facilities and items required for daily use. The by products of mining industry include computers, television sets, motor cars, aeroplanes, tooth pastes and the like testify the role that mining is playing in contributing to social and economic development.

The exploitation of minerals in Kenya could be a potentially important contribution to development. A substantial benefit can accrue if the existing mineral industry is properly structured and administered. In addition to providing foreign exchange earnings, mining activity may produce additional revenue through taxation and royalties. It attracts foreign capitals, provides infrastructure, creates opportunities for employment as well as generating demand for local goods and services .

Among the major minerals which are currently under exploitation in Kenya include; Soda ash, Fluorspar and Limestone among others. The study examines the socio-economic and environmental effects of fluorspar mining in Kerio Valley. The study area covers much of the Southern part of Kerio Valley region which lies within the boundaries of the Kerio river basin, and falls under the jurisdiction of the Kerio Valley Development Authority (K.V.D.A), which in itself is a resource planning region. The Fluorspar mining activities in this area is undertaken by the Kenya Fluorspar Mining Company (K.F.C).

1.2 Statement of the research problem

Minerals play a very important role in the integration of developing countries into the world economy. The major contribution of mineral resources to the local economy has been as a source of foreign exchange and Government revenue. In Kenya mining like agriculture has a role to play in contributing to the National output of goods and services(G.N.P). Mining and quarrying contribute slightly more than 4% of Gross Domestic Product(Kenya 1992). This is by itself a powerful contribution, and that the funds generated by exporting unprocessed or semi-processed commodity can be reinvested in the economy to stimulate the growth of other sectors and thus fuel eventual diversification and development.

A well established mining industry could serve as a panacea for curbing the high rate of unemployment and the high rate of rural-urban migration that continues to be experienced in Kenya. Although mining in itself may not seriously tackle the problems of unemployment in Kenya, the solution of unemployment lies in the establishment of industry based on available mineral resources and

in linking industry with agriculture. Mining may also require the establishment of infrastructure which benefits the adjoining areas. Mining is therefore an activity which may form the nucleus of regional development in Kenya.

However, mining in most of the instances is a risk business because of the uncertainties involved particularly in the exploration for new deposits which has been domain of foreign own Companies. The exploitation work is highly technical and extremely expensive and costs a great deal, but usually only a small percentage of exploration efforts lead to the discovery of economically exploitable deposits. The second area of uncertainty is over the long-term rate of return on mining investments. The size of investment necessary to develop a new mining complex is huge but in some cases costs billions of shillings. The risks associated with such huge investments are compounded by long development time involved which is usually at least over 10 or so years between the discovery of a major mineral deposit and the first production. These uncertainties make mining an extremely risk business (Soussan ,1988).

It has been noted with justification that many developing Countries producing minerals are locked into an economic structure which depends upon exporting minerals but this economic structure does not generate a wider and sustained pattern of economic development that permits them to break out of the cycle of poverty (Soussan 1988 Gregory 1980). This is particularly true because mining activities are in many cases owned and controlled by foreign-owned companies thus profits are taken out of the country and many of the benefit go to the multinational companies. The second factor disparaging the mineral sector in developing countries is the fact that most stages in the full production process are located outside the country in which the minerals are mined, so employment, profits and other benefits from refining, producing finished goods and so on, do not go to the host country. Thirdly minerals production is usually highly capital-intensive (generating few local jobs) is located in remote regions and has very few links with other sectors of the economy (Ocholla, 1975, Soussan 1988). In particular few ancillary activities are generated, as most equipment is imported and no local inputs are required. As a result, mineral production

forms a foreign-oriented enclave which sits in but is not really part of the national economy and which generates few multiplier effects and therefore economic growth in other sectors of the economy.

Mineral resources utilization in Kenya has been divorced from a consideration of effective utilization of other natural resources, notably manpower and agricultural resources. Minerals are depleting and non-renewable, once a deposit is mined and exported it is gone for ever leaving merely large "wounds" or holes in the ground. In view of the conflict over the use of land for mining, and other land use activities, there is an urgent need to underscore the importance of rational management of mineral exploitation vis-à-vis environmental conservation.

The fluorspar mining in Kerio Valley has attracted a number of urban oriented activities such as commercial, recreational and residential functions. Although the population of the existing market centres are relatively smaller, it is anticipated that these commercial centres have good potential for growth and development and to be designated as future urban centres. Therefore there is an urgent need to plan for these activities which

have mushroomed as a direct consequence of fluorspar mining. It is true that some of the World's major Cities and towns like Birmingham and Kimberley started as small centres of mining activities and that fluorspar mining will comprise one of the major towns of tomorrow. It is also suggested that mining sector in general will play a pivotal role in terms of supplying industrial raw materials required to propel Kenya towards industrial take-off by the year 2020.

In examining the socio-economic and environmental effects of fluorspar mining in Kerio Valley region, the following pertinent question is raised; To what extent is the development of Kerio region associated with fluorspar mining activities? What are the socio-economic and environmental concomitants of fluorspar mining in Kerio Valley? An in-depth analysis of the production operations of fluorspar mining activities and the corresponding socio-economic, and environmental effects of mining are presented as a guide to this research problem.

1.3 Objectives of the study

The general objective of the study is to examine the socio-economic and environmental effects of mining, with reference to fluorspar mining in Kerio Valley South. The specific objectives of the study are:

1. To review the mining policies and regulations in Kenya.
2. To examine the current production operations of fluorspar mining in Kerio Valley.
3. To investigate the socio-economic effects which have arisen from fluorspar mining activities in Kerio Valley.
4. To examine the environmental effects associated with fluorspar mining in Kerio Valley.
5. To suggest courses of action that can be taken for the sustainability of fluorspar mining activity in Kerio Valley.

1.4 Hypotheses of the study

The general hypothesis formulated for the study is that mining activity is necessary to foster regional development.

Fluorspar mining in Kerio Valley has contributed to a measure of socio-economic development without compromising the quality of the environment. In order to verify this main hypothesis, the following specific hypotheses are tested;

1. There is a significant relationship between the employment trends, production and export earnings of fluorspar.
2. There is a positive correlation between some selected socio-economic characteristics of the people living in the mine region and adoption and accessibility levels of the mineral based infrastructure.
3. There is a relationship between the quality of water discharged into Kerio river and fluorspar mining activities in Kerio Valley.

1.5 Justification of the study

Minerals produced from the earth's crust are not only important for the development of any nation but indispensable at the individual or household level. It is through the extraction of minerals that electricity, hot water, refrigerators, automobiles,

airplanes, books, newspapers, radio, television and all manner of plastic goods become available. The origin of most of the available facilities in modern society are either directly mineral products or else produced with the aid of mineral derivatives such as steel, fertilizer or energy. Fluorspar material from Kerio Valley is used as a compound in many heavy industries such as in iron and steel industries. Tooth pastes that we use to prevent tooth decay and strengthen teeth owes its genesis indirectly from fluorspar mining. In view of the myriad array of mineral-based goods and services used in our daily lives, this study has been found to merit investigation.

Although Kenya is poorly endowed with mineral resources, the exploitation of the available minerals could serve as a potentially important contribution to development. The intensification of mineral wealth prospecting could overshadow Kenya's dependence on agriculture as the main-stay of the economy. The fluorspar mining in Kerio Valley is one of the large scale metallurgical operations in Kenya, and ranks second leading foreign earner after Soda Ash. In 1995 Fluorspar earned about 13.076 million pounds in terms of foreign exchange. The mineral

sector account for over 4% of the total GDP thus it has a role to play in the country's economic development. In addition to foreign exchange earnings, mining provides employment opportunities directly or indirectly for the ever increasing population in Kenya. It also calls for the provision of infrastructure which in turn benefits the people living in the peripheral areas thus raising their living standards.

The role of agriculture in rural development, and more specifically the contribution of agro-based industries in regional and urban development has been addressed adequately in Kenya as exemplified by studies done on the growth of Mumias town and Awendo in Sugar belt regions. Similarly tea and coffee have been known to have induced and accelerated development in tea and coffee growing zones. Besides the agro-based industries most of the other industries, in Kenya are concentrated in the major urban areas and towns such as Nairobi, Mombasa, Nakuru, Kisumu, Eldoret and Thika and in-depth studies have been conducted on urban oriented industries. However scant attention has been accorded to mineral-based industries which are located in the remote and dry areas. Against this background fluorspar mining

in Kerio Valley basin was found to be worthy of investigation, and that the outcome of this study will help the operating company and other development agencies in the region to realise greater efficiency and sustainability of this human venture.

1.6 Methodology of Investigation

The methodological approach adopted for the study was based on the objectives and the hypothesis of the study. It employed several steps and phases. Research started in the library, followed by reconnaissance and field data collection and finally data processing, analysis and presentation of research findings.

1.6.1 Types and sources of data

The data collection exercise utilized mainly two sources of data, notably, the primary and secondary sources of data collection. The second hand information pertinent to the study was generally derived from library research. The various materials which included the development plans, statisticals, abstracts, journal, KFC and KVDA reports among others, were scanned

through along with citation of other works. In addition the topography and the remote sensing maps served as useful tools of secondary data.

The firsthand information relevant to the study was acquired through the administration of questionnaires. Four categories of questionnaires were designed for the households, the company management, key informants and the businesses questionnaires. The samples of the questionnaires are attached to the end of the last chapter (Appendix II and III). The questionnaires developed for this purpose combined the advantages of both open and closed responses forms by the use of unstructured and general questions along with other structured questions, all of which cut across a wide spectrum on issues dealing with socio-economic and environmental concerns as they relate to mining in Kerio Valley.

The other detail information worthy of investigation was derived from participants observation. A general survey of the activities and occurrences in the study area were monitored and noted. Since environment is seriously placed at risk by extractive industries, the areas which have experienced environmental

degradation as a result of mining were identified and mapped out. Therefore the abandoned mines and quarries together with dumping grounds and river courses were mapped. Photography was also used to give the mirror image of the mine area.

1.6.2 Sampling methodology

The fluorspar mineral reserves occur in the Southern part of Kerio Valley which covers much of the Soy and Chemoibon Divisions. Unfortunately the administrative boundaries do not coincide with natural resource base delineation, hence the available statistic on population of the study area are estimates.

The total population of the study area in 1989 was 5,398 and was projected to be 7,458 in 1997. Assuming that demographic characteristics of Kerio Valley conform with the national average family size of 5 people, the number of households in the study area is estimated to be 1,491 households. A total of 110 households were interviewed instead of the expected 120, and this represented 92% of the sample selected earlier. In order to make the sample as representative as possible, a quota random sampling was adopted whereby a proportionate number of

respondents were drawn from four sub-locations in the mine area, notably, Kimwarer, Chepsirei, Kabokbok and Muskut sublocations in the mine areas. The target respondents in the sampling areas were arrived at using the quasi-random sampling whereby the third respondent from then on was established using the random numbers table. The table below shows the distribution of households and samples taken.

Table 1.1: Distribution of households and sample size

Sublocation	Number of Households	Sample taken	Percentage of sample size
Chop	521	38	34.5
Chepsirei	283	21	19.0
Muskut	319	24	22.0
Morop	368	27	24.5
Total	1491	110	100.0

Source: compiled by the author.

The business questionnaires were administered in four trading centres in the mine area. The purpose of this task was to establish whether there is any relationship between fluorspar mining activity and commercial development. Among the centres which are found in the mine area are Kimwarer, Nyaru, Turesia, Kabokbok, Soy and Muskut. Apart from Kimwarer most of the

other centres have got weak commercial developments. Therefore a complete enumerational analysis of all business activities in four centres was conducted, except for Kimwarer with strong commercial development whereby about 3/4 of all businesses were sampled for interviews. In total 44 licensed and unlicensed businesses were identified and selected for interviews with a view to establishing whether there is a relationship between fluorspar mining activities and commercial development in Kerio Valley.

1.6.3 Data Analysis

Having collected the relevant data, the raw information was arranged and organized to facilitate qualitative and quantitative techniques of analysis. The household and business data assessment questionnaires were coded before inputting them into computer. The SPSS statistical package was mainly used for data validation and analysis. The data processing technique involved critical examination of frequency distributions in all variables of the raw data so as to show how many individuals fall in each category or at each value to the variable. Descriptive statistics which incorporated the means, percentages and frequencies were

used simultaneously with other parametric and non-parametric techniques.

In seeking evidence of the association, emphasis was given to those variables which are specified or implied in the stated objectives and hypotheses of the study. The socio-economic variables were selected and screened for association in order to establish the relationships between pairs of variables. The relationship between variables was better examined and revealed by the use of contingency tables (cross-tabulation) in which each variable was analysed against other related variables. The Pearson's correlation co-efficient r was used in determining both the direction (whether positive or negative) and strength of associated variables (Lounsbury, 1979).

The multiple regression analysis has been used to assess the significance of each of the independent variables in regression equation and the overall influence of these variables on the dependent variable. The variables in question are production, employment, and export earnings of fluorspar and other socio-

economic variables of the households. The multiple regression has been used with the following assumptions:

- (i) the regression model is linear with the following equation: $y = a + bx$
- (ii) there is no specification error in the model, and
- (iii) there is no multicollinearity and autocorrelation.

Multiple regression analysis has been preferred in this case because of three advantages. It shows; the kind of relationship(s) between dependent and independent variables, how much influence each independent variables has on dependent variable, and the strength and direction of relationship that exist between each independent variable and dependent variables (Keya 1990). However Multiple Regression analysis technique has some disadvantages since it works on averages. Outliers present a major problem with small data sets because it distorts the results (Blalock, 1960). In this study a number of variables of production of fluorspar in tonnes and export earnings had some outliers. To solve this problem the outliers were temporarily eliminated from data set and then regression analysis was run using the statistical

package of social sciences (SPSS / PC⁺ Package). In addition to qualitative and quantitative techniques of data analysis, other cartographic techniques such as graphs, and tables were used to summarize and present data collected.

1.7. Limitations of the study

The study was compounded by several constraints regarding data collection. It was established that owing to the existing weak mineral resource base and therefore its insignificant contribution to Kenya's national economy, scant attention has been paid to mineral oriented studies. The available information on mining largely deal with geological aspects. In view of paucity of the information, it was found expedient to review literature on other minerals apart from fluorspar and other primary related sectors in order to put this study into proper perspective.

Secondly, the information dealing with minerals in Kenya was considered strictly sensitive, classified and confidential and therefore could not be divulged without the permission of the Commissioner of Mines and Geology and the mining company. Despite the requisition made for some data through these

institutions, peripheral information were made available. The data acquisition process was further complicated by the implementation of the terms of the parastatal reform programme by the government which saw Kenya Fluorspar mining company (KFC) privatised and placed under the hands of the chemical manufacturers Limited, a Multinational Corporation. The new management were uncooperative and unwilling to release any information, hence there are some missing links in the study.

The data collected from the households especially on issues pertaining to land sizes and incomes are mainly estimates. This is due to the fact that land adjudication and registration process has not been done widely in Kerio Valley and majority of the people in the region are still leading a semi-pastoral way of life, but their incomes are seasonal. In addition, the population and settlement pattern are sparsely distributed over Kerio Valley area with extremely rough terrain and poor road network. Consequently the researcher had to walk on foot for many kilometres over intractable terrain to administer the questionnaires thus making exercise more tedious and time consuming but worthwhile.

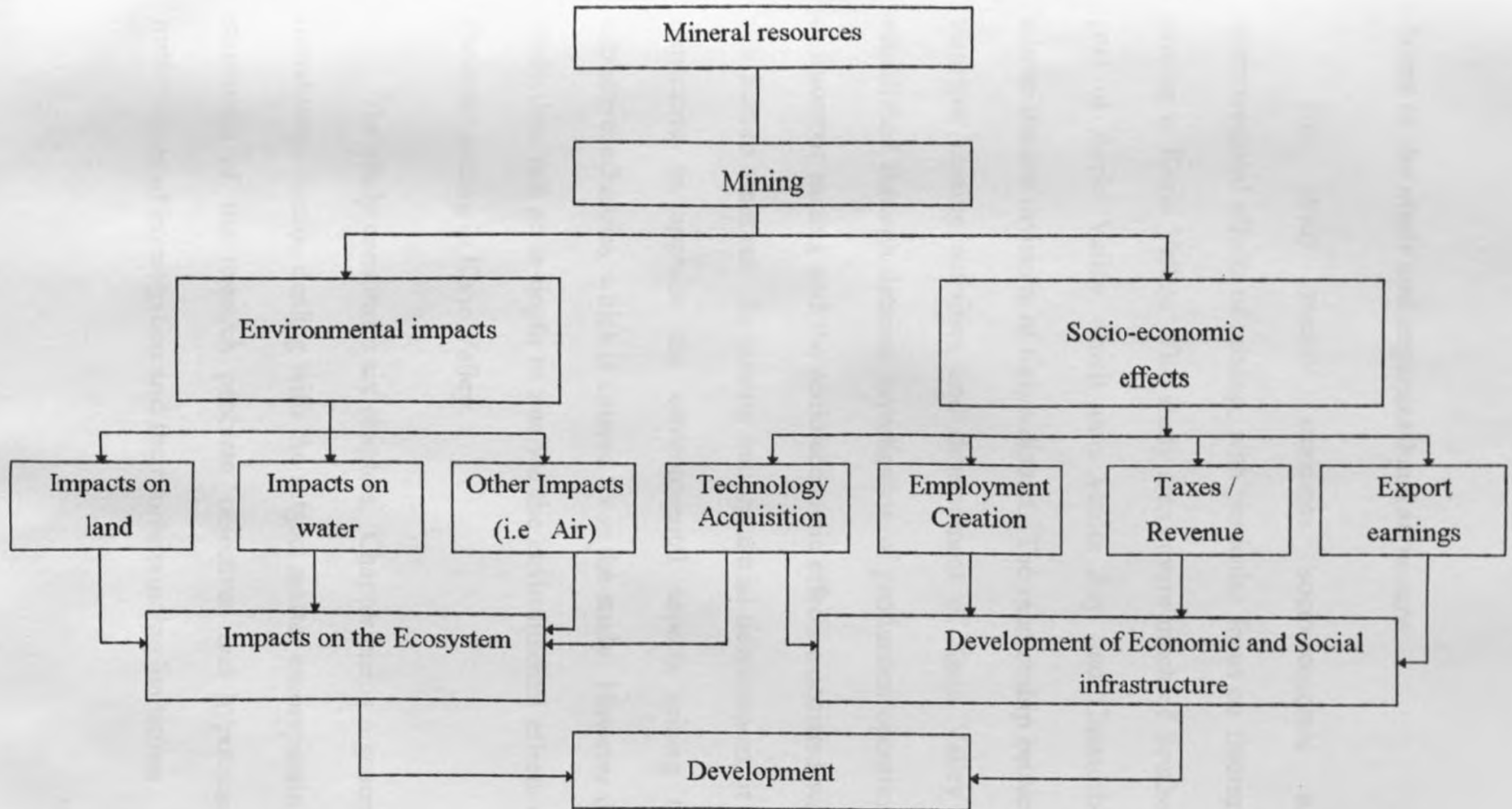
Owing to lack of scientific skills and equipments, it was not possible to carry out any chemical analysis of the quality of water, so as to ascertain whether fluorspar mining activities is contributing to pollution of surface water sources in Kerio Valley.

1.8. Conceptual Framework

Mining is supposed to contribute to development through direct and indirect fiscal effects. The direct effects are forward and backward linkages which involves the use of resources as input for other local industries, while indirect fiscal effects entails the acquisition of inputs required by the mines from local suppliers. The direct effect could include the generation of incomes and investments funds in the case of retained earnings; accumulation of foreign exchange with which to import capital goods for development of other sectors; generation of employment; creation of skilled workforce necessary to propel industrialization process, the development of infrastructure by providing economies of scale, especially transport and electricity, with the complementary industrial activities to be relatively affordable.

Investments in mining could contribute immensely to the economic development of Kenya. It could provide foreign exchange besides raising domestic income and increasing domestic skills. Domestic income increases because of wages and salaries the mining organizations pay to the local people, in addition to buying local supplies and paying taxes to the local councils which can be earmarked for general development in the mine areas and environs. On the other hands, investment in mining may create enclaves which may have little connection with the rest of the economy and does not give rise to any significant spillover effects on the local economy. In addition, mining in itself causes irreversible damage on the environment leading to loss of agricultural land. Figure 1.2 gives a conceptualized model of the socio-economic and environmental effects of mining.

Figure 1.1 A conceptualized model of the impacts of mining on Development of an area.



Source: own design

1.9 Scope of the study and organizational structure

The study mainly examines socio-economic and environmental effects of mining, with particular focus on fluorspar mining in Kerio Valley. The study area covers much of Southern part of Kerio Valley which cuts across Soy and Chemoibon administrative divisions of Keiyo district. The relationship between fluorspar mining activities and development of Kerio Valley is established through detailed investigation of production operations of fluorspar mining and the socio-economic effects associated with this human ventures. In mining and industrial development, it is imperative to appraise the environmental aspects arising for extractive industries, which is catered for in the study. However the study does not go in-depth to analyse the environmental effects of fluorspar mining in Kerio Valley.

The study constitutes six chapters. Chapter one is a general introductory section dealing with the subject matter encompassing: statements of the research problem, objectives and hypothesis, methodology of investigation and their corresponding limitations.

Chapter two provides the background information on the study area, including details of geology and other bio-physical and environmental aspects, together with population and socio-economic profile of Kerio Valley region as they related to mining activities.

Theoretical and practical issues on mining are covered in chapter three which include a review of mining policies and regulations in Kenya during the colonial and post-colonial periods.

The production operations of fluorspar mining is devoted to chapter four. It covers extraction and processing operations of fluorspar. Employment and production trends, transportation and other supportive services which contribute directly or indirectly to fluorspar production, are also taken care of in this chapter.

Chapter five entails the analysis of socio-economic and environmental effects of fluorspar mining in Kerio Valley. The contribution of fluorspar mining to development of Kerio Valley area is provided together with an assessment of environmental effects.

The final chapter constitutes a summary of the findings, conclusion and recommendations. Appendices have been attached to the end of this last chapter.

1.10 Operational Definitions

Mining: Mining is defined as those activities engaged in for the purpose of winning minerals including drilling and blasting, excavation, processing, concentrating, smelting or refining, waste disposal, and site reclamation.

Fluorspar: Fluorspar is the commercial name of the various concentrates of the mineral fluorite (CaF_2). Fluorspar has three common grades - metallurgical, ceramic and acid grades. It is used mainly by cement industry as an ingredient, and in glass and foundry work.

Open-cast mining: This simply involves the removal of the overburden, that is the earth or other rock bands lying above the mineral-bearing strata. It involves blasting of the overlying rocks of ore with the use of explosives thus leading to land disfigurement.

Fluorite contamination: Denotes the process of discharging industrial effluence (tailing) which contains fluorite materials, into the surface water sources, leading to discolouration of water and therefore unfit for domestic uses.

Development: Development has been perceived here as the process by which national authorities and other complementary agencies initiate, construct and maintain productive mechanisms and perpetuate the productive base of an area such as in agriculture, commerce and industry, so as to ensure that the society can overcome the pressures and necessities of the national and related economic systems for all future times. Accessibility to all the basic needs of life such as good public health, shelter and educational facilities, by the entire population are some of the qualitative indicators of development.

CHAPTER 2: BACKGROUND TO THE STUDY AREA

2.1 Overview

This Chapter provides the general information about the study area. It highlights the physical and socio-economic factors related to; or influenced by mining activities. Without the geological formation of the area, there could have been no mining in Kerio Valley therefore the science of rocks is considered to be more critical in understanding accurately the genesis of mining activities in Kerio Valley and the concomitant effects.

2.1 Location and Extent

The study area is situated geologically on the Central Kenya Dome, on the Western flank of the Great Rift Valley. It is bounded geographically by latitudes $0^{\circ} 18'N$ and $0^{\circ} 22'N$ and by longitudes $35^{\circ} 40'E$ and $35^{\circ} 38' E$ (Map 1). The study area covers over 157 km^2 on the Kipkabus sheet 104/1, Series Y 731 (D.O.S 423) Edition 5-D.O.S of the survey of Kenya 1 : 50,000 scale, Map sheets. The area falls under the jurisdiction of Kerio Valley

MAP 2-1 : LOCATION OF KERIO VALLEY SOUTH IN KENYA



LEGEND

- - - - - International Boundary
- - - - - Provincial Boundary
- - - - - District Boundary
- ▨ Study Area

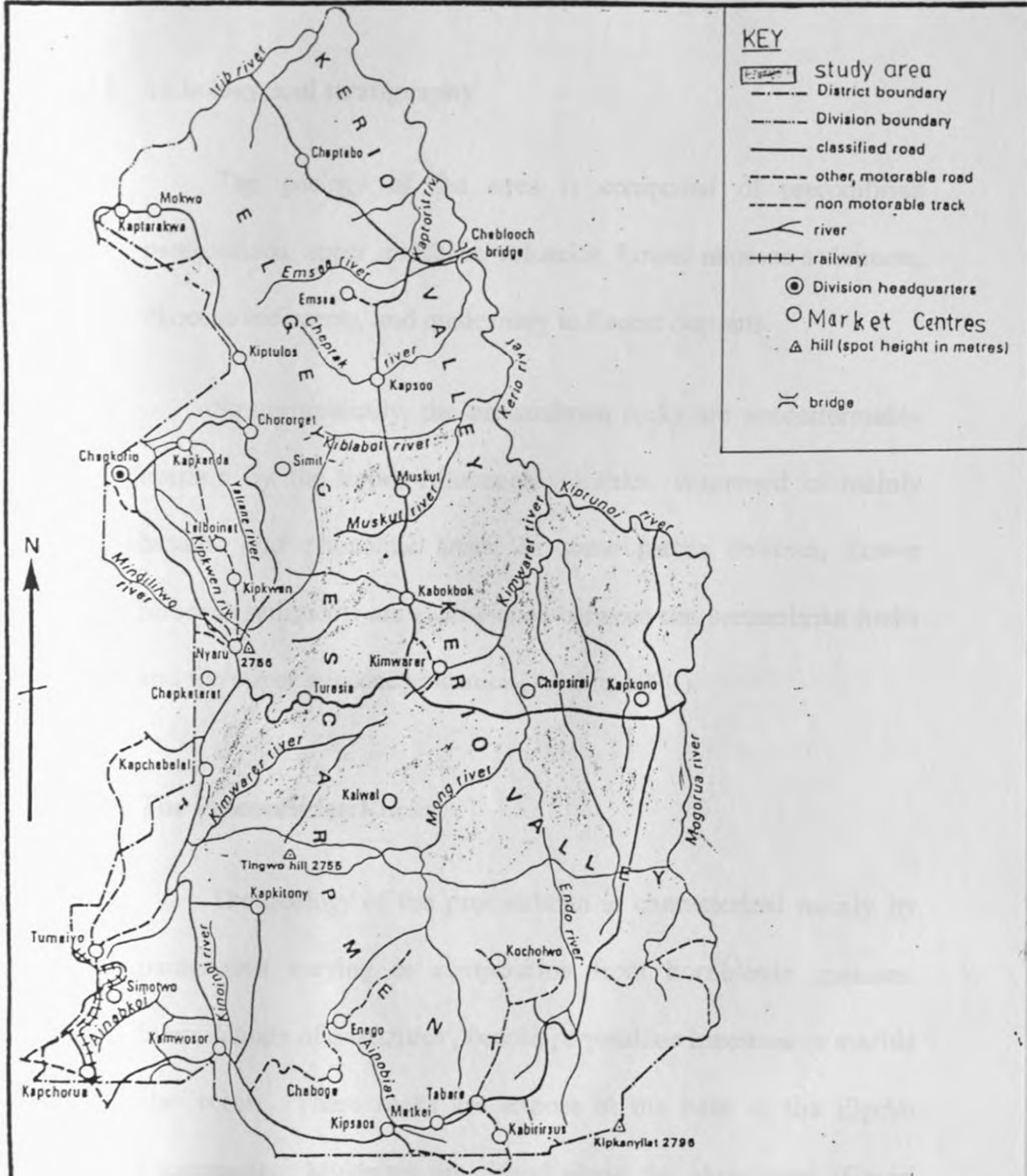
Source: Survey of Kenya

Development Authority (K.V.D.A) which is a resource base planning agency for the Kerio River catchment system. The mining area covers administratively some parts of Soy and Chemoibon Locations of Soy Division in Kerio South Valley Keiyo district (Map 2). The mining activities are undertaken by the Kenya Fluorspar mining Company (KFC).

2.3 The Geology of the Study Area

The Kerio Valley is part of the Rift Valley system, formed as a result of a combination of several forces in the late Tertiary period (one to ten million years ago). A pre dominantly north -south network of faults can be observed, crossed by north east and north west running faults, caused by later movements. Some faults are hidden under the relatively young sediment cover. In particular the large Kerio fault (which runs through the whole of Elgeyo Marakwet) and the Elgeyo Kula fault (more to the north) are covered with sediments. Due to this fault the Elgeyo Escarpment was formed; it retreated to the east because of backward erosion. The Escarpment marks the eastern edge of the Uasin Gishu Plateau, an extensive lava plain, as shown in Map 3.

MAP 2.2 : LOCATION OF THE STUDY AREA IN KERIO VALLEY



0 2 4 6
kilometres

2.3.1 Lithology and stratigraphy

The geology of the area is composed of precombrian paragneisses, upper miocene volcanics, Lower miocene sediments, Pliocene sediments, and quaternary to Recent deposits.

Stratigraphically, the precambrian rocks are unconformably overlain by the upper Miocene volcanics, composed of mainly basaltic and phonolitic lavas. In some places however, Lower Miocene sediments are sandwiched between the precambrian rocks and the upper miocene volcanics (Aljabri, 1990).

2.3.2. The Precambrian Rocks

The geology of the precombrian is characterized mainly by paragneisses varying in composition from hornblende gneisses. Intercalations of quartzities, breccia, crystalline limestone or marble also occur. These rocks are exposed at the base of the Elgeyo Escarpment. Mylonites are found along the shear zone (Gaciri 1975), while quartzo-feldspathic, biotite and hornblende gneisses have specks of galena. Biotite Schists and amphibolites form the rest

of the precambrian rocks. The crystalline limestone is structurally bound parallel to the foliation direction of gneissic rocks.

2.3.3 The lower Miocene sediments

The lower Miocene sedimentary deposits uncomfortably overlie the precombrian rocks, in places separating the latter from the overlying upper Miocene volcanics. These lacustrine deposits consists of two distinct series; laminated red sandstone deposits 5-10m thick, exposed to the South West of fluorspar mill, at Sarbap Hill and the grey to yellowish green shaly limestone deposits, exposed along Elgeyo Escarpments. The later geological unit usually referred to as the Kimwarer sediments is encountered in the study area (Gaciri 1975).

2.3.4 The upper Miocene Volcanics

These are the oldest Volcanic rocks of Central and Northern Kenya, which rests locally on fossiliferous lower Miocene sediments or on precambrian rocks. These volcanics were extruded continuously from early Miocene to holocene times. In the mine

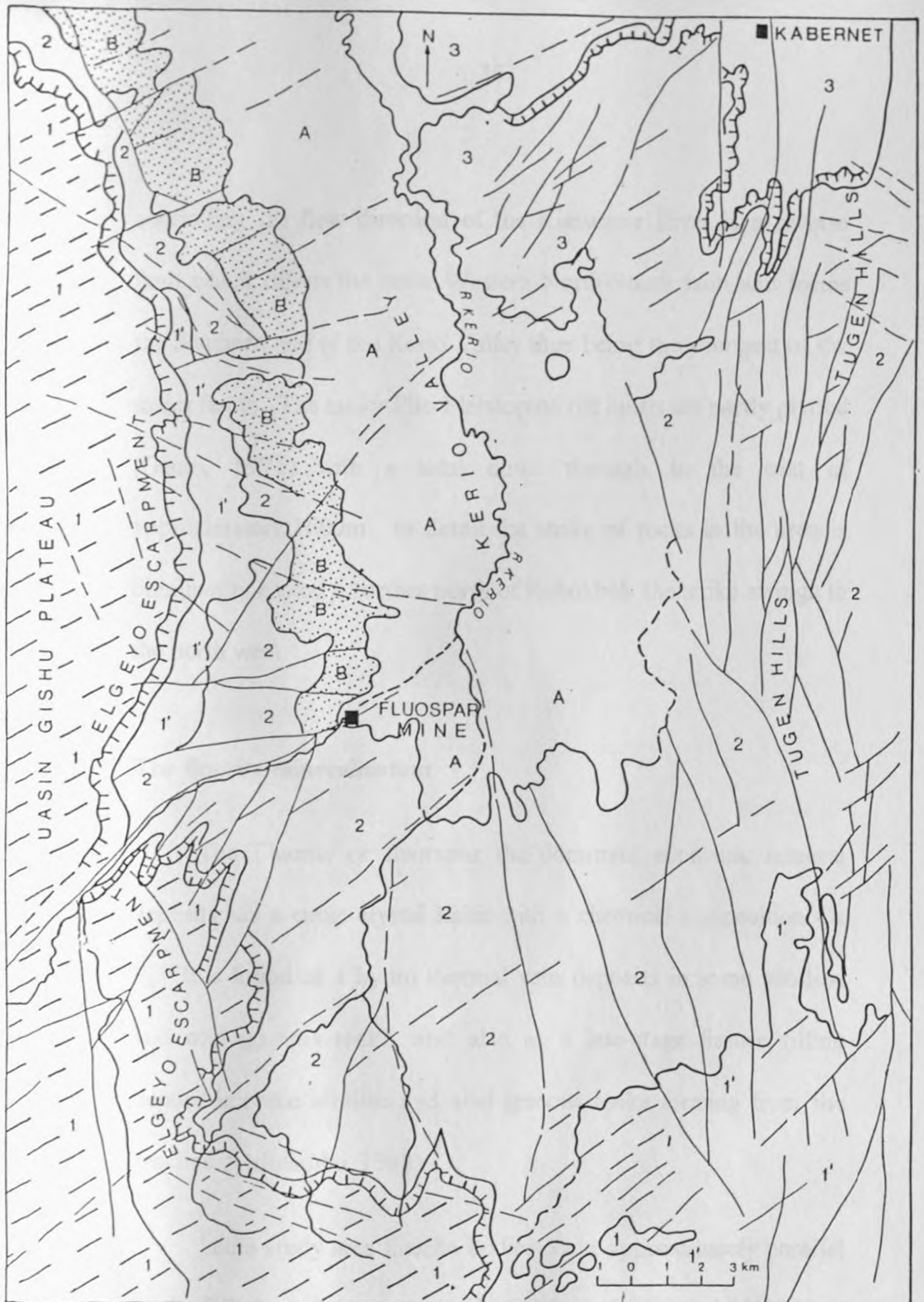
area , Miocene volcanism is represented by the non - porphyritic Uasin Gishu Phonolites (dated as 12.0-0.3 MY which conformably overlie the Elgeyo basalts dated as 15.1-3.2 M.Y (Odhiambo 1988).

2.3.5 Quaternary and Recent Deposits

These superficial deposits are weathering products derived basically from miocene volcanics, and form the precambrian rocks, and deposits at the valley bottom between the foot of the escarpment and the main Kerio river. It is notable however that the soils derived from the precambrian paragneisses are basically sandy in texture, while those derived from the volcanics are mainly clayey / loamy soils. (Aljabri, 1990).

2.3.6 Structural features of rocks

Structural features are restricted mainly to the precambrian rocks while the post-miocene normal rift faulting resulted in a stepped terrain higher up the escarpment . East-West shear fault occur in the precambrian rocks, marked by mylonites and quartz in the Kamnoan and choff areas (Gaciri 1975). The East west fault



MAP.23: GEOLOGICAL SKETCH MAP OF

KERIO VALLEY FROM LANDSAT DATA

KEY:

- | | | |
|---------------------|--------------------|---|
| Fault, linearment | Escarpment | Tinderet volcanics (phonolites) |
| Geological boundary | Alluvium | Uasin Gishu series (phonolites, tufts, basalts) |
| River | Kabernet trachytes | Basement system |

controlling the flow direction of the Kimwarer River is a reverse fault which offsets the main Western North-South fault and forms the Southern end of the Kerio Valley thus being the youngest of the major faults. The major Plio-Pleistocene rift faults are partly pivotal (Gaciri, 1975) with a total down through to the east of approximately 1600m. In detail the strike of rocks in the area is dominantly easterly, further north of Kabokbok the strike swings to the north west.

2.3.7 The fluorite mineralisation

The Fluorite or fluorspar the dominant economic mineral deposits has a cubic crystal habit with a chemical composition CaF_2 . It is found as a hydro thermal vein deposits in some alkaline and acid igneous rocks, and also as a late-stage fissure filling deposit in some alkaline and acid igneous rocks forming from the reaction. (Odhiambo, 1988).

In the study area fluorite bodies occur approximately parallel to the foliation of the metamorphic rocks (which trend $\text{N}10^\circ \text{N}$ at Kimwirer and $\text{N}45^\circ \text{W}$ at Kamnaon) in contact with the breccia.

The paragenesis of the fluorite mineralisation has been ascribed to hydrothermal examinations, largely replacing calcite mineralisation is further elucidated by the association of a felspar altered at great depths with fluorite deposits. The general lack of high temperature minerals along the zone of alteration however, suggest emanation of hydrothermal fluids at low temperature (Nyambok 1973).

To north of Kerio Valley fissure vein fluorite deposits have been reported as restricted fissures. Around muskut - Kimwarer area , fissure vein deposits is indicated by banding of fluorite. The fluorite mineralisation occurs mainly in shear zone as replacements and as statiform deposits with foliation planes serving as channel ways of mineralizing hydrothermal funds (Gaciri 1975) and also as fissure deposits with mineralisation being partly by replacement and mainly by fissure fillings. Fissures also occur in Elgeyo basalts, infilled by calcite South of the fluorspar mill area (Odhiambo,1988).

The fluorite formation, therefore came into being through a set of intricate historical tectonic processes which acted upon the earth's crust. Map 4 gives a detailed description of the lithography

of Kerio Valley and its environs. Fluorspar mineral produced is a non-renewable resource hence it underscores the importance of rational management of mineral exploitation.

2.4 Soils

The soils in Kerio Valley and their suitability for cultivation vary with location and altitude. A few zones running more or less north-south throughout Kerio Valley and adjacent to each other can be distinguished. These zones are generally homogenous with regards to fertility and suitability for cultivation, however local differences occur starting from Kerio river in the east, the following zones occur, along the river runs a fertile zone, the alluvial plain. Starting in the south where the rivers, Mong, Mogorua and Kimwarer join to form Kerio river and running up to Cheseгон area. The zone varies in width from one to five kilometres. Adjacent and running up to the base of escarpment is a zone of moderate fertility. The soils to the south of the above zones, in Soy and Kocholwo locations, are of a variable degree of fertility and largely unsuitable for cultivation because of shallowness. The soils affected by erosion are found in various parts mainly on the

escarpment (Aljabri, 1990). Most of the erosion along the escarpment and in the valley is caused by water which sweeps down the escarpment in numerous small streams when it rains. A lot of soil is washed away, trees and bushes are uprooted and gullies formed. Especially in Mutei and Irong locations this kind of erosion is serious and the vegetational cover on the escarpment is sparse. On the valley floor below, gully -erosion occurs. The gullies cut deep into the loose alluvial soil. It was also observed that mining activities in Kerio Valley area have exposed the bare surface for erosion to set in.

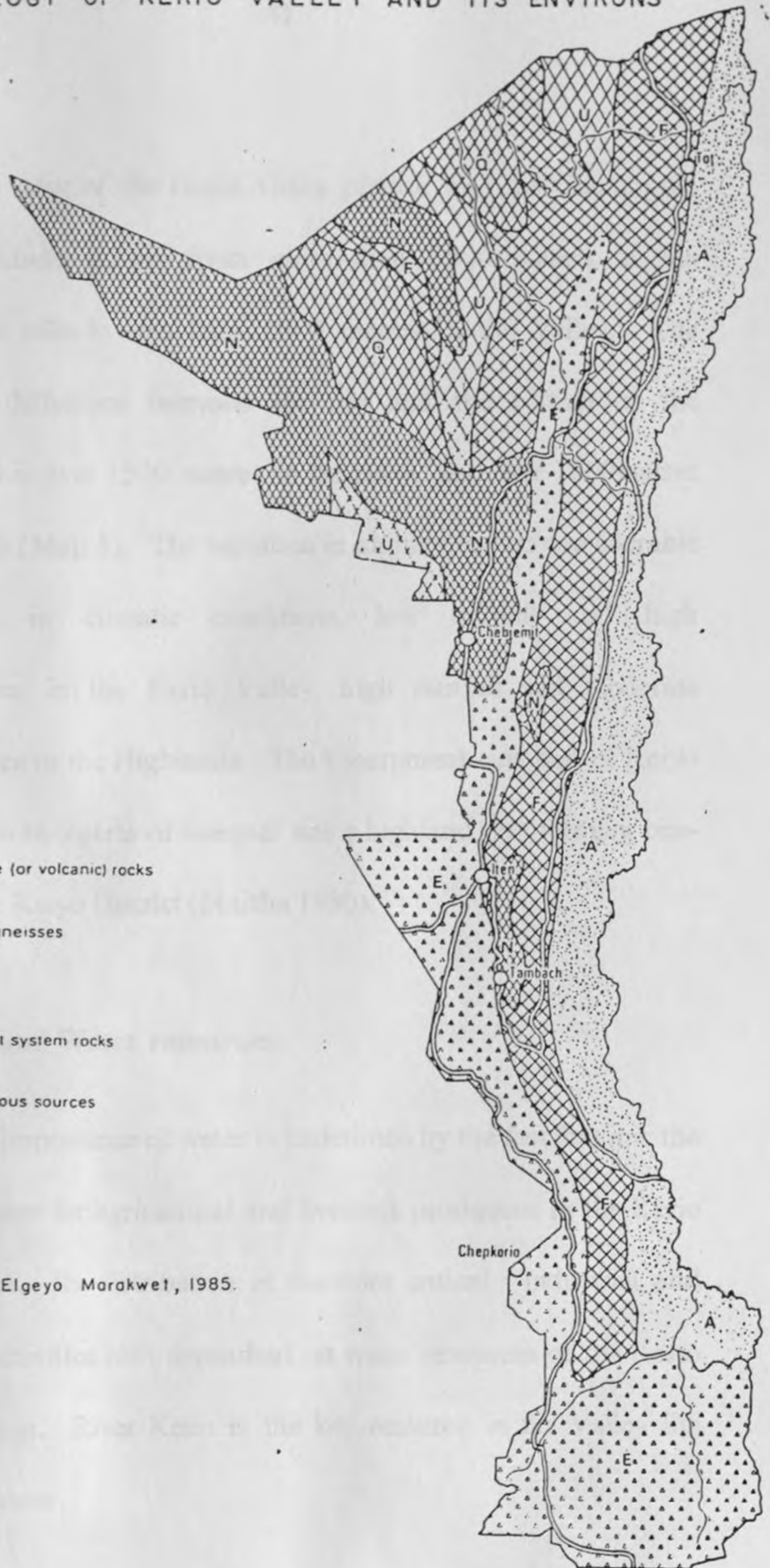
2.5 Surface configuration, drainage and climate

Kerio Valley is strikingly marked off from the adjoining highland mountain range by abrupt transition. The drainage pattern of Kerio Valley is strongly influenced by topography.

2.5.1 Surface Configuration

The relief of Kerio Valley is very distinct. The low Kerio Valley-floor is bordered by the Elgeyo Escarpment, which marks

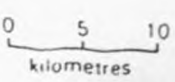
MAP 24: LITHOLOGY OF KERIO VALLEY AND ITS ENVIRONS



KEY

- Extrusive igneous rocks
 - ▲ E ▲ undifferentiated extrusive (or volcanic) rocks
- Metaphoric rocks
 - X Q X quartzites and granitoid gneisses
 - W N W biotite gneisses
 - X F X hornblende gneisses
 - U U undifferentiated basement system rocks
- Sediments
 - A A alluvial deposits from various sources

Source : District Atlas - Elgeyo Marakwet, 1985.



the eastern edge of the Uasin Gishu plateau and the Charangani hills. Altitude ranges from more than 3500 meters in the Charangani hills to less than 1000 metres in the Valley. The maximum difference between the top and the bottom of the escarpment is over 1500 metres in the north, and over 1000metres in the south (Map 5). The variation in altitude causes considerable differences in climatic conditions, low rainfall and high temperatures in the Kerio Valley, high rainfall and moderate temperatures in the Highlands. The Escarpment cuts part of Keiyo District into two parts of unequal size a highland part forming one-third of the Keiyo District (Maitha 1980).

2.5.2 Drainage and Water resources.

The importance of water is underlined by the fact that it is the limiting factor for agricultural and livestock production in the Kerio Valley zone. Its distribution is therefore critical. Industrial and domestic activities also dependent on water resources of the Kerio Valley region. River Kerio is the key resource in the Valley life support system.

The main water divide runs along Escarpment. East of the divide is the Kerio river catchment area, which drains into Lake Turkana while West of the water divide drains into Lake Victoria. The Kerio River and some of its distributors are perennial. The main rivers are: Kerio River, Chesegon River, Embobut, Embamon, Aror River, Torok river, Kimwarer River and Mong River among others. Many streams dry up before they reach the main river. This is due to evaporation and infiltration into the loose cover of the valley-floor and in the northern part because much of the water is used for irrigation purposes. In West of the main water divide the drainage pattern is often disturbed. Many minor streams end in marshy depressions. Apparently the underlying volcanic rocks has a low permeability (water can hardly percolate) and since the time that this area was uplifted during the formation of the Rift Valley system the streams have not had enough erosive power to cut themselves through the rolling terrain to form a more regular and coherent drainage pattern. The Kerio river originates in the Metkei and Timboroa forest areas and flows some five hundred kilometres to the north east before discharging into Lake Turkana. Its major headwater tributaries are, Ainabkoi, Kimwarer, Mong, Endo and

Mogorua Rivers. At Chebloch the Kerio river flows through a deep gorge. The perennial tributaries north of Chebloch are, Torok River, Arror River and Embobut. The Kerio River itself dries up towards the end of dry season. The combined Kimwarer Mong River catchment areas is about three hundred and thirty square kilometres while Arror River catchment area is about four hundred and sixty square kilometres and Embutut catchment area is circa one hundred thirty square kilometres. The higher parts of these catchment areas receive abundant rainfall of 1200 millimetres and over annually (District Atlas, 1985).

2.5.3 Climate

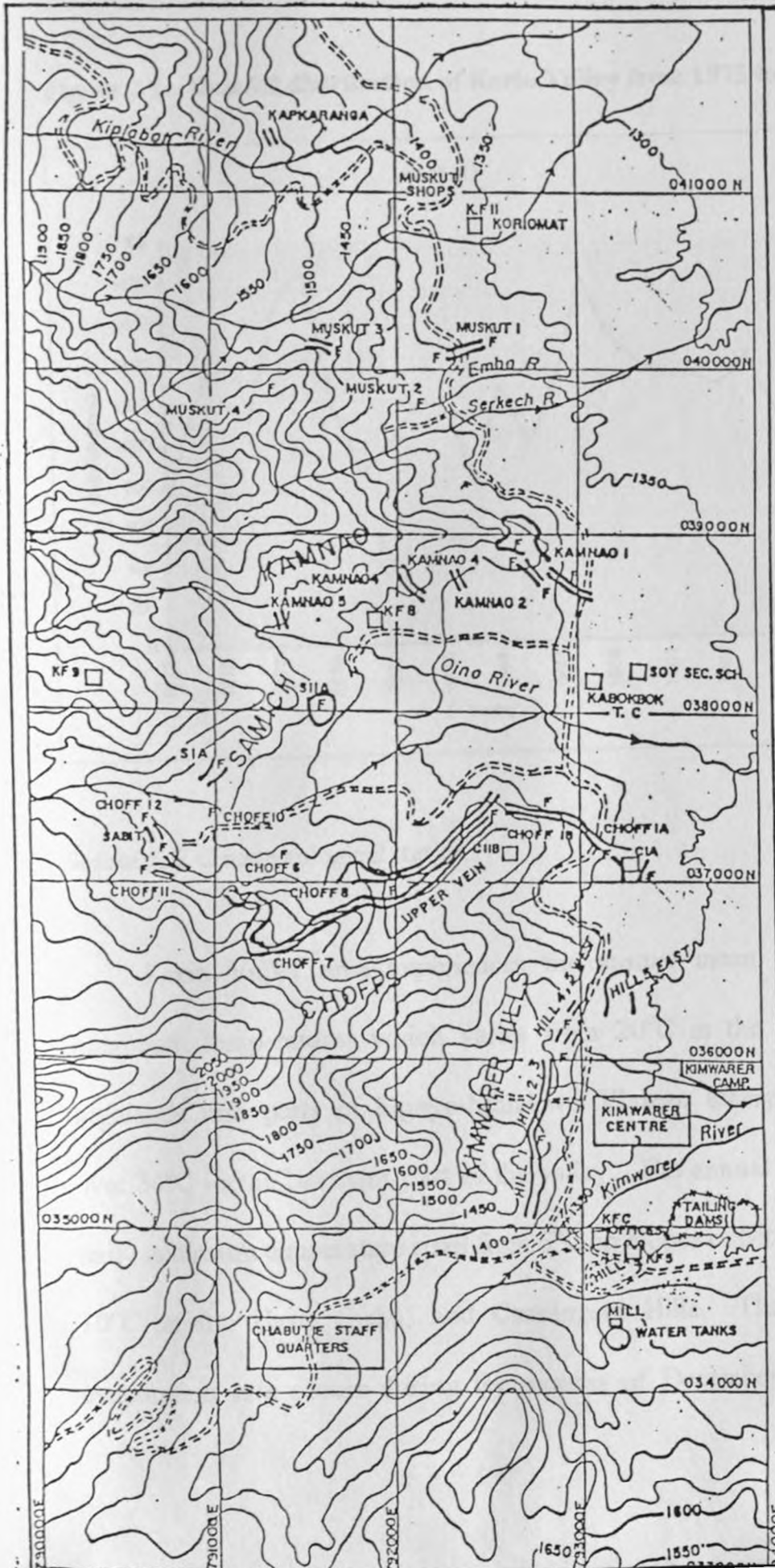
Climatic data is considered important in the production process of fluor spar by the mining company. The information collection on climate is the domain of laboratory unit. Rainfall for example has a direct bearing on the number of working hours in mining operations and might even cause some temporary stoppage besides facilitating the process of erosion in the extraction site. The high temperatures contribute to corresponding high rate of evaporation of the surface water bodies and enhances chemical

reactions particularly of fluorspar (Calcium fluoride) and other reagents utilised in industrial operations. The scorching effect of the sun in Kerio Valley was cited as one of the problems faced by the operatives involved in extraction of the ore.

The study area has four distinct climatic seasons. A bimodal peaks occur in April / May and around August / October. These months are relatively cold and wet with November through February being the hottest months June and July are usually relatively dry, and are the coldest months. The rainfall figures shown in Figure 2.1 have been collected from the meteorological station in Kenya Fluorspar mining company describes the rainfall characteristics of Kerio Valley.

In the Southern part of Kerio Valley, torrential rains occur in distinct catchment areas of the tributaries of the main Kerio River, causing flash, floods. Heavier down-pours occurs from storms moving south westerly from Tugen Hills, or north - easterly from the Uasin Gishu plateau.

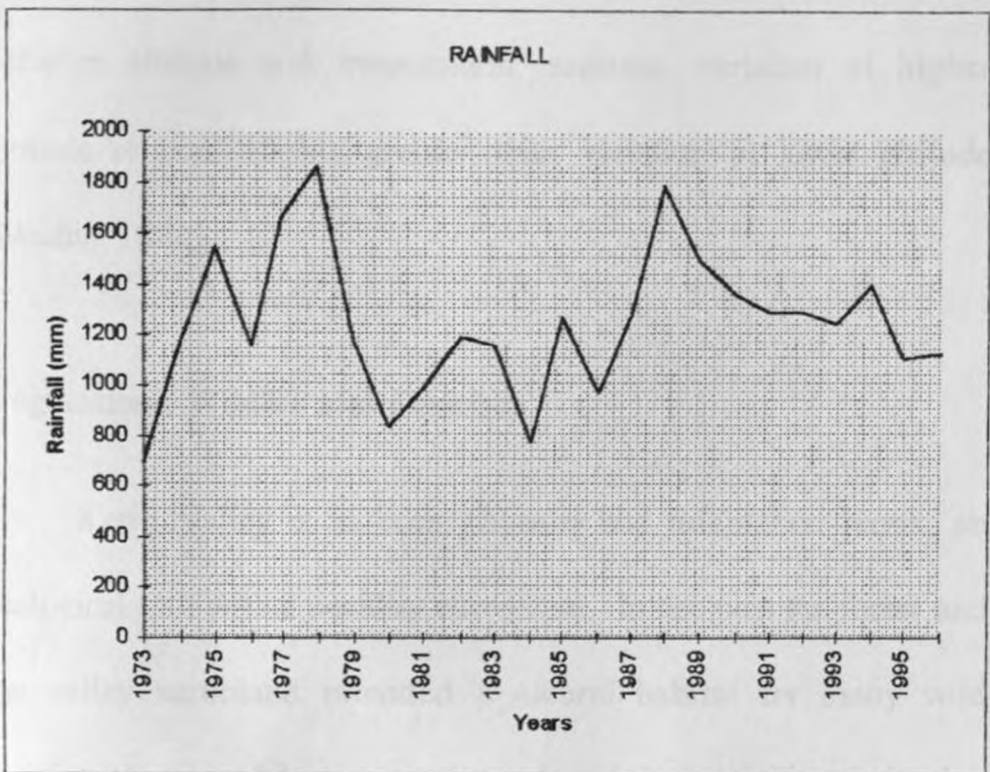
MAP 2-5: TOPOGRAPHY AND DRAINAGE OF THE MINE AREA



KEY

- ==== Road
 - ~1600~ Contour
 - ~ River/Stream
 - ~ Dam
 - Ore Body
 - KF....Kenya Fluc
- Scale:
- 0 6Km
- 1 : 40,000

Figure 2.1: Rainfall distribution of Kerio Valley from 1973 to 1996



Source:K.F.C meteorological station

Kerio Valley area experiences the annual mean of daily maximum temperatures which varies from 20°C in the adjacent highlands and parts of Elgeyo-Marakwet Plateau escarpment to over 34°C in the Northern part of the valley. The annual mean of daily minimum temperature rises from 6°C on slopes of Mt Elgon to 10°C on the Uasin Gishu, and Charangani Hills. The highest evaporation rate occurs during the months of December through

April with an extreme in March. There is a clear relationship between altitude and evaporation, seasonal variation at higher altitude is considerably greater than variation at lower altitude (Maitha, 1984).

2.6. Vegetation , Wildlife and Tourism

Kerio Valley is in both physical and adaptation terms, an ecological unit with a peculiar ecosystem. In the past the forest and the valley scrubland provided a natural habitat for many wild species. Increased human settlements, mining activities, irrigation and deforestation have partly led to the disappearance of many species of wild game (Ssenyonga, 1980).

2.6.1. Vegetation

The Vegetation of Kerio Valley is largely controlled by the terrain which as elsewhere in Central Kenya is affected by the Rift Valley tectonics. The Savana type of vegetation in Rift Valley is associated with special soil and drainage conditions or to be of secondary character having other vegetation types. In the Valley,

the Kerio and Turkwel rivers sediments as well as the flood plains consist of alluvium. These deposits have influenced the types of vegetation found in the valley.

The dominant plants in the Valley includes: Harrisomia abyssinica, Euphorbia Commiphora and Accaciaspecies, which includes Acacia mellifera and Acacia Spirocarpa. The species common among the lower scrubs include those of Andigofera, Barlevia, Aerva, Seriococomophis, Disperman, Latipes, Tetrapogon, Enneapogon and Chrysopogon. Some of these plant communities in Kerio Valley are sources of herbal medicine for the people living in the Valley (KVDA 1990).

2.6.2 Wildlife and Tourism Development

Kerio Valley provides sanctuary to a number of wild animals which include, elephants, tree hyrax, Buffalo, Burchell's Zebra Greavy's Zebra, water bucks, Hyena, Grant gazelle, Leopard, Baboon and Hunting dog among others. Some of these species of wild game such as baboons could be seen in some hills in the mine

area, and occasionally some people in Kerio Valley get engaged in hunting for Dikdiks and Grant gazelles.

The uniqueness of the specific species commonly in the Valley is mainly their colourful skins, and spiral horns. The rivers and streams contains different varieties of fish such as Tilapia of the Apostles. Small scale fishing is done along Kerio river and its distributaries (KVDA, 1990).

The birds include ; Ostrich, Pelicans, Cormorants, Herons, Egrets, Stork, Secretary bird, Duck Vultures, Buzzards, Eagles, Falcons and Hawks among others while the reptiles list includes Nile Crocodile, Lizards, Tortoises.

One of the few resorts where wild game still abounds in the area around Lake Kamnarok in the Southern Kerio Valley whereby apart from its scenic beauty, the area has black rhino, elephants, buffalos and crocodiles. The government negotiated for the alienation of a 1,024 km² tourist resort around Lake Kamnarok. However this aroused hostility from the local communities (Kipkorir, 1980).

2.7 Development of Mineral Resources

A large portion of the surface area of Kerio Valley south has been explored for mineral development. A number of minerals have been found. There are a vast fluorspar mineral deposits throughout the valley zone. The fluorite mineral is currently being commercially exploited at Kimwarer in the Southern Kerio Valley which is the subject of this study. Map 6 shows the distribution of fluorite ore bodies in Kerio Valley. Other rich deposits of fluorspar have also been reported further north in the Kolloa - Sigor area (Aljabri, 1990). Copper deposits have also been found in the Elgeyo Escarpments. The Charangani hills have a high potential in minerals such as limestone graphite and asbestos. However high financial risks and costs have retarded the exploration and extraction of these and other minerals (KVDA 1990).

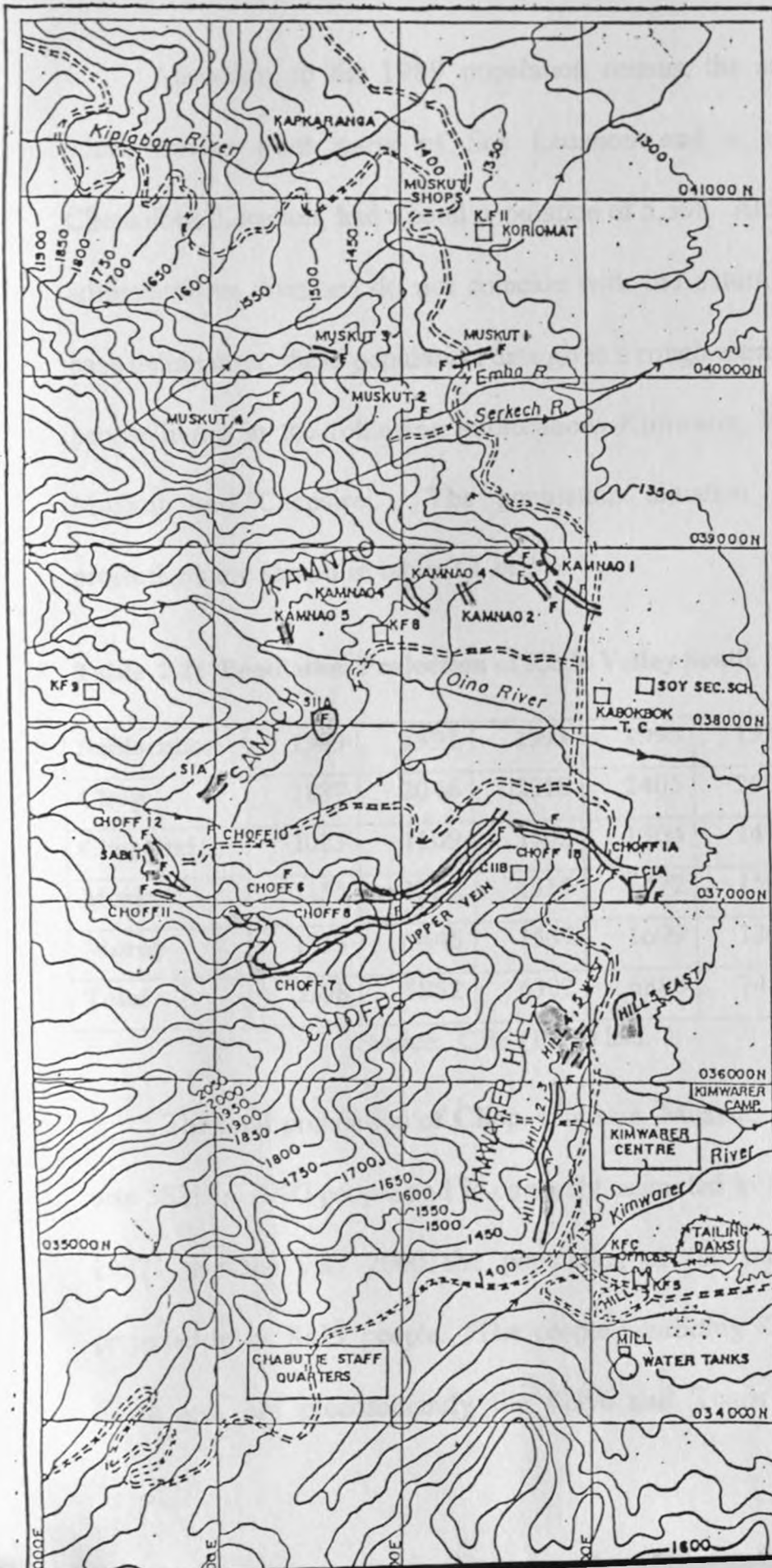
2.8 Demographic Profile

The population growth rates in the Kerio Valley region are generally lower than the national average. The study area in particular has tended to register a declining population and this is

largely attributed to the difficult and harsh environment which has meant that over a period of time there has been outmigration of population from the Kerio valley to surrounding districts in search of social and economic amenities which are presently not available in the region.

In Elgeyo-Marakwet districts, the intercensus period of 1969-1979 was occasioned by outmigration of many people attracted by availability of fertile land in neighbouring districts of Uasin Gishu, Nandi and Transzoia. (Maitha, 1984). However present indications are that population out migration of the sixties and early seventies in the district are no longer continuing because there is no more land for settlement outside the district. It is also reported that because of recent Government efforts to intensify development in Kerio Valley, a situation has been created whereby there are no significant disincentives to encourage out migration from the Valley.

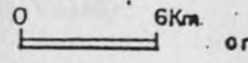
MAP 2-6: DISTRIBUTION OF FLUORITE ORE DEPOSITS



KEY

- ==== Road
- ~1600~ Contour
- ~ River/Stream
- ~ Dam
- Ore Body
- KF.....Kenya Fluorap

Scale:



1 : 40,000

According to the 1989 population census, the study area which covers most parts of Soy Location and a section of Chemoibon Location, had a total population of 5,398. Although the administrative divisions do not coincide with the natural resource base delineation, these population data gives a rough estimate of the people living in the following sublocations Kimwarer, Kabokbok, Muskut and Chepsirei. The population situation and their projections are shown in table 2.1 below.

Table 2.1: Population Projection of Kerio Valley South.

Sublocation	1989	1991	1993	1995	1997	2000
Chop	1887	2046	2218	2405	2607	2943
Chepsirei	1023	1109	1202	1304	1413	1596
Muskut	1155	1252	1315	1472	1596	1801
Morop	1333	1445	1567	1699	1842	2079
Total	5398	5852	6302	6880	7458	8419

Source: CBS (1997) Iten.

The total population of Chop, Chepsire, Muskut, and Morop was 5621 in 1990 people and is currently estimated to be 7,458 in 1997. By the year 2000 the population of the study area is projected to be 8419 people. The people inhabiting Kerio Valley South area are predominantly the Keiyo and Tugen Sub-ethnic

Communities of the large Kalenjin Community. Out of 110 households interviewed, the average family size in Kerio Valley was 5.9 which can be estimated to 6 members in a household. Most of the household heads had no Schooling, out of 110 households interviewed, 39.1% of the household heads had no schooling, 19.1% of the household heads had lower primary level, 32.7% had attained the upper primary level, while 9.1% had a secondary level of education.

As compared to the people living in the highlands, the Valley people have somewhat lagged behind in development owing to semi-arid nature of the environment and communication problems arising from extremely rough terrain. For example the adaptational systems in Kerio Valley have successfully resisted most of the externally initiated changes as shown by the fact that 32.7% of the respondents interviewed still live in temporary housing structures while only 6.1 % have permanent housing units. Other than the construction of temporary structures, the Valley people are still living in their traditional way of life in terms of keeping hardy livestock breeds and other systems of resource management.

2.9 Land Tenure and Agriculture

The discovery and subsequent exploitation of the mineral may override the land and resource rights of local people in areas containing mineral deposits. Thus an accurate understanding of land tenure and land use patterns is fundamental in examining the socio-economic impacts of fluorspar mining on the people of Kerio Valley region.

2.9.1 Land Tenure and Adjudication

Ownership of land in Kerio Valley was traditionally determined through customs going back to the time when all land was communally owned by the clans. Such strips were often demarcated by a row of stones or certain type of Vegetation. However this traditional form of land ownership has gradually disappeared through legalization and adjudication of that existing situation. In Kerio Valley, very little land has been adjudicated to date. Two areas which lie outside the scope of adjudication, because they have been set aside for public use, are the fluorspar mine claim and Rimoi Game Reserve (Kipkorir 1980). Land-

adjudication in Kerio Valley is somewhat problematic because a lot of land is still being used as communally grazing land so that no individual claims to own the land. Out of 110 households interviewed in the study area, the average land size per household was 17 acres, of which 78.7% acquired land through inheritance while 21.3 bought land in Kerio Valley.

2.9.2 Agriculture

Agriculture is one of the dominant economic activities of the people living in Kerio Valley. Large herds of livestock and small-scale farming is a common practise in the mine area and its environs. This is largely for domestic consumption but any surplus is sold to acquire income which is used to meet other socio-economic demands.

The people living in Kerio Valley practice a mixed form of economy of farming on small-scale units at subsistence level. The people of Kerio Valley cultivate fragmented pieces of land for the simple reason that most of the land surface is covered by different types of rocks, thus making farming to be almost impossible.

A traditional irrigation farming system is practised in Kerio Valley, especially in the vicinity of permanent rivers and streams descending from the escarpment such as Embotut river. Water is diverted on the river on escarpment through channels, led down to the garden where minor channels are made from the main channels through which water is spread all over the gardens, (Rutto, 1988).

In the valley, the size of individual cultivated plots are much smaller with no family having more than three acres made up of small strips in different holdings. In the Valley the hot climate condition determines the type of crops grown there. The crops grown includes maize, finger millet, cassava, beans, bananas, pawpaw and groundnuts among others. About 45% of the household interviewed grow finger millet, sorghum and groundnuts while 52% of the 110 households grew maize and beans together with sorghum, millet and groundnuts.

The problems associated with agriculture cultivation in Kerio Valley include: long dry season, unreliable rainfall, soil erosion, lack of infrastructure, limited amount of available land, plot

subdivision, wildlife menace and excavation of farms by the fluorspar mining company.

Long dry season is experienced between the months of December and February or March. This result in severe hot and dry conditions in Kerio Valley, drying most of the vegetation and leaving the land surface almost bare. The volume of water and streams is greatly reduced. Rainfall is even unreliable during the rainy season so that the available amount of rainfall is unevenly distributed. About 73 % of the respondents noted that the arid nature of the Valley climate is a major problem in crop production. Soil erosion is one of the most serious problems facing Kerio Valley. This problem is pronounced in the Elgeyo Escarpment.

Lack of infrastructure especially roads and means of communication have inhibited the extent to which crops can be moved to the market. There is also a shortage of services such as given by extension staff and the market outlets in Kerio Valley (Rutto, 1988).

There is limited amount of arable land especially in the Kerio Valley. Plot subdivision involving the system of having fragmented

pieces of land does not allow substantial yields per acre. In addition, there are also problems of wild animals, pests and birds which destroy the farm produce. Out of the 110 households interviewed 18 % of households noted that the wildlife poses great problem in crop production.

The mining company which deals with extraction of fluorite from the earth's surface has excavated, and destroyed limited amount of cultivable land and even disrupted the courses of surface water especially the streams which flow from the escarpment, thus reducing availability of water for small-scale irrigation besides decreased food production.

The control measures applied to curb these problems are irrigation, and soil conservation. One of the most important technological achievements of the people of Kerio valley is their system of furrow irrigation which compliments the rain system and facilitates production of a second crop during the short rains (Rutto, 1988).

In terms of soil conservation some of the soil conservation measures that have been adopted include tree planting, contour ploughing and terracing.

For wild animals, pests and birds. The peasants keep watch on wild birds . Because of organised hunting in the past, the number of wild animal near cultivated areas are now manageable.

2.9.3. Animal husbandry

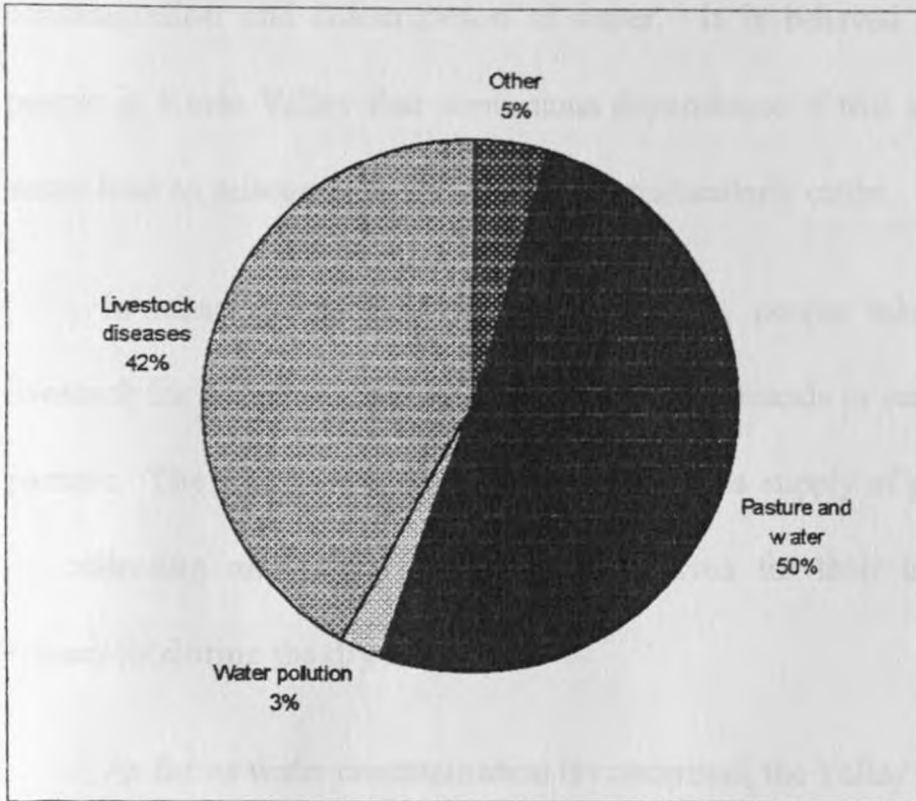
Like agriculture, keeping livestock is an important economic activity among the people living in Kerio Valley. The domestic animals provide milk, meat and blood for consumption and hides and skins. The animals can also be sold to provide money needed to meet day-today needs and as bride-wealth and for functions such as ceremonies. There is no limit on the size of herd. An individual person can own as many domestic animals as possible. The average number of livestock kept by 110 households interviewed was 13 cattle, 14 for sheep and 20 goats per household.

Grazing practices in Kerio Valley is carried out in communal grounds because land adjudication and consolidation process has

not been fully applied to limit an individual person to a single plot of land.

The problems facing the livestock sector in Kerio Valley are: dry season, lack of pasture particularly during the long dry season between August and February when most of the pasture dries up. Water is also one of the critical problems facing livestock production. Other than water shortage, some streams leeches contain micro-organisms such as leeches which clings tenaciously on to the livestock thus causing animal bleeding . This was observed to be particularly pronounced in Soy Sub-location. Figure 2.2 gives a summary of problems facing livestock production in Kerio Valley.

Fig. 2.2: Problems of livestock production



Source: Field data

Occasional outbreaks of diseases such as East coast fever, foot and mouth and trypanosomiasis affect livestock production in Kerio Valley. Lack of veterinary services and poor management of cattle dips have worsen the practice of animal rearing.

It was also noted that fluorspar mining activities in Kerio Valley have rendered the surface water sources for animals to be unfit for consumption. The solid and liquid wastes from the mill is

discharged directly into Kerio river without treatment thus causing contamination and colourization of water. It is believed by the people in Kerio Valley that continuous dependence of this unclean water lead to miscarriage of the livestock particularly cattle.

In terms of solving livestock problems, people take their livestock for long distances, especially to the highlands in search of pasture. The residents of the Valley also ensures supply of pasture by collecting and preserving grass and leaves for their animals especially during the dry season.

As far as water contamination is concerned, the Valley people have in the past made several delegations to discuss the water problem with the management of the Kenya mining company (KFC) . As a result, the effluence discharge into Kerio river has been reduced so that the waste material is channelled to the river at least twice a week, but still a permanent solution to water pollution in the Valley has not been found.

2.10 Commercial and Industrial Development

It is important to examine the commercial and small scale industrial sector of the Kerio Valley area in order to unravel the relationship between mining activities and the development of commerce and industry.

The commercial sector in Kerio Valley is small and is composed of small scale traders located in various market and local centres. Most of the centres are unplanned and poorly developed with no water supply and poor access roads, except for Kimwerer which has benefited from the mineral-based infrastructure. There are small scale industrial undertakings scattered all over the centres. Fluorspar mining is the only major industrial undertaking in Kerio Valley. The major micro-industrial concerns deal with bicycle repairs, tailoring, charcoal dealing, furniture manufacture and grain milling among others. The commercial and industrial establishments are geared towards the production and distribution of essential goods, in Kerio Valley. Wherever people are settled, permanent trading centres and small-scale industrial concerns are established to cater for such domestic needs such as furniture,

building material and food-stuffs among others. The following market centres were identified in the study area; Nyaru, Turesia, Kimwarer, Kabokbok, Chepsirei, Kapkono, Muskut and Mogorwa. Some periodic markets which take place once a week or after a fortnight are located within the premises of the mining company and Mogorwa trading centre. There are also livestock sales in various market places where auctions are generally held once a month in Kerio Valley region. The market centres and periodic markets provide opportunities for people living and working in Kerio Valley to get access to farm produce and other household items. Table 2.2 shows the number of shoats auctioned in Kerio Valley in 1994/1996.

Table 2.2 Number of livestock auctioned in Kerio Valley

Auction centre	1993/94	1994/95	1995/96
Kimwarer	8	--	18
Kabokbok	11	5	11
Muskut	16	7	14
Chepsirei	21	9	52
Total	56	21	95

Source: Field Data

Many residents of Kerio Valley sell their animals so as to buy mainly food-stuffs because the Valley climate is not conducive for crop production. Table 2.2 shows that 56 sheep and goats were sold in 1993/4, but declined to 21 in 1994/95. In 1995/96 about 95 sheep and goats were auctioned in Kimwarer, Kabokbok, Muskut, and Chepsirei market centres in the mine area. The revenue generated by the sale of shoats to the County council of Keiyo was Kshs 1,120 in 1993/94, Kshs 630 in 1994/95 and Kshs 2,850 in 1995/96. Most of the customers of the stock auctions are predominantly the employees of the Kenya fluorspar mining Company and other businessmen from within and without Kerio Valley.

2.11 Summary

Kerio Valley is in both physical and adaptation terms an ecological unit with a peculiar ecosystem. The geology of the area owes its genesis to the formation of the great Rift Valley. The fluorite deposits are believed to be of the hydrothermal origin in the post-miocene era when lavas formed a protective cap rich in fluoride. The rocks include: basalts, phonolites, trachytes and

pyroclastic rocks. The Kerio Valley beds were formed less than 1 million years ago through sedimentary alluvial fill of the Kerio Valley quaternary alluvial deposits. The relief in Kerio Valley is very distinct. The lower Kerio Valley floor is bordered by Elgeyo Escarpment. The maximum difference between the top and the bottom of the Escarpment is over 1500 metres in the north, and over 1000 metres in the south. The variation in altitude causes considerable differences in climate conditions leading to low rainfall and high temperatures. The dominant vegetation in the valley is the savannah type of vegetation which includes Acacia species and shrubs among others. The main water divide runs along the escarpment. The rivers and stream discharge water into River Kerio. The main tributaries of Kerio are Kimwarer, Mong, and Kiptunoi rivers. Other than Fluorspar mining, agriculture is practised together with irrigation especially around the permanent water sources. The problems associated with agriculture in Kerio Valley includes: long dry season, lack of infrastructure, soil erosion and diseases among others. Land adjudication and registration process is yet to be extended fully to Kerio Valley. The population growth rate in the Kerio Valley region are generally lower than the

national average owing to the harsh environment which facilitates the outmigration. The population of the study area was 5,398 in 1989 and in 1997 the population is projected to be 7,458 which will increase to 8,419 by the year 2000. The small commercial centres and periodic markets have sprung up in the Kerio Valley area especially in the mine area and its environs. The Keiyo county council gets revenue from the market centres in Kerio Valley. The Kenya fluorspar Company remits about Kshs 453,675 rent to the county council every year. The revenue generated is earmarked for the general development of the jurisdictional area of the Keiyo County Council. Therefore the accurate understanding of these environmental and socio-economic characteristics of Kerio Valley region provides insight on the consequences of the introduction of fluorspar workings into the Kerio Valley region.

CHAPTER 3: MINING POLICIES AND REGULATIONS IN KENYA

This chapter reviews more directly the mining policies and regulations in Kenya. The mining policies are significant elements in any assessment of mineral development status of any country. The mining policies are important because they provide the general guidelines and standards for sustainable mining operation. In order to deal effectively with and outline systematically the various sets of mining policies and regulations, these are sorted into two eras notably pre-independence and post-independence mining policies. The pre-independence mining policies were mainly contained in the mining laws of Kenya which incorporated the mining ordinances numbers; 1 of 1931, 15 of 1932 and 52 of 1932. The post-independence mining policies are reviewed under the Mining Act Chapter 306 together with the National Development Plans.

3.1 PRE-INDEPENDENCE MINING POLICIES

At the Berlin Conference of 1884-85, the European powers divided Africa into various spheres of influence. The major

element which sparked off the scramble and partition of Africa was the need to explore and exploit the mineral resources which were known to have existed by the early missionaries. the continent of Africa was seen as the source of cheap materials for the industrial complexes of the metropolitan countries.

The British began to rush for colonial possessions in East Africa by taking over the interests of the British East Africa Company. The British had its main interest in Uganda, such that Kenya was of little immediate interest owing to what was considered as a weak resource endowment. After effective occupation of Kenya by the British, their major handicap was how to acquire land directly from natives because the British land acquisition regulations could not be applied to the newly established colonies. Therefore, the British had no right to confiscate, own and use the available land for various uses including mineral extraction. In their efforts to exploit land resources, the British authorities imported other land acquisition policies which had been applied elsewhere in their colonies, prominent among such policies was the Indian Land Acquisition Act of 1894 which provided for compulsory acquisition of land for

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mining and other public purposes (Kenya, 1933). Throughout the colonial era when these regulations were operational, the mineral sector in Kenya was fairly performing up to the expectations of the imperialists such that by 1953, about ten different minerals had been exploited and repatriated for industrial complexes of the metropolitan economies. Table 3.1 shows the mineral production situation in Kenya during the colonial period.

Table 3.1: Mineral production in Kenya 1952-1954
(in tonnes, with exception of Gold in oz)

	<i>1952</i>	<i>1953</i>	<i>1954</i>
Asbestos	348	150	200
Carbon dioxide gas	383	465	582
Diatomite	5932	4378	3258
Gold	10209	9590	6607
Graphite	34	183	310
Gypsum	1593	841	503
Salt	16750	20886	18795
Soapstone	231	155	99
Soda ash	118371	76032	96074
Vermiculite	--	73	720

Source: The Ministry Journal (1955), Railway and Commercial Gazette, London.

The table 3.1 indicates that gold was the most valuable mineral extracted during the colonial period and in order to foster gold production in the mid 1950s in Kenya, a new plant at Macalder mine which was to treat 10,000 tons a month had been

planned to be constructed and was expected to go into production in the first half of 1956. Production of fluorspar mineral in Kerio valley did not take place until after independence.

3.1.1 The Colonial Mining Regulations

The mining laws of Kenya which incorporated the mining ordinances and regulations were covered under the Mining Ordinance of 1933 which owed its genesis from the British government and were applicable to all British spheres of influence. The 1933 Mining Ordinances stipulated mining regulations which cut across all stages of mining operations including such areas like: prospecting rights, disposal of minerals obtained in prospecting, possession and purchase of certain minerals, health and safety of the miners and public properties as well as environmental protection.

3.1.1.1 Prospecting Rights

The Mining Ordinances of 1933 stipulated that the prospecting right was to be issued to any person provided that the prospecting right was not to be granted to any person who was

under eighteen years of age. The prospecting right was not granted to a company or partnership. Therefore, the application for the prospecting right was to be made by the individual in person, who was either to be the lawfully constituted attorney of the company or partnership. A prospecting was not transferable and was to be in force for a period of one year from the date of expiration. A prospecting right was to be produced whenever demanded by the owner occupier of private land on which the holder is prospecting.

Section 13 of the Mining Ordinance, 1933 had several stipulations as regards land excluded from prospecting and these included land dedicated or set apart as place of burial or for any public purpose other than mining, except with the consent of the Governor. The other area excluded from prospecting was any area situated within the municipality or township not unless authority was obtained from the Governor or municipal or township authorities.

The other type of areas excluded from prospecting during the colonial era were:

- (i) Land reserved for the purpose of any railway or situated within one hundred yards of any railway except with the consent of the Railway Administration.
- (ii) Any street, road or highway without the consent of the Governor or of the Municipality corporation or other public body in charge of these types of infrastructure
- (iii) Land within a native reserve except with the consent of the Native Trust Board.

For the purpose of this ordinance, every native reserve was to be deemed to be private land, and the Native Lands Trust Board was deemed to be the owner. But the Ordinance also provided that any money received by the Board by way of rents or compensation was devoted to the use of the natives concerned.

Section 23 of the 1933 Mining Ordinance catered for the disposal of minerals obtained in prospecting. The minerals obtained in the course of prospecting under a prospecting right or an exclusive prospecting licence was treated as the property of the

government and that the Commissioner could authorise the removal of minerals from the land from which they have been obtained to any area approved by for safe custody, subject to such conditions, if any as required to be imposed.

The Mining Ordinances of 1933, section 26 part 1 addressed the payment of compensation to owners or occupiers of land. In this regard the holder of a prospecting right or of an exclusive prospecting right licence was, on demand made by the owner under which prospecting operations were to be carried on, paid fair and reasonable compensation for any disturbance of the rights of such owner or occupier, and for any damage done to the surface of the land by such operations, and was on demand made by the owner for any crops, trees, buildings or works damaged by the holder of the right or licence, paid compensation for such damage.

3.1.2 Lawful Mining

During the colonial era mining was considered ~~during the colonial era~~ ^{as} lawful under a claim or a mining lease provided that the Commissioner granted permission to the applicant to mine

on the area applied for on conditions subject to restrictions as the Commissioner found it fit, and provided also that the provisions of the ordinance and regulations which were applicable to mining lease were applied to any areas in respect of which application had been made for a lease and on which permission to mine had been granted. Such permission were subject to withdrawal at any time by the Commissioner.

In Section 29 of the Mining Ordinance, no rent was to be paid for a claim while for the mining lease rent was paid, subject to the provisions of Section 48 of the Ordinance whereby a rent of five shillings per annum per acre was paid.

The 1933 Ordinance provided for the 'reward claims' in that any holder of a prospecting right who discovered minerals in apparently payable quantities was in addition to the claims allowed by the ordinance, pegged five extra claims of the prescribed area, and applied to the Commissioner for registration of such claims as reward claims. The holder of a claim was therefore expected to enter upon the land which was the subject of the claim, and lodge the exclusive right to prospect and to remove

and dispose of the mineral in respect of which the claim had been registered.

Section 40 part 1 of the Ordinance provides the obligation on abandonment. In this respect, any person who would abandon the claim was expected to notify the Commissioner immediately of such abandonment. Any person who would abandon his claim and any person whose claim was forfeited was required to fill, fence, or secure to the satisfaction of the Commissioner all shafts, pits, holes and excavations in such a manner as to prevent people or stock from entering them.

In terms of the applications for leases, the ordinance required the application to be made accompanied by the payment of one years rent in advance at the rate prescribed. The applicant for a lease was therefore expected to show sufficient capital for working of mining operations on the area applied for. The duration of lease was granted for a term not more than twenty one years. The duration of lease was renewable at the expiration of the term originally granted and the lessee was entitled on payment of the prescribed fee to obtain a renewable of the lease for a further

term not exceeding twenty-one years upon the conditions which were then generally applicable to new leases.

The surface rights which the lessee enjoyed on the lands included in his lease were:

- a) to make all necessary excavations;
- b) to erect, construct, and maintain houses and buildings for his use and for the use of his agents;
- c) to erect, construct and maintain such engines, machinery, buildings and workshops and other erections as may be necessary or convenient; and
- d) to stack or dump any of the products of mining.

The ordinance also stipulated the provisions for the law relating to water, to lay water pipes and to make water courses, dams and reservoirs, and to divert from a natural water-course any water on or flowing entirely through the land, provided that:

- i) any water diverted not containing noxious or poisonous matter was to be returned to its natural channel before leaving such land
- ii) any existing rights to use any source of natural water supply was not disturbed.

The lessee had the right of the land surface included in his lease to construct and maintain all such tramways, roads, communications and conveniences as may be necessary.

Section 56 of the Mining Ordinances of the colonial period prohibited mining near public buildings, railways without the consent of the governor. A lease would not authorize the lessee to occupy or mine land occupied by a native village, a market, burial ground, and under land within one hundred yards of any government, public building, works, any market, burial ground, public road or of any railway without the consent of the governor.

The Ordinance gave the right the lessee and claim-holder to take timber available on the lands included within the area of his lease or claim. Cutting, taking and use of any tree when required for mining or domestic purposes was allowed provided

that they were liable for any fees or royalties payable under any law relating to forests.

3.1.3 Possession and Purchase of Minerals

The 1933 Mining Ordinances restricted other persons from possessing any minerals especially tin ore and mica in the unmanufactured state unless they were the holders of mining leases claims, prospecting licence or rights. The purchasers of minerals were expected to be the holders of a licence issued by the Commissioner on payment of the prescribed fee authorizing the person named to buy minerals. The duration of the licence granted for the purchase of minerals was valid for one year and was not transferrable.

The holder of a licence to purchase minerals was liable for the due payment to the Government of all royalties due on any minerals bought and was required by the Commissioner to give security for due payment of all such royalties.

3.1.4 Safety Regulations

The Mining Ordinance of 1931 contained regulations which were cited as "The Mining (Safety) Regulations, 1932. These regulations laid much emphasis on the protection of surface subsidences or cavities. In this situation, where mining operations have caused subsidences or cavities on the surface or where such were securely fenced and conspicuous notice boards were erected to warn other persons.

In some cases where excavations were made contrary to the regulations, the sites were immediately filled with loose rock, debris or earth by the persons responsible for such excavations, but on failure to do so, the initiative was taken up by the government at the expense of the owner of the mine. The disused prospecting works was therefore to be filled with appropriate material up to the ground level of the surface or otherwise securely fenced by the claim-holder or the holder of a mining lease of the ground.

The Mining Ordinances also took into consideration the precautions necessary to deal with poisonous and injurious

chemicals solutions used in the treatment of gold or other ores. The areas containing such chemical solutions were required to be fenced to prevent inadvertent access and notice boards were again to be erected in suitable places warning persons from making use of such water.

With regard to the open cast workings, the ordinance stipulated that an optimum angle of slope was to be determined and maintained from time to time on any mine workings to ensure the safety of mining operations. In the open face working of alluvial or of soil, gravel, clay, tailing, slimes, ashes, debris or other similar ground, no undercutting was allowed and unless securely timbered and no vertical face would have a height of more than 10 feet but such unsecured open face was worked in terraces or at an angle of safety.

The safety regulations of the ordinances provided guidelines on storage of explosives, such that not more than 100lb of dynamite or other explosives would be kept at any one time at any one place in a mine except in a registered "Explosives Magazine". In the instances where on the surface the quantity of

explosives was only 100 lb, or less, the same was kept in safe and secure wooden boxes which were placed not within 100 feet of anything liable to ignition, or of a furnace, steam boiler, entrance to or outlet of a mine, or a shaft in course of sinking. In a situation whereby the mine was closed down, all explosives were to be disposed of, and no explosives were stored in any such closed down mine without the permission of the Inspector of Mines.

Section 82(a) of the safety regulations prohibited any miner from conducting any blasting operations in a mine unless the miner was a holder of a blasting certificate. The holder of a blasting certificate was responsible for the safety of all persons not in the possession of a blasting certificate but working in the same place, and also was responsible in seeing that no person entered the place until the fumes and dust caused by blasting had sufficiently dissipated.

3.1.5 Preparation and Responsibility for Plans

The Mining Ordinance of 1933, under Section 110(a) underscores the need for preparation and responsibility for plans. In this connection, every mine where more than one hundred

persons were on the average employed underground, the manager would appoint a surveyor to be responsible for a general surface plan. A general surface plan on tracing cloth of the property appertaining to the mine, showed the boundaries of the various holdings, names of farms, the outcrops and dip of the reef or deposits, all open surface workings, shaft openings, bore-holes, buildings, water courses reservoirs, trailing sites, dumps, public roads, railways, permanent tramways, electric power lines, public telegraph and telephone lines, cable ways, main pipelines, fences, and all surface objects which it was needful to protect against undermining. The scale of this plan was either 1:500 or 1:2500.

The managers of mines were expected to deposit true copies of tracing cloth with the Commissioner of Mines, of the plans and updated at the end of each year. Section 117 of the ordinance stated that:

'No copies of the plans and sections mentioned in Regulation 111 or any information concerning them shall be given by the Mines Department to any unauthorized person; nor shall plans be open to the inspection of any

such person without the permission of the mine manager. Nothing in this regulation shall prevent the Mines Department exhibiting or supplying to the public maps showing boundaries of titles and topography.'

Section 117 shows that the responsibility of mine plans to be kept, and the copies of plans to be deposited with Commissioner of Mines as involving a confidential procedure.

In general, the Mining Ordinance of 1933 of the Colony and Protectorate of Kenya were designed to regulate the levels of mineral development. The ultimate authority to make and effect mining regulations laid within the hands of the Governor in Council, the Commissioner of Mines as well as other officers of the Mines Department. The staff of the Mines department during the colonial period were mandated to conduct a prosecution for any offence against the ordinance.

3.2 Post-Independence Mining Policies

During the post-independence period, all prospecting, mining and other rights and titles granted under the Mining

Ordinance, 1933 were repealed and placed under The Mining Act Chapter 306 (Kenya 1987). In the post-independence Mining Act Cap 306, little or no effort was made to review and make adjustments to the Mining Ordinance of 1933, thus the name was only changed but the content of the Mining Act is similar to the ordinance made in 1933.

In the Mining Act Cap 306, it is stipulated that all unextracted minerals (other than the common minerals) under or upon any land are vested in the Government, subject to any rights which by or under this Act or any other written law, have been or are granted, or recognized as being vested, in any other person. In comparison of Cap 306 with the Mining Ordinance of 1933, this post-colonial mining Act was derived directly from Section 5 which stated that the entire property in and control of all minerals and mineral oils in, under or upon any land in the colony were vested in the Governor in trust for His Majesty. In the post-independence period the Commissioner of Mines was given more powers in the administration of mineral development as compared to the colonial period whereby the Governor and other members of staff of the Department of Mines had more mandate to handle

matters pertaining to mining. This is particularly true for example in the mining ordinance of 1933 Section 18 part 1 whereby the governor had powers to grant an exclusive prospecting licence to any person who had a prospecting right or any person who employed a holder of a prospecting rights but Section 18 part 1 of the Mining Act CAP 306, the Commissioner of Mines adjudicated the task formerly under the powers of the Governor. However in some instances ~~where~~ the Minister of Environment and Natural Resources has authority to intervene in the mineral administration matters. This is again true in section 5 of the Mining Act CAP306 whereby the Minister may suspend the prospecting right or exclusive prospecting licence or the right to work a location of the person in default until the amount awarded has been paid and until the holder of the right, licence or location has deposited with the Government such further sum as security for any future payment as the Minister may demand, and if such payment and deposit is not made within such time as the Minister may consider reasonable the Minister may revoke the prospecting right, exclusive prospecting licence or forfeit the location of the person in

default. During the colonial period the Governor assumed the powers of a Minister according to the 1933 Mining Ordinance.

The Mining Act Cap 306 of the Laws of Kenya is therefore a duplicate of the 1933 Mining Ordinance with minor appropriate modifications. The major adjustments effected in Cap 306 revolved around the distribution of powers and responsibilities as well as restructuring the organisation of the Department of Mines. As outlined in the pre-independence period the mining regulations cut across a wider spectrum notable in areas of prospecting rights, mining extraction, leases, inspection and other miscellaneous regulations.

3.3 The Role of the Department of Mines and Geology

The broad responsibilities of the Mines and Geology Department, are mineral resources development and geological survey and research. These responsibilities comprise three distinct but complementary spheres; First is the formulation of policy relating to exploration and exploitation of the country's mineral resources and the subsequent articulation of these policies into a

system of legislative measures, once they have proved themselves to be workable. (Kenya, 1996).

The second role of the department is to control and direct mining related to the exploitation of known mineral deposits, which are non-renewable resources, for the benefit of the nation. The exercise of Government authority over mineral exploitation is undertaken by the department through the administration of an Act of parliament and a series of subsidiary legislation. Its powers extend to include safety inspections, the safety and welfare of workers in the industry and the safeguarding of the environment against pollution resulting from mining activities.

The third role of the department is geological exploration, survey and research, using geological, geophysical and/or geochemical techniques with the aim of establishing a national inventory of mineral resource data. The maintenance of this database, and the retrieval and dissemination of information, is vital for mineral resources planning and development.

The department of Mines and Geology has established that a wide range of minerals occur in Kenya. These are the Soda Ash,

Fluorspar, Barite, Gypsum, Salt, Dimension Stones, Silica, sand Kisii stone (soapstone), manganese, zinc, wallanstonite, graphite, kaolin, copper, nickel, chromite, pyrite, various clays, rare earth elements and phyrochlore, more of which have yet to be exploited. These minerals are found in the several geological environments notably; Archaen Nyanzian shield area of Western Kenya, the proterozoic Mozambique Belt, sedimentary rocks, and the volcanic rocks associated with the rift system. (Kenya 1996)

3.4 National Development Plan's Policy Framework

Immediately after independence, Kenya's production of minerals and processed minerals reached a value of about £2.5 million (Kenya, 1965). the rapid mineral development was impeded by the shortage of venture capital for intensive exploration, and by small size of basic industry to provide a local demand, and by the small size of the known deposits. Therefore, the objective of the governments mineral development policy during the 1966-1970 planning period was to discover and utilize deposits that would provide raw materials for local industrial development and to contribute to the country's export earnings.

The main effort was to be switched from extensive geological survey towards intensive, specific mineral development, and on the other hand local and overseas investors were to be induced so as to contribute to Kenya's mineral development. This was to be done through the provision of certain tax concession for those who undertook prospecting or mine development. The other area required to be addressed in the first planning period was the review of mining legislation especially the granting of licences or rights to private persons to search for, extract and sell minerals with provisions for disturbance to owners or occupiers of land.

During the second plan period (1970-74), the development of mining was still being held back by the fact that the industry was a highly technical activity which entailed large capital investments. The relevant skills and capital was required to be attracted from overseas to the country. The measures needed included guaranteeing the continuation of many titles over a period of several years and assurances in the levels of taxation, royalty and export duties (Kenya, 1971).

The third development plan (1974-78) accorded the highest priority to the search for oil, natural gas and geothermal energy. This was due to inadequate domestic energy sources which was a constraint to economic development. The second priority was to establish programme for training, upgrading and equipping technical and professional staff on a scale appropriate to the increased scale of responsibility to be undertaken by the Mines and Geology Department.

During the 1974-78 plan period, an average annual growth rate of 19.6 per cent was expected in terms of mineral production. The major source of increased production was expected to emerge from more intensive exploitation of worked deposits, and in particular a much higher output was expected from the mining of fluorspar and of lead, silver and zinc. In achieving the increase in output projected for 1978, substantial capital investment outlay was to be made by both the government and private enterprise. It was estimated that capital investment total was K£12.25 million of which the government was to contribute K£2.75 million (Kenya, 1974). The rest was to come from the private sector.

During the third plan period (1974-78), geological mapping and basic research studies were to be renewed with the object of completing the reconnaissance mapping of the country. In order to increase both professional and subordinate staff in the department of Mines and Geology, a special project of in-service training as well as a strengthening of technical records section was to be made available in 1974-78 plan period.

During the fourth planning period (1979-1983), the output of the non-metallic mineral industry increased tremendously from K£4.2 million in 1973 to K£7.7 million in 1976, and it was projected to grow at the rate of 8.6% per year to reach K£13.7 million by 1983. Major contributions to this total was expected to come from soda ash, fluorspar, limestone products and salt. (Kenya, 1979)

In terms of the Programme for Action, the government was to continue with the geological surveys programme involving regional mapping, economic geology and mineral prospecting and geothermal energy exploration. Education and training programme was also to be promoted in 1979-1983 plan period so

as to curb the problem of lack of qualified technical manpower. The training programme was to be designed to involve both undergraduate and post-graduate programmes (Kenya, 1979).

In terms of mineral marketing, in 1979-1983 plan period, the government did not intend to intervene in marketing mineral products except of essential commodities such as salt and cement which were to be subject to Government Control when the marketing and general distribution system proved to be inefficient. The government intended to make every effort to get full information on the production and export of gemstones during the plan period (Kenya, 1979).

The 1984-1988 Development Plan gave scant attention to the mineral development. In this period, the first attempt to care for the environment was introduced. In order to protect the environment, and avoid soil erosion and ground subsidence, the Department was to undertake the rehabilitation of disused mines and quarries which also posed hazards to both life and property (Kenya, 1984).

The 1989-1993 National Development Plan addressed the problem of mineral resource development and environment. During this plan period the government intended to carry out; geophysical surveys and research programmes, chemical prospecting for appraisal of mineral deposits and core drilling to carry out in-depth investigation of the economic potential of such deposits, and maintenance and continuous up-dating of the mineral inventory of the country. The government also intended to carry out effective measures to ensure the safety and security of mine workers in mining and quarrying industries during the 1989-1993 plan period (Kenya 1988).

The sixth development plan period in policy objectives were to ensure that the private sector took the lead in minerals development such that the role of the government remained to be that of promotion and encouragement by creating favourable incentive for both domestic and foreign investors.

The strategies for the 1994-96 plan period were to involve the undertaking reviews of policies and mineral legislation, and undertake promotion measures and publicity of the mineral

investment potential in Kenya. The government was to focus its attention on minerals which would support the agricultural sector thus ensuring food production and on construction materials for shelter.

In terms of promotion of mineral resources, the government was to redraft the mining laws with environmental considerations being incorporated and secondly to establish the Mineral Resource Data Centre. Other programmes included land reclamation of disused mines and quarries and revision of mapping in high mineral potential areas of Coast, Rift Valley, Nyanza, Western and Eastern provinces (Kenya, 1994).

The current development plan (1997-2000) pays scant attention to the mining sector. In this planning period a review of the Act which was initiated in late 1993 is expected to be completed so as to enhance investment in mineral exploration, and to ensure that the Mining Act matches the contemporary international mining practices. It will also provide for greater environmental protection from the undesirable effects of mining. The implementing agencies involved in the revision of the Mineral

Act are the Attorney General Chambers and the Ministry of Environment and Natural Resources and the time frame is 1997. (Kenya, 1996).

Generally, the performance of the mineral sector has been declining from the late 1980s. Mineral production in Kenya has been showing a downward trend in growth, declining at an average rate of 1.7 per cent from about 442,904 tonnes in 1988 to about 405,000 tonnes in 1992 excluding cement and cement materials. Soda ash accounted for 45 per cent of total mineral production. In current prices, the value has grown from K£27,956,000 to K£64,446,000 over the same period. Due to export incentives accorded to gold and diamonds, gold was exported to the tune of 1,923,021 grammes worth K£31,933,720 in foreign exchange in 1991 and 1,937,909 grammes worth K£31,876,087 in foreign exchange in 1992. Similarly, diamond jewellery exports earned the country foreign exchange equivalent to K£7,712,500 in 1990, K£77,397,920 in 1991 and K£616,796 in 1992. (Kenya 1994).

3.5 Summary

The pre-independence mining policies and legislation cut across a wider spectrum. They encompassed: the prospecting rights and exclusive prospecting licences, mining (extraction) regulations, leases, inspections and accidents (safety) and other miscellaneous mining regulations. These policies and legislations were contained in the Mining Ordinances of 1933 which had its genesis in the British administrative system. Immediately after independence, the same version was adopted with minor adjustments under the Mining Act Chapter 306 of the Laws of Kenya, which is currently in operation.

The role of the Department of Mines and Geology is to formulate policies relating to exploration and exploitation of the country's mineral resources and to carry out geological exploration, survey and research. The National Development Policies and programmes have accorded little attention to the mining sector. The rapid mineral development is impeded partly by the shortage of venture capital for intensive exploration, partly by the small size of basic industry to provide a local demand, and

the small size of the known deposits. In order to further promote mineral development, the government intends to carry out the geophysical surveys and research programmes and maintain inventory of the country. The major strategy for enhancing investment in mineral exploration and development should revolve around the review of the existing mining regulations to incorporate environmental conservation.

CHAPTER 4: PRODUCTION OPERATIONS OF FLUORSPAR IN KERIO VALLEY.

4.0 Overview

This chapter focuses on the production operations of fluorspar in Kerio valley. The Fluorspar mining company is the sole mining organisation of fluorspar in Kenya. In this section, therefore, the mechanics involved in extraction and processing of the fluorite ore is examined alongside with the employment situation because it contributes to the production levels of fluorspar. The analysis of the relationship between production, trends in employment and fluorspar sales is also covered under this chapter.

4.1 History of Fluorspar Mining in Kerio Valley

The main fluorite deposits of Kerio Valley which are located in the areas of Kimwarer, Choff and Kamnaon were first discovered in 1967 by a prospector searching for semi-precious stones. All-Amin, the prospector who initially mistook the purple fluorite evident in some of the outcrops for gemstone, started a

hand-mining operation at the rich deposits on Kamnaon ridge to supply fluorspar to the Bamburi Portland Cement Company Ltd, in Mombasa. The operation, which relied on donkeys to transport the fluorspar up the escarpment, produced at its peak approximately 400 tonnes per month of high grade fluorspar, it was bought out in 1971 by the newly formed Fluorspar Company of Kenya Ltd (FCK), which under the auspices of the Kenya Government planned to exploit the deposits on a much larger commercial scale (Jones, 1982).

FCK was owned 51% by the Kenya Government through the Industrial Commercial Development Corporation of Kenya, 24.5% by the Continental Ore Corporation Ltd, who were managing partners and 24.5% by the Bamburi Portland Cement Company Ltd. FCK aimed to use the deposits located at Kamnaon and Choff for metallurgical-grade fluorspar and the deposits at Kimwarer for acid-grade fluorspar. In 1971 the Company established a crushing and gravity jigging plant to produce metallurgical-grade fluorspar and also commenced construction of a road up the escarpment to give access to the

railhead at Kaptagat. Diamond Drilling of the Kimwarer deposits began and this located substantial quantities of fluorite ore which could support a large scale operation. Metallurgical testwork on this ore was carried out by the International Minerals and Chemical Corporation Ltd which by then had taken control of the Continental Ore Corporation Ltd. With assistance of the Denver Equipment Company a fluorspar concentrator with a design capacity of 10,000 tonnes per month, of acid grade fluorspar was erected and commissioned in 1975. The initial investment in the factory was Ksh. 43.5 million.

FCK continued to operate both the metallurgical and acid-grade operations, but in doing so it experienced a number of serious technical, sales and financial problems. The availability of suitable ore for the metallurgical-grade gravity jigging plant diminished and production fell to less than 10,000 tonnes per year in 1978. The acid-grade operation suffered from grade specification problems due to high silicon dioxide (SiO_2) grades in the concentrate thus making the product more difficult to sell in what was already a tight market at that time. Consequently, the

mining programme was geared to search for ores giving low SiO_2 grades in the concentrate. These problems, coupled with poor company financing, unsatisfactory operations, a lack of sales planning and shortage of spare parts for the plant and mining machinery, culminated in FCK being put into receivership in May 1979. The Kenya Fluorspar Company Ltd (KFC), a wholly owned Kenya Government Company, bought the assets of the old company in September 1979 and continued operation.

On taking control, KFC closed the metallurgical-grade plant and revitalized the acid-grade operation with an injection of operating funds which allowed the purchase of new mining machinery and spare parts for the concentrator plant. These measures effectively boosted concentrate production. The formation of KFC also coincided with an improvement in the fluorspar market, and this, along with some long term customer contracts, gave the company security and prosperity for over two years.

In the late 1980s and early 1990s, the Kenya Fluorspar Company faced a number of challenges which stemmed from

World Market fluctuation of fluorspar, inflation and the effects of the Structural Adjustment Programmes. Through Kenya Government's parastatal Reform programme involving the privatisation of some of the state owned corporations, Kenya Fluorspar was sold to the chemical manufacturers, a multinational corporation. The new management under the chemical manufacturers took over from KFC as from early January 1997.

4.3 Mine Planning and Milling Operations

The fluorite ore bodies mainly occur in Kerio Valley some ten kilometres long and about three kilometres wide at the foot of Elgeyo escarpment and stretch from Kimwarer ridge to Muskut. There are three major fluorite ore bodies or the mining sites notably, Kimwarer, Kamnaon and Choff ore bodies.

Kimwarer orebody is by far the most important and the largest containing some 3 million proven tonnes of fluorite. Most of Kamnaon fluorite deposits have been mined while the Choff ore body has a reserve estimate stands at about 500,000 tonnes. The mineral-based land was leased by the KFC.

4.3.1 Mine Planning

Prior to mining, an orebody is surveyed on a 1:250 scale. Detailed sampling of a block is then undertaken in cases where the ore is exposed. Block size is determined by the length of the strike along the contour and is limited to 12m depth due to drilling limitation. Sampling of the block is done by percussion drilling on an 8m x 8m with the flush clippings being analysed for calcium fluoride and calcium carbonate content.

These values are plotted, along with visible ore contacts and zones of barren ground, on a mining plan. Zones of low grade ore and barren ground are marked and reserves of the block are estimated. An average block has reserves of between 120,000 - 150,000 tonnes at grades of approximately 45% calcium fluoride. The footwall is maintained at a slope 60° dipping east where the ore occurs competent rock.

4.3.2 Mining Method

Mining is by open cast method with Hill II currently being mined (see Map 4.5). Overburden is removed by ripping and

dozing waste rock on the hanging wall down the slope of the hillside. Stripping is done by heavy mining machinery with giant rippers. The usual stripping ratio is about 1:1, without around 150,000m³ per year of waste being stripped at current levels of production. In order to extract an in-depth fluorite materials, explosives are used to fragment the hard core material so as to expose the fluorite ore.

The quarrying activities in KFC is undertaken by the department of mines which is also charged with the task of exploration and survey of the mine area. The whole process of extracting fluorite from the selected sites renders the land permanently degraded. This forms the genesis of environmental problems of mining in Kerio Valley.

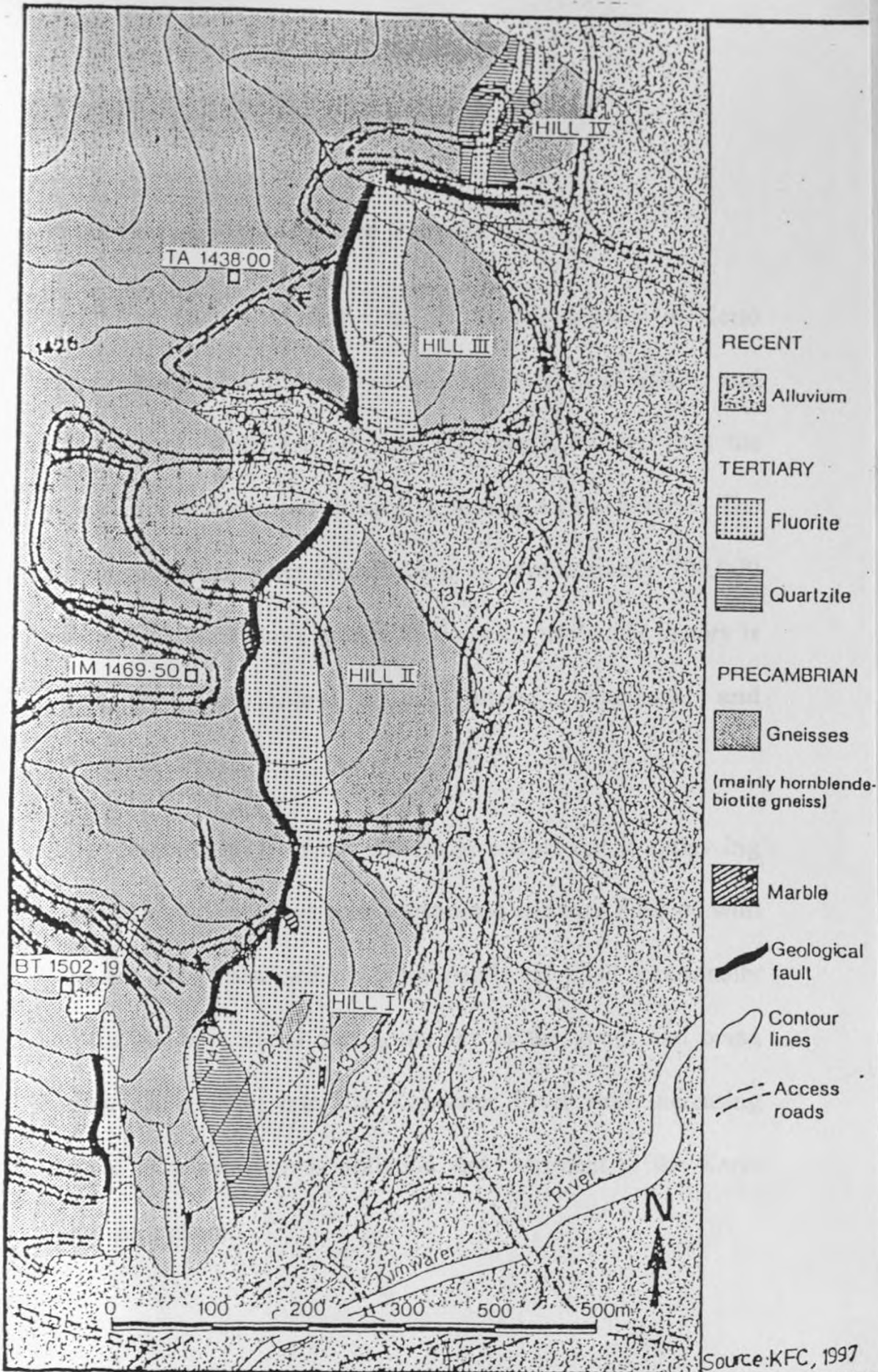
4.3.3 Processing

The fluorite ore is subjected to four main processing stages notably: crushing, grinding, flotation and dewatering. An accurate understanding of this intricate network of processing will help to

explain some of the environmental problems arising from this technology.

The fluorite ore is crushed at different sites, one about 6 km from the factory and the other at the factory. The crushing is done in a crusher jig. The crushed ore is ground in three grinding mills, one operating with iron bars and two with iron balls. The fluorspar is separated from the silica and iron oxides in a flotation process working at a pH of approximately 10.3.

Chemical reagents are added mainly soda ash, sodium oleate and mimosa extract. For each tonne of ore treated, approximately 4m^3 of water is required. Air is blown into the slurry, the sodium oleate adheres to the fluorspar, the air bubble adheres to the oleic acid and lift the mineral to the surface as a froth which is removed by paddles, further concentrated and dried. At the end of the process, the waste water (tailings) contains waste minerals as well as soda ash, resulting in a pH in the range of 9.5 - 10.



MAP 4.1: Geological map showing Hills I-IV of the Kimwarer orebody and indicating the approximate extent of the ore boundaries.

4.4 Waste Water Treatment and Disposal

The factory is sited close to the ore deposits in Kerio Valley, about 1 km upstream of the confluence of Kimwarer and Mong Rivers. Water for industrial purposes is diverted from the Mong River and pumped through a pipeline to the factory. The current industrial water consumption is approximately 700,000 gall/day (32,000m³/day). Water for domestic use on the factory is drawn from the Kimwarer and filtered, chlorinated and distributed.

Sedimentation of the effluent is carried out in rather big ponds. Three ponds have been constructed and then filled up with sand and silt. These sedimentation ponds get filled occasionally and the waste is stored during the day in the ponds and being discharged at night into the Kimwarer River thus increasing chances of causing gross pollution and detriment to the Kerio Valley ecosystem.

4.5 Production and Employment situation of Fluorspar Mining in Kerio Valley

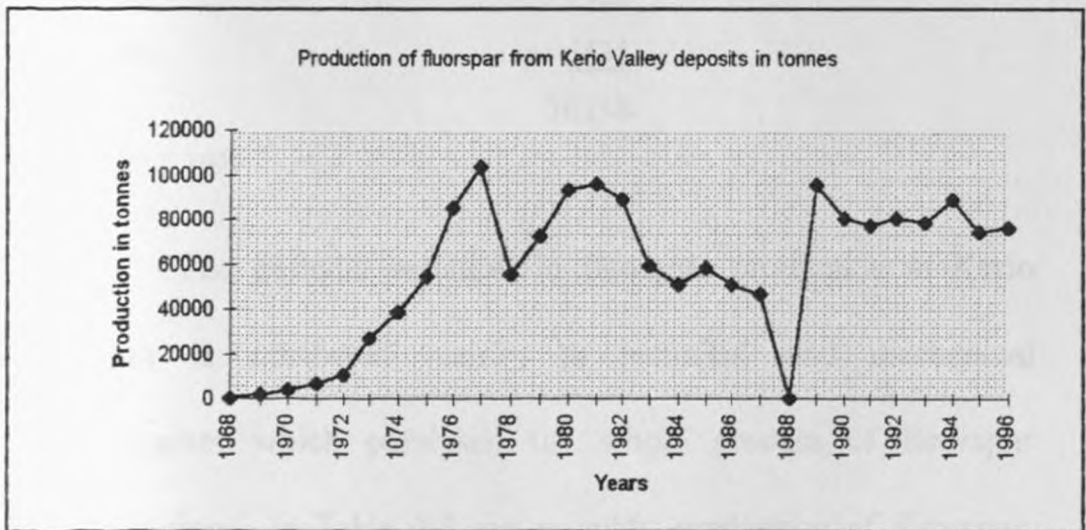
4.5.1 Production

The production of fluorspar from Kerio Valley deposits was undertaken initially by Fluorspar Company of Kenya (FCK) and later by Kenya Fluorspar Company (KFC) together with hand-mining operations. Over the years, there has been a continuous increase and fluctuation of fluorspar production. The quantity of fluorspar produced in Kerio Valley is determined by the customers demand specifications. Figure 4.1 shows the production of fluorspar in tonnes since its inception.

In order to match the production and demand levels of fluorspar mineral, the extraction and the milling networks involved in the production of fluorspar operates in the shift basis for twenty four hours. The quality of the material produced is ascertained by subjecting the samples which are taken after every half an hour from all phases of mineral production system into laboratory analysis. The laboratory unit advises the quality control section on

the courses of action necessary to be taken to maintain the acceptable quality of Calcium Fluorite in line to customers specification. The fluorspar mineral produced at different stages in the industry is blended as a way of arriving at the desired quality material required for export. Table 4.2 indicates the quantities of fluorspar produced from July 1995 and June 1996.

Figure 4.1: Production of fluorspar from Kerio Valley deposits (in tonnes)



Source: Kenya (1970 - 1996) Statistical Abstracts C.B.S

4.1 Monthly Production of Fluorspar

Month	Tonnes
July 1995	6465
August 1995	6689
September 1995	5881
October 1995	6899
November 1995	6084
December 1995	6344
January 1996	6762
February 1996	5175
March 1996	5834
April 1996	6169
May 1996	7301
June 1996	<u>6535</u>
	76138

Source: KFC, 1997

The periodic variation in fluorspar production in Kerio Valley is attributed mainly to technical and mechanical constraints which paralyses the whole process of fluorspar production. In Table 4.1, on monthly production of fluorspar, during 1995 / 1996 production period, the major downtimes recorded included; accumulating ore, lack of loading machines and cone crush repair. In the process section the major downtimes were; power interruption, power shading, accumulating crushed ore and the collapse of the primary cyclone

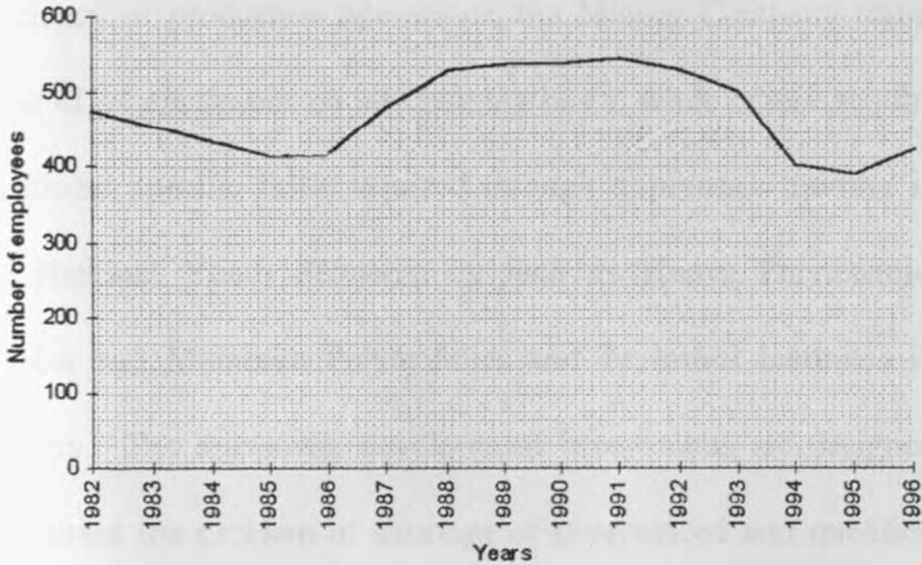
line. The net result of these operational constraints is that colossal sums of money are earmarked to normalise production operations and again more time is expended on the search for industrial spare parts and repairs, thus leading to continuous fluctuation of fluorspar production.

4.5.2 Employment Trends

Labour is one of the most important inputs required to propel the production operations of any industry. It can be obtained locally or acquired from foreign countries. The Fluorspar Company has experienced a continuous fluctuation in recruitment and training of its working staff since its inception. The current number of operatives involved in fluorspar mining stands at 423 permanent personnel and additional 150 labourers on a casual basis. The total labour force are classified into four broad categories notably, skilled, semi-skilled, unskilled and casuals. The senior and some junior staff fall on the skilled level of which there are about 300 people while 95 people are in the semi-skilled category. The unskilled and casual labourers are 28 and 150 respectively. Figure 4.2 shows the employment trends of

the Kenya Fluorspar Mining Company since 1982. Generally there was an insignificant decline in labour force of Kenya Fluorspar between 1982 to 1986 while tremendous increase was experienced in 1987 onwards. However in 1993 the Mining Company suffered from the consequences of the structural adjustment programmes executed by the government through the Parastatal Reform Programme. This programme rendered about 90 permanent staff redundant in 1994. The rationale for identifying the labourers retrenched was questionable, disheartening and unprocedural in that the principles of redundancies were not followed in accordance to Kenya Quarry and Mine Workers Union.

Figure 4.2 Employment trends at KFC in 1982 to 1996



Source: KFC, 1997

The Fluorspar mining Company recruits its casual and unskilled labourers mainly from Kerio Valley region and its environs while the semi-skilled and skilled personnel are drawn from all parts of the country. The company also hires two males foreign expertise to augment the locally available labour. The labour force is dominated by males who occupy the senior level positions and work mainly in the industry while the female counterparts work mainly in secretarial and clerical services. The reason given for this disparity is that most of the routine work in

the factory involve the task of handling heavy industrial materials and equipment not best suited for women. In order to enhance efficiency in production operations, the Mining Company trains some of its employees on job training basis, while others acquire additional specific skills required through apprentice training in the National Youth Polytechnics such as Kenya Polytechnic, Eldoret and Mombasa Polytechnics and Technical Institutes in Kisumu. The manpower development investments are designed to address the problem of shortage of experienced and qualified personnel in the mining sector.

The employees of the Kenya Fluorspar Company constitutes one of the branches of the Kenya Quarry and Mine Workers Union. About 350 KFC operatives are registered with the Union. The objective of the Union is mainly to take care of interests of employees through;

- 1) regulation for better terms
- 2) improvement of their living standards
- 3) reconciliation with workers and workers and employees and employers

- 4) handling of the grievances in favour of the employee in most cases
- 5) education of the workers concerning their rights
- 6) enlighten the workers on health and safety regulations
- 7) organisation of workers to agitate against common interest
- 8) negotiation for salary increment
- 9) promotion of democratic elections in the Union and,
- 10) education of workers against misconduct.

In the light of the objectives of KFC Union, the Union was successful in reconciling 6 workers who were wrongfully dismissed, with the employer. The problem of the company staff retrenched consequential from the terms of the Parastatal Reform Programme is yet to be resolved. Although the affected personnel hailed from all cadres, the criterion employed in singling out the labourers who lost their jobs was unprocedural. However the Union requires the employer to compensate the victims of

redundancies with an equivalent of 8-months salary, so as to iron out the contentious problem of retrenchment.

Besides the violation of the principles of redundancies by the employer, there are other instances pointed out which the employer has occasionally infringed. As indicated elsewhere that the Kenya Fluorspar Company is under the hands of the new management, which was effected through Parastatal Reform Programme by Kenya Government, the KFC Union branch was not involved in negotiations relating to the privatisation of the Mining Company. In view of the changes in the management of the Mining Company, the Union submitted a memorandum to the new management specifying among others; the modalities for change, outstanding grievances, health and safety conditions, medical services, and a proposed 75% salary increment to be made in 2 years in 40% and 35% phases of increment.

The other area of dissatisfaction identified by the Union and the employees in particular is the violation of the principles of promotion and demotion and procedures of employment which dampens the working morale of the mining operatives. It was

noted that some senior level staff are occasionally recruited from outside the company and promoted without consideration of merit and experiences.

4.5.3. Management Structure and Services

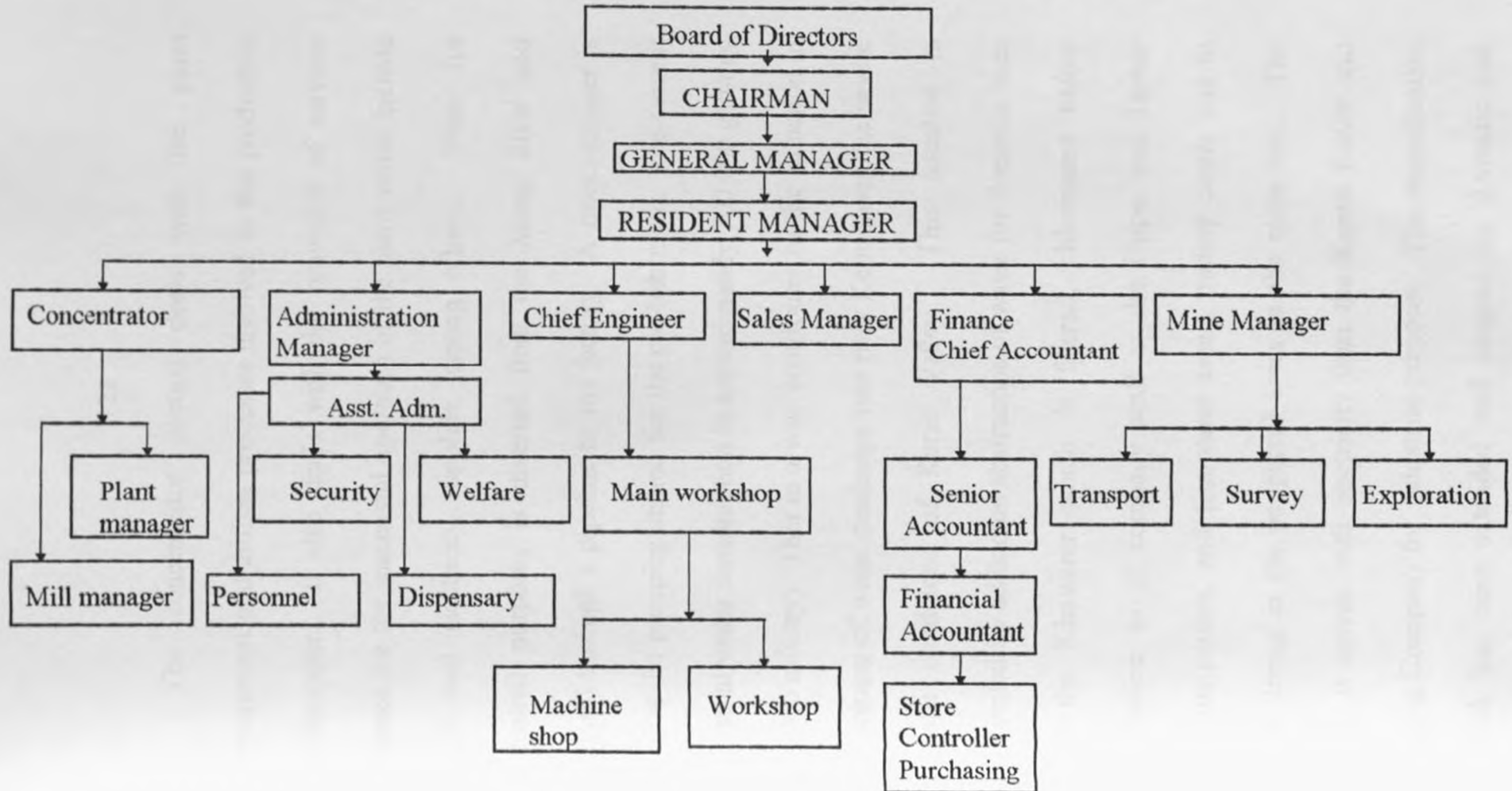
The production capacities of any industrial organisation can be better examined in terms of the organisational structure and the relationship between the sub-units of the organisation. There is a correlation between the levels of management organisation and production operations.

The top management of the Company is comprised of the Board of Directors. The members of the Board include: the Chairman KFC, the Permanent Secretaries of the Ministries of; Commerce and Industry, Finance, Environment and Natural Resources; and the Managing Directors of the Kenya Railways and Industrial Credit and Development Corporation (I.C.D.C). The Chairman of the Mining Company is answerable to the Board of Directors. The General Manager who is the Chief Executive of the Company is assisted by the Deputy General

Manager who is also the resident Manager of the Company. There are six main departments involved in management and organization of the Company notably: mining, concentrator, Engineering, Administration, Finance and Sales departments. These department report directly to the General Manager. Figure 4.3 shows the organisational structure of K.F.C.

The mining department is comprised of the sub-units dealing with exploration, survey and transportation. This section mainly deals with the mechanics involved in extracting fluorite deposits from the mine sites. Transportation function can be viewed in two ways; first the mining department deals with sub-contracting of the means of transport to haul fluorite ore excavated from the mining sites to the factory over a distance of over six kilometres, and secondly the transportation unit opens up new access routes to the mine sites as well as maintaining the main all weather road from Nyaru in the highlands to Kerio valley floor in the mine area. All other roads in the vicinity are also maintained by K.F.C., thus enhancing accessibility of the Kerio Valley region and its environs.

Figure 4.3 MANAGEMENT STRUCTURE OF K.F.C.



Source: Based on Field Data.

The concentrator section deals with the plant management and milling processes involved in the production of fluorspar. It also deals with the provision of services required for the successful operation of the plant which include water and electricity supplies, among others. Water for industrial purposes is diverted from the Mong River and pumped through a pipeline to the factory. A micro-strainer is used at the pumping station for the pre-treatment. The current industrial water consumption is approximately 700,000 gall/day (32,000 m³/day). This in a way contributes to the reduction in the volume of water discharge into river Kerio given the severe climatic conditions of Kerio Valley. This situation is aggravated by additional abstraction of water for domestic uses from the Kimwarer which is filtered, chlorinated before distribution to all company staff in the Upper and Lower Chebutie estates, and Kimwarer estate, trading centre and to people living in the peripheral areas in the mine area. The K.F.C. is served with electricity from the Kenya Power and Lighting Company for industrial purposes. The electrification network has been extended and adopted for domestic and

commercial uses by the people living and working in Kerio Valley region.

The department of engineering mainly deals with the maintenance of all the mineral-based facilities including mining equipment. The main workshop is comprised of the machine shop and the workshop. The latter is involved in the production and repair of office, residential and other welfare facilities such as furniture, doors and dispensary facilities among others. The personnel in this section occasionally provides similar services to the outside environment on part time basis independently from the company's working schedules thus contributing indirectly to improvement of the standard of living of the people living and working in Kerio Valley region.

The administration section of K.F.C. is charged with the responsibilities of personnel training and recruitment, provision of security operation of all the company's properties and that of their workers, management of health services and the welfare of all the employees. The Mining company runs and maintains a private clinic with free medical attention being given all

employees and their families. In addition these health services are extended to local residents in Kerio Valley region at nominal charges as part of the company's programme to foster good relations. In recognition of deficiencies and inaccessibility of health services in Kerio Valley, a Family Planning Private Sector (FPPS) which is a Non-governmental organisation funded the construction of a Maternal Child Health and Family Care (MCHFC) building in liaison with the Mining Company. The maternal child health and family planning services are provided in this unit free of charge by KFC dispensary. The AMREF donated a microscope which is manned by one health officer attached to the Ministry of Health but based at KFC health services. The KFC health unit makes use of the ambulance services to transfer patients with critical cases both from the employees and the local people to Eldoret and Plateau Mission hospitals for better medication attention. Therefore KFC contributes to the improvement of health aspects of the people living in Kerio Valley.

The welfare section of the department of administration deals with housing, domestic matters, cleanliness of KFC living

environments and provision of recreational facilities. In terms of housing, the welfare unit puts requisitions for services such as repairs through building and construction department. The section therefore looks into the affairs of about 238 housing units in Kiwarer Estate and 60 housing units in Chebutie Estate catering for junior and senior staff respectively. Other employees live in rental houses at Kimwarer and Kabokbok market centres. The other aspect of welfare service is the maintenance of good sanitation. This is done through collection of solid wastes and regulation of sewerage systems as well as tree planting activities within the living environments. Some of these sanitary services are utilised by the local people especially at Kimwarer Centre whereby the KFC uses its bowsers to dispose of the liquid wastes generated.

The welfare unit also provides and organises for a cross section of recreational facilities for both senior and junior staff together with local people willing to utilise the available recreational facilities. The sports facilities available include tennis courts, squash court, swimming, football, volleyball with clubs for both senior and junior staff. Some talented local

people occasionally play for KFC and even earn a living out of it.

The KFC runs a private primary school of high standard for the children of the company staff. This education service has been extended also to local residents at subsidised rates. The total student population of KFC Primary School stands at 450 with the majority of the children (350) coming from the local community. The Kabito Non-governmental organization sponsors ten bright pupils from poor families in Kerio Valley, every year at KFC school and makes a follow up to Secondary level thus benefitting the local residents. Therefore KFC has been used directly by NGOs as the entry point to the development of Kerio Valley.

The Department of Finance which is headed by the Chief Accountant and the Financial Controller deals with the financial aspects of the entire organization including all the departments. The sales department is based in Nairobi and is responsible for exports of fluorspar and imports of spare parts and other grinding media.

The sub-units of KFC are not only involved in production operations of fluorspar but also concentrate on the welfare of its workers and that of the people living in the mine area and its peripheral areas. The KFC has contributed to improvement of transportation network in Kerio Valley and thereby opening up the region for development in other spheres of life. An assessment of the effects of the mineral-based infrastructure to the socio-economic development will be covered in the next chapter.

4.5.4 Transportation and Marketing of Fluorspar

The by-product of fluorite is stockpiled in a concentrate shed before the material is transported by contractors to Kaptagat for railage. The distance from haulage to the railhead up the escarpment is about 45 km. There are over 30 contractors involved in the transportation fluorspar on 8-tonne lorries, but they are required to assure the KFC that fluorspar mineral is not contaminated in the process of transportation. The concentrate is stockpiled temporarily at the railhead at Kaptagat before it is dispatched in Kenya Railways Wagons to

the Mbaraki Wharf in Mombasa, a distance of 860 km, taking about four to seven days to complete the journey. Concentrate is again stockpiled at the port, before it is exported. Plates 4.1 and 4.2 shows fluorspar mineral being dried and stored at Kaptagat.

The quantity of fluorspar produced in Kerio Valley is a function of demand in the world market. The customers make orders detailing the quantity and quality of the fluorspar they require so that the mining company matches production and demand targets. Over 75% of fluorspar produced in Kerio Valley is exported to Netherlands. The other principal importers of fluorspar include: Germany, Greece, India, Japan and U.S.A. Fluorspar is used mainly by cement industry as an ingredient, and in glass and foundry work. In 1995 / 96 production period, the fluorite market was favourable and it fetched about Ksh. 436,581,860 earnings in terms of foreign exchange. Figure 4.4 shows the trends in terms of export earnings for the period between 1979 to 1986 in Kenya Pounds. Over the last three years KFC has considerably



Plate 4.1: shows fluspar mineral being off-loaded and dried at Kaptagat, 45 km from Kerio Valley. The train show in the background transport fluspar to Mombasa for export.

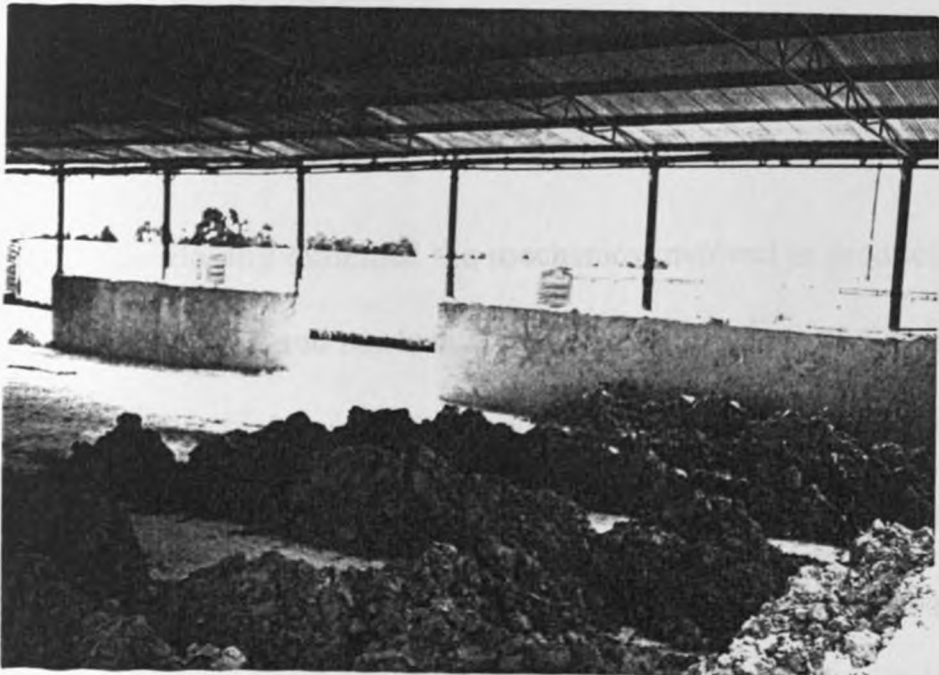
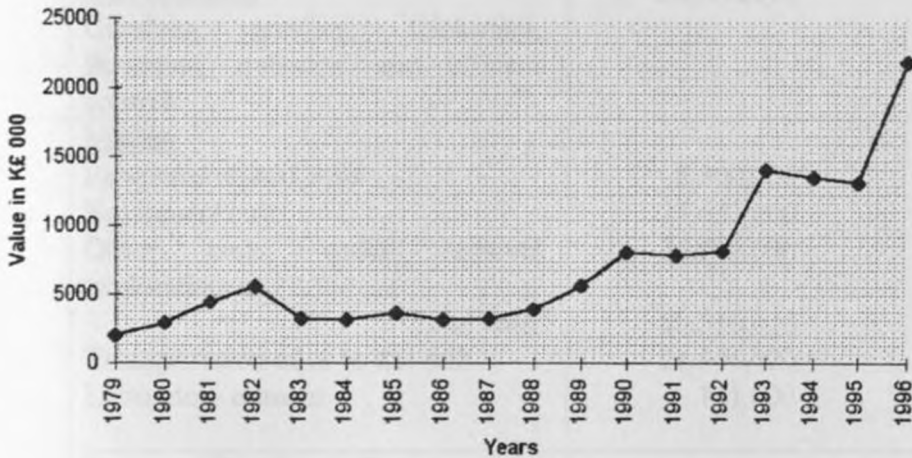


Plate 4.2 : Fluspar mineral is stored and protected from contamination at railhead at Kaptagat.

increased its production because of the availability of reliable fluorite market.

Figure 4.4 Export Earnings of Fluorspar in 1979 - 1996



Source: Based on Field Data

4.5.5 Production Operations Expenditure

Having examined the mechanics involved in production, transportation and marketing of fluorspar in Kerio Valley, it is imperative to focus on the expenses involved in each phase of mining operations. Owing to the sensitivity and confidentiality of the information, the information on expenditure over the past years could not be divulged. Table 4.2 provides a breakdown

of the company's expenses during the 1995 / 96 production period.

Table 4.2 : Expenditure of KFC from July 1995 to June 1996.

	Activities / Items	Costs in Ksh.
1	<u>Concentrator Production</u> : Overhead costs, personal transport, safety, protective clothes and others	9,617,000
2	<u>Mill operation</u> Crushing, grinding, thickening, floatation, pollution and effluent control.	94,000,000
3	<u>Mining</u>	
(i)	Personnel related costs	5,300,000
(ii)	Equipment costs	27,637,000
(iii)	Other costs, water removal exploration etc.	<u>26,579,000</u>
	Total costs	<u>59,516,000</u>
(iv)	Transportation of or to the mill	21,506,000
(v)	Laboratory element	131,000
4	<u>Storage, Loading, Transportation and Handling</u>	
(i)	Plant site to Kaptagat	29,400,000
(ii)	Kaptagat to Mombasa (Railage)	82,500,000
(iii)	Handling costs	11,500,000
(iv)	Other costs related to sales for salesmen travelling costs.	4,200,000
5	<u>Other Heavy Expenditure</u>	
(i)	General administration	17,000,000
(ii)	Finance cost	9,000,000
(iii)	Liaison office	3,700,000
(iv)	Finance department	3,800,000
(v)	Stores	6,000,000
(vi)	Medical	9,000,000
(vii)	Personnel and General Welfare	14,800,000
(viii)	Schools	2,000,000
(ix)	Security	5,000,000
(x)	Safety	400,000
(xi)	Building, Construction repairs	6,000,000
	Total expenses	389,070,000

Source: KFC, 1996

The structure of expenditure as shown in the table above provides a general assessment of the cost benefit analysis of fluorspar mining in Kerio Valley. During the 1995 / 96 production period, the KFC earned about Ksh 436,581,860 from the sale of fluorspar mineral. The total costs incurred in the production of 76,138 tonnes of fluorspar amounted to Ksh 389,070,000. The expenditure incurred in production varies from phase to another. The activities which command heavy expenditure; include mill operation, with Ksh 94 million (Table 4.2); mining (extraction), Ksh 59,516,000 and transportation which costed Ksh. 82,500,000. The net earnings of fluorspar during the 1995 / 96 production season was Ksh 47,511,860. Therefore the cost of production of the mineral is many times higher than the savings. There is need to narrow down the gap between the cost of production of fluorspar and the profit levels.

4.6 Relationship between production, export earnings and employment trends

Production of whatever quantities of fluorspar in Kerio Valley is generally in response to the prevailing world market

situation. The principal customers of KFC in overseas usually make orders and specifications regarding the quality of fluorspar required, so that production of the mineral is matched with the consumers demands. In examining whether there is any relationship between the production of fluorspar in tonnes and export earnings in Kenya Pounds, a correlation analysis was subjected to these two variables, based on production and export data available for a period of 27 years. The correlation coefficient output showed that r stands at 0.40 which indicates that there is a positive but fairly strong relationship between production in tonnes and export values of fluorspar. This implies that KFC has a fairly good potential for producing many more tonnes of fluorspar as well as increasing its export earnings. However, the Pearson correlation coefficient demonstrated that there is a weak but spurious relationship between employment trends and production of fluorspar, since r is 0.01 which shows that there is no significant relationship between the number of mining operatives and the quantities of fluorspar produced in Kerio Valley. Other confounding factors such as management and technology among others determine production of fluorspar.

4.7 Problems of Fluorspar Production in Kerio Valley

Although the opening up of fluorspar mining works has triggered off some important economic activities in Kerio Valley, its attempts to intensify production and attendant trickle down effects is constrained by several factors. The main problem facing fluorspar mining is inaccessibility of mine area and Kerio in general due to poor road network attributed to extremely rough and intractable terrain in the escarpment and several rivers and streams which call for construction of bridges to enhance accessibility of the region. All these boil down to limit the transportation of fluorspar, movement of people and other required services. This situation is exacerbated by the frequent landslides because of rains resulting in the main Nyaru road being blocked. The Company maintains the existing roads and bridges together with an airstrip which is operational, as a means of circumventing inaccessibility and remoteness of Kerio Valley region.

There are two contentious issues involving the mining company and the local community which is yet to be addressed, notably, the land boundary disputes and pollution of river Kerio which is the lifeblood of the Kerio Valley people. The land leased to the Mining Company originally belonged to the local residents and had not been adjudicated. The people who owned the mineral-based land were coerced to move out of their land without adequate compensation. There are also some areas of boundary conflicts which the Mining Company has to deal with in order to intensify its production. A feasible solution has not been formulated for resolving pollution of River Kerio. People living along the river cannot drink the water when it is polluted. Effluents from the mill require research and control to contain silt.

Other than poor road network which influences the cost of transportation, transportation of fluorspar is the most expensive undertaking given that change of modes is involved. The fluorspar mineral is transported by road to Kaptagat, then from Kaptagat to Mombasa by rail and finally by ship to the customers. In 1995/96 Production season for example,

transportation alone incurred over Ksh. 82.5 million, which represented a greater percentage of the total earnings of KFC. In addition the transportation schedule in line with the customers' demand orders and specifications is disrupted by Kenya Railways which transports fluorspar because they have other goods to carry to Nairobi and Mombasa. Consequently, this causes delays and therefore expiry and revocation of customers orders thereby affecting the cash flow position of KFC.

In terms of fluorite market, the quality produced in Kerio Valley faces stiff competition with other principal producing countries especially with China which operates the largest fluorite reserves and also enjoys its strategically placed position to the mass consumers of fluorspar in Europe. The quality of fluorspar in Kerio Valley is relatively poor in that it contains impurities such as silica, and phosphorus among others, present in large quantities, thus leading to production of material which cannot compete favourably with other major producers in the World Market.

4.8 The Future of Fluorspar Mining in Kerio Valley.

Unlike Soda Ash, fluorspar is a non-renewable mineral resource. Once fluorite is mined and exported it is gone for ever. This calls for rational management of this mineral resource. The projected life of the mine based on current proven ore reserves is a further 10-15 years but it is considered that an additional five years operation could be sustained on probable ore reserves as these are verified in the future (People, 1997). Rich deposits are reported further North in the Kolloa-Sigor area in Kerio Valley which could be explored as additional reserves.

It is likely that a competitive cost of production can be maintained for some years to come, with planned development such as extending phases involved in processing so as to remove present constraints on production and also upgrading the transport and materials handling section. However all these strategies will depend on the priorities of the new management which has just taken over the management and control of KFC as a private organization. Therefore many fundamental changes

are anticipated to be initiated by the new management whose motives are likely to be more of profit-oriented than protection of environment and welfare of the people living and working in Kerio Valley region. Finally the future of fluorspar will be determined by the World Market situation as it relates to the demand and supply of the mineral.

4.9 Summary

Kerio Valley is well endowed with fluorite deposits which have been extracted for a fairly long period by different organisations. Open cast method of mining is used in extracting the material from four sites in Kerio Valley notably, Kimwarer, Kamnaon, Choff and Muskut. The fluorite ore extracted is subjected to four phases of industrial production involving crushing, grinding, flotation and dewatering. The chemicals which are added in production process include; soda ash, oleic acid and mimosa extract. The tailings (effluence) is discharged into river Kerio without treatment thus contaminating this surface water source which is the key resource in the Valley support system.

Since its inception in 1971, there has been a continuous fluctuation in the production, employment and the export earnings of fluorspar. The marked decline of fluorspar production was as a result of the restructuring of the company's operations which began in 1993. During the 1995 / 96 production season the quantity of fluorspar produced was 86280 tonnes and fetched Ksh 436,581,860 earnings in terms of foreign exchange. The KFC incurs colossal sums of total sales on mill operation, extraction and transportation of fluorspar for export. The major constraints facing fluorspar mining are; inaccessibility of Kerio Valley in terms of road network which influences transportation costs, and world price fluctuation of fluorspar mineral.

CHAPTER 5: THE SOCIO-ECONOMIC AND ENVIRONMENTAL EFFECTS OF FLUORSPAR MINING IN KERIO VALLEY

5.1 Overview

This section gives the socio-economic and environmental effects which have arisen as a result of fluorspar mining operations in Kerio Valley. It is worth noting that fluorspar mining operation is one of the national projects and therefore its spillover effects have not only been felt in the mine area and its peripheral areas but also in Kenya and Keiyo district. This is particularly true because the export earnings and the revenue obtained by Keiyo County Council is earmarked for general national development. In this Chapter, analysis of the benefits accrued to the people living in the mine area and its environs by the mineral-based infrastructure is presented.

5.2 Income Generation

The fluorspar mining in Kerio Valley is ranked second to Magadi in the mineral sector in terms of the contribution of mining

to the Gross National Product (GNP) in Kenya. Fluorspar mining generates revenue for development projects and earns foreign exchange. Table 5.1 shows a comparative analysis of the average export price of fluorspar and soda ash in 1991 - 1995. Fluorspar mining, like soda ash play a very significant role in Kenya's economy.

Table 5.1: Average Export Prices of Fluorspar and Soda Ash in 1991 - 1995

	K£ per tonne				
Mineral	1991	1992	1993	1994	1995
Fluorspar	111.50	108.46	181.73	191.91	176.00
Soda Ash	191.70	235.29	375.95	421.17	133.00

Source: Economic survey (1996), CBS.

The earnings have found their way into the generation of development of the economy as it increases the productive capacity of the economy, and encourages the increase in the importation of other goods required by the country.

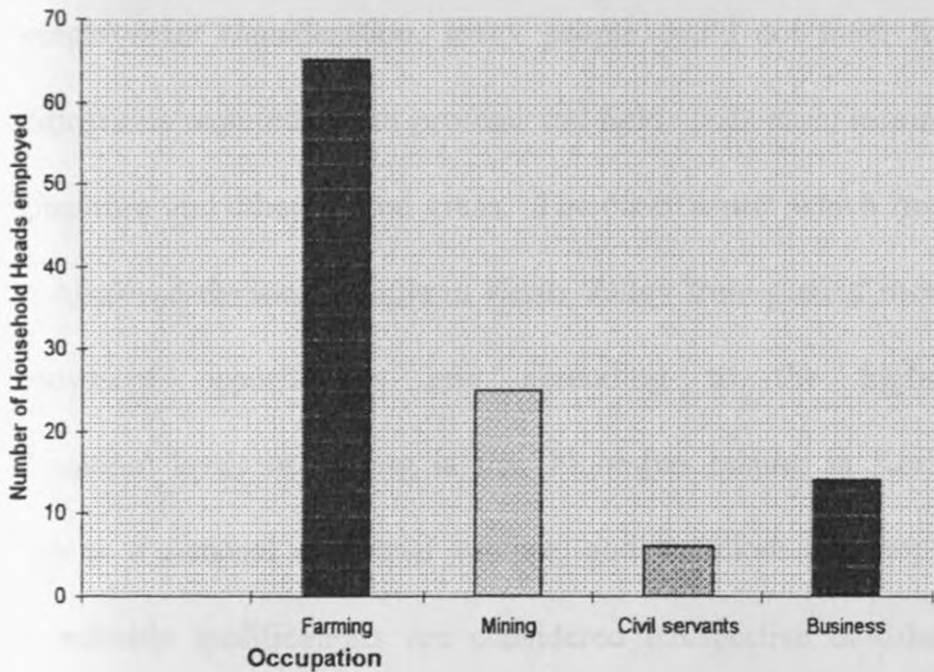
The government revenues in the mineral sector are principally based upon royalties and tax payments. The Kenya fluorspar mining operations pays Ksh 453,675 in terms of land

rates to Keiyo county Council annually. The fluorspar mining has therefore continued to strengthen the council's resource base and hence its ability to meet the mandatory and permissive development obligations.

5.3 Employment Generation

Since its inception in the early 1970s, Fluorspar mining has continuously generated employment opportunities for some Kenyans and foreign nationals. As indicated in Chapter 4, the current labour force in Fluorspar mining stands at 423 and the additional 150 casual workers. It was observed that majority of the local people in Kerio Valley are working at unskilled or semi-skilled levels. In terms of occupational analysis, out of 110 households interviewed, 22.7% said that at least one of the household members was working with the Fluorspar mining company at non-skilled or semi-skilled levels. Figure 5.1 shows the types of occupation of the household heads in Kerio Valley.

Figure 5.1: Comparative analysis of household heads employed in mining sector vis-à-vis other types of occupation:



Source: Field survey

The Mining Company employs some of the local people who are exclusively engaged in manual labour involving the breaking of the fluorite ores before conveyance into the crushing phase of industrial processing. It was also observed that a negligible number of local people had been absorbed in the semi and skilled cadres in the fluorspar mining operations. This is particularly confirmed by the fact that most people in Kerio Valley have low levels of education. Out of the 110 households

interviewed, the average educational level for most of the respondents was that of the lower primary level, therefore in terms of employment consideration, many people could not meet the qualifications required in the professional fields such as in mining Engineering and other related areas. The other aspect which may have hindered the local people in Kerio Valley from getting more employment opportunities and ascending to the higher professional levels in mining is that Fluorspar mining in Kerio Valley is a national industrial venture, and therefore all people with suitable qualifications are considered irrespective of other parochial priorities. This is supported by the fact that there are indications that people who originally owned land and lost to the Mining Company were not considered for employment nor adequately compensated.

The bottom line of the creation of employment directly or indirectly by the mining operations in Kerio Valley is the increase in the purchasing power of the working people which have stimulated the demand for locally available agricultural products and services, thus opening up new dimensions in Kerio Valley for local people to venture in. Other than creation of employment,

fluorspar mining is in a way taking part in training a skilful work force necessary for modern industrial development.

5.4 Development of Transport and other Infrastructure units

The location of mineral workings in Kerio Valley has opened up the region for development by providing transport facilities, electricity and water development among others. These mineral based infrastructure have been extended to benefit the people working and living in Kerio Valley south.

5.4.1 Development of Transport Facilities

During the initial stages of mining operations, the major constraint of fluorspar mining was inaccessibility of the mining site owing to extremely rough terrain as indicated in Chapter 4. The Fluorspar Mining Company which was formed in 1970 responded to the problem of poor transportation network by constructing a 24-kilometre all weather road from Nyaru to Kimwarer at a cost of Ksh 4 million; thus opening up the area to the outside world. Plate 5.1 shows the position of KFC's private road. The Mining Company has also constructed a bridge over the

Mong River which carries small cars, bicycles and pedestrians. A similar bridge has been constructed over Kimwarer river. In addition to these two bridges, there is a foot bridge which is used by company employees, people in the area and Kimwarer, primary school children over Kimwarer river.

The Mining Company maintains all the roads in the nearby vicinity of the mine and the road up the escarpment. As indicated in Chapter 4, the transport unit of the mining department undertakes all responsibilities involved in transportation of the ore from the mineral sites to the factory and from the factory to the railhead at Kaptagat, as well as carrying out the rehabilitation and maintenance work of all the roads in the mine area and its environs. This is effectively performed in liaison with the Keiyo County Council which provides fuel to the Mining Company which in turn uses its mining equipment to murrum the existing roads. The major constraint in road development is the frequency of landslides arising from rains which result in the main Nyaru road being blocked.

Although roads developed in Kerio Valley South are geared exclusively to the fluorspar mine, they have enhanced accessibility of the region. At the time of establishment several hardships were already experienced by the people of the area who were almost cut-off completely from the other developed areas by lack of transport and communication. The Company employees and other people in the area used to go to Eldoret and other places using the Tambach road, but with the construction of the 24-kilometre road to Nyaru by KFC, the distance to Eldoret and other places was ultimately shortened by so many kilometres. In addition, the bridges constructed over Kimwarer and Mong rivers have linked Soy Division and Sacho Division in Baringo district thereby facilitating the movement of people, goods and services in Kerio Valley. The common modes of transport utilised by the people living in Kerio Valley are mainly the lorries subcontracted by the Kenya Fluorspar Company. Out of the 110 households interviewed in the study area 91.8% noted that there was shortage of public transport and uses KFC lorries as alternative to travel via Nyaru and Kaptagat to get public means of transport for travelling to Eldoret and other places. The rest of the



Plate 5.1: shows an All weather road constructed by KFC using fluorite bearing rocks. Notice that electrification and telephonization services have been extended to Kerio Valley.



Plate 5.2: Shows the position of an All-weather dirt Airstrip for light aircraft maintained by KFC.

respondents, 8.2% occasionally uses the KFC lorries and bicycles as modes of transport. Therefore the mining operations have not only created passable roads but also provided a reliable means of transport through sub-contracted lorries transporting fluorspar to Kaptagat. About 8.5% of the total respondents interviewed ranked 'improvement of transport' as the most important contribution of Fluorspar mining operations in Kerio Valley.

Other than road transport, the fluorspar mining company runs and maintains an all-weather Airstrip for light aircraft at Chepsirei area. The airstrip was constructed for the purpose of dealing with emergency requirements by the mining company. The airstrip has in the past been used by the government in beefing up security in Kerio Valley, as well as fighting against the outbreak of the Yellow Fever pandemic in Kerio Valley especially in 1993. Plate 5.2 shows KFC's Airstrip. There were no indications of the utilisation of air transport by the people living in Kerio Valley. It was also noted that people of Kerio Valley who had migrated to other areas are returning to the area now because of improved transportation.

5.4.2 Health and Educational Facilities

Apart from the following assets owned by the Mining company; a Floating Mill which costed 49 million shillings, offices, jigs and crushes, modern residential buildings for its employees; recreation facilities and heavy earthmoving equipments worth millions of shillings, the Company has also put in place the health and educational facilities. As indicated in Chapter 4, a primary school of high standard is provided with free medical attention given to all employees and their families. In addition, all education and health services are extended to the local residents at nominal charges as part of the Company's programme to foster good relations.

The task of provision of health and educational services is the responsibility of the department of administration of the Company. The Mining Company's dispensary diagnoses the common diseases such as malaria, typhoid, diarrhoea, upper respiratory infections and malnutrition especially among children. The other health services provided include the maternal child health and Family planning. In recognition of the quality services

rendered by KFC, the government provided one officer from the Ministry of Health to man the Company's medical laboratory.

The average number of cases diagnosed per day are over 50 of which there are more cases reported from the local residents than the Company's employees. The cost of medical services varies from one case to another, but the mean health service charges for minor cases such as malaria is about 200 shillings per head. However in the event of the inability of patients to pay, the Mining Company's dispensary shoulders the responsibility of meeting the medical bills of such extreme cases. Out of the total of 110 households interviewed in Kerio Valley, 59.6% noted that they utilise the health services of the Mining Company more than the public dispensaries and the herbal medicine. Table 5.2 shows the relationship between places of medication and occupation of household heads living in Kerio Valley.

Table 5.2: The relationship between occupation of the household heads and utilisation of health facilities

Household Occupation	Places of medication							Row Total	% Total
	Eldoret	KFC	Muskut	Chepsirei	Herbal medicine	Other			
Farming	5	35	9	3	11	1	64	58.7	
Mining	1	19	1	1	3	--	25	22.9	
Civil Servant	--	4	1	--	1	--	6	5.5	
Business	--	7	3	--	4	--	14	12.8	
Column Total	6	65	14	4	19	1	109	100	
% Total	5.5	59.6	12.8	3.7	17.4	0.9	100		

Pearson's R = 0.05905 Significance = 0.87787

Source: Field data

Table 5.2 shows that many farmers and people of Kerio Valley who are engaged in mining utilise Kenya Fluorspar's dispensary. However there is positive but weak relationship between the household heads occupation and types of medical facilities used. The correlation coefficient r is 0.05905 while its corresponding significance is 0.87787. These shows that there is almost no significant relationship between the two variables at all. Other rival factors such as distance to place of medication and

communication could explain better than occupation accessibility of the households to health facilities.

The Mining Company's health facility is popular among the residents of Kerio Valley and even the highlands owing to the availability of adequate drugs and other related health equipment. The catchment of KFC health services stretches as far as Chepsirei, Kocholwo, Muskut, Simit, Kalwal, Turesia and Kapkelelwa in Baringo district. Some patients requiring medical attention in public dispensaries are referred to KFC for treatment. The Mining Company makes use of its ambulance vehicle to transfer patients from Kerio Valley to Eldoret and other hospitals for urgent medical attention. The Mining Company is therefore playing a benevolent role in terms of combating human diseases and therefore supplementing the available public health services in Kerio Valley.

Many people in Kerio Valley want their children to attend Fluorspar Primary School (KFC private school) and to be given medical treatment. The population of pupils in Fluorspar primary is currently over 450 pupils of which over 77.8% (350 pupils) are

children of the people living in mine area and the peripheral areas while the 22.2% (100 pupils) are the KFC employees' children. The local people pay 30 shillings fees per pupil per month while the children of the Company employees are educated free of charge. Owing to better educational facilities available at Fluorspar primary school, the local people compete for the limited vacancies such that the Company finds it difficult to cater for the increasing number of pupils. The World Vision, NGO sponsors ten bright children from poor families in Kerio Valley but schooling in Fluorspar primary school every year and extends similar gesture up to the secondary level of education. The catchment of Fluorspar primary school is limited to the families living in the mine area especially at Kimwarer, Kabokbok and Chepsirei sublocations. Table 5.3 shows that about 21.8% of the respondents interviewed had their school going children at the Company's private school.

Table 5.3: The distribution of primary schools utilised by the Valley residents.

Primary school	Number of households	% of the total
Sesia	27	24.5
Muskut	28	25.5
Fluorspar	24	21.8
Chepsirei	16	14.5
Soy	9	8.2
Other	6	5.5
	110	100.0

Source: Field data

Fluorspar private school is not the only available school in Kerio Valley, there are other schools such as Sesia, Muskut and Chepsirei primary schools, and Soy, and Kimwarer secondary schools. Nevertheless the Mining Company's school has benefitted the households in Kimwarer area and its environs by way of relieving the households of the burden of building and equipping schools as it is undertaken by other people living in Kerio Valley, and also enhancing the quality of education because of the readily available educational facilities.

5.4.3 Electricity and Water Supply

Power and water are ingredients required to propel any industrial production. The Mining Company is served by electricity from the Kenya Power and Lighting Company, and used for industrial and domestic uses. As indicated in Chapter 4, water for industrial purposes is diverted from the Mong River. The current water consumption is approximately 700,000 gall/day (32,000m³/day). Water for domestic use on the factory is drawn from the Kimwarer and filtered, chlorinated and distributed. Most of the permanent employees are housed by the Company and given free water and electricity. The engineering department is mandated to regulate electricity and water consumption.

Having supplied the Mining Company with electricity, the Kenya Power and Lighting Company has since then responded by meeting the energy demands of the local people, consequently electrification process has been extended to most of the commercial and administrative centres as well and institutions in Kerio Valley. The Mining Company helps the households to get piped water supply from their main water scheme. All that KFC

requires in order to facilitate effective water supply to the people living in the mine area and its adjoining areas are the water pipes needed for water connection so that technical aspects involving plumbing and water regulation is performed by the Mining Company. The Mining Company expediently ventured into water supply exercise as a response to public outcry on fluorite contamination of surface water sources consequential from the discharge of industrial effluence. A number of households in Kerio Valley have benefitted from the Company's water supply system, for instance 11.8% of the total households interviewed had KFC piped water connection, while 20.8% and 68.2% utilises community piped water supply and rivers and streams respectively.

In terms of screening of the association between the household income and the type of water connection and water sources utilised by Kerio Valley residents, it was established that there is no significant relationship between the household income and the types of water sources available. The correlation coefficient r is -0.21972 which indicate that there exist a very weak but negative relationship between the two variables and therefore

insignificant. Table 5.4 shows the relationship between household incomes and type of water connection. Other overriding factors which explain the relationship between household income and the type of piped connection include, distance to the water point and other sources of water.

Table 5.4: Cross tabulated values of household income and water sources.

Income Category	KFC Connection	Community Piped Water	Other	Row Total	
< 3000	2	12	36	50	45.5
3001 - 6000	8	5	33	46	41.8
6001 - 9000	1	3	2	6	5.5
9001 - 12000	--	1	4	5	4.5
> 12000	2	1	--	3	2.7
Column Total	13	22	75	110	100
	11.8	20.0	68.2	100	

Pearson's R = -0.21972

Significance = 0.00760

Source: Field data

The business community on the other hand has adopted the use of electricity to enhance and promote their commercial activities. The Jua Kali Sector and other small scale industries in Kimwarer, Kabokbok and Chepsirei use electricity to boost their production. Over 72.1% of the total businessmen (44) interviewed at four trading centres have adopted the use of electricity in their business premises, while piped water supply is limited to some

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businessmen at Kimwarer Commercial Centre owing to its proximity to the mining complex. The KFC supplies piped water to both households and businessmen at Kimwarer area free of charge while electricity bills are met directly by the consumers, which include other than the businessmen, schools such as the Kimwarer and Soy Secondary Schools and Chepsirei National Youth Service (NYS) Camp. Despite the fact that fluorspar mining activities have made it possible for electricity to be closer to the households in Kerio Valley, it was observed that none of the households interviewed had adopted the use of electricity as a source of energy. This is because, first many people have low incomes and therefore cannot afford electrification and secondly there is abundant supply of fuel wood in Kerio Valley especially in the mine area and the escarpment. The common sources of energy used by all respondents, in Kerio Valley are mainly wood / charcoal fuel and paraffin for lighting.

The main method of managing domestic liquid wastes by the Mining Company is the main sewer which handles the wastes from Chebutie and the Kimwarer Estates. The lagoons system is used for the treatment of water before it is discharged into river

Kerio. The welfare section of the administration department monitors all the matters regarding sanitation in the residential areas of KFC. The businessmen at Kimwarer have taken advantage of regular water supply by adopting septic tanks as methods of sewage disposal system. However, the valley people have not shifted from the traditional method of waste disposal as exemplified by the fact that out of 110 households interviewed, 51.9% had no toilets, 1.9% use septic tanks, while 46% had pit latrines constructed. The solid wastes generated in the mine area are collected and disposed of by the Mining Company in the pits created. The valley households manage the solid wastes through pit dumps and burning of the refuse, of which 61.1% use this method, while the rest (38.9%) households merely throw the wastes generated to their farms. Unlike the urban areas solid wastes in the valley do not present major problems.

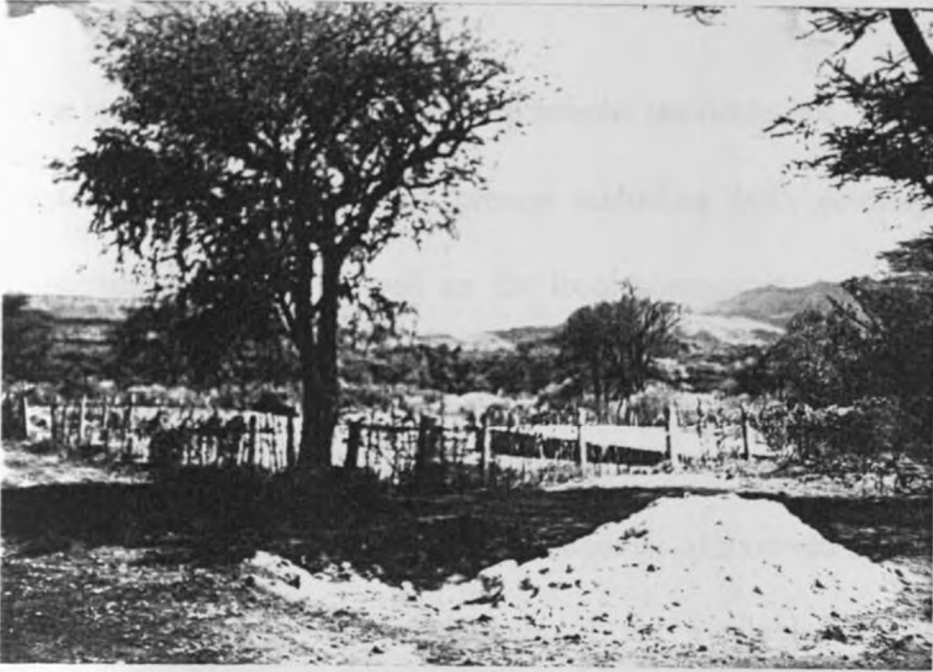


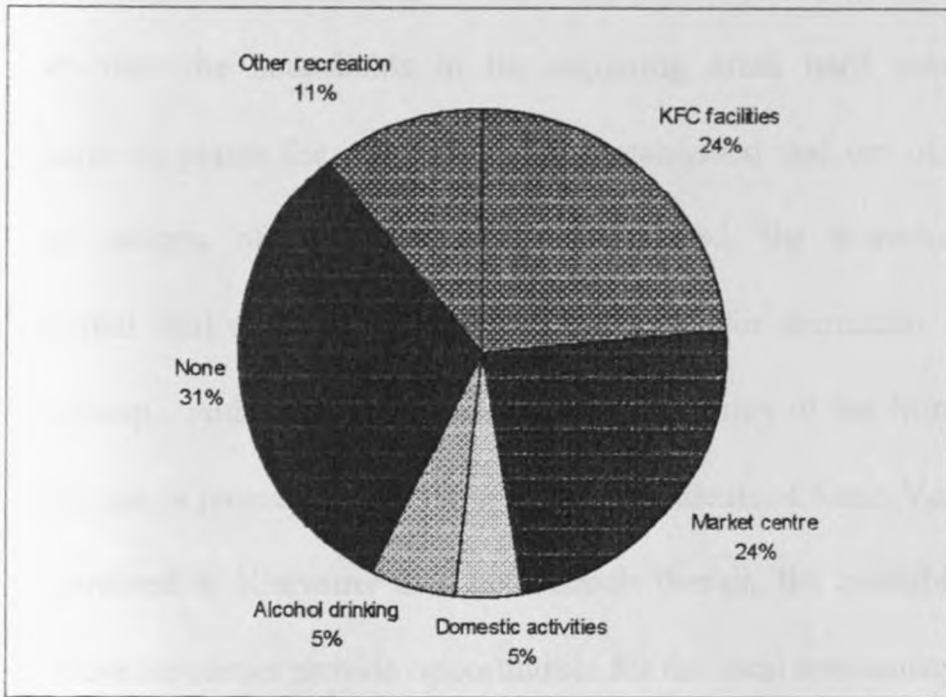
Plate 5.3: shows the position of waste disposal site in the mine area. The white material dumped on the foreground is the fluorite residue.

5.4.4 Recreation

The mineral-based recreational facilities and activities designed for use by the Company employees and their families constitute; tennis courts, squash court, swimming pool and volleyball with clubs for both senior and junior staff. The Welfare unit of KFC is mandated to adjudicate and administer all recreational activities. It prepares and keeps clean all the playgrounds at Kimwarer and Chebutie residential areas. Although it is not part of the Company's programme to cater for

the recreational needs of the local people, the doors are open for all interested individuals and groups including both primary and secondary schools as well as the local community to utilise the existing recreational facilities. In terms of assessment of accessibility to recreational facilities by some household members in Kerio Valley, 23% of 110 households interviewed noted that they occasionally take advantage of the available recreational facilities of the Mining Company. Figure 5.2 shows the recreational patterns and facilities utilised by the Kerio Valley people.

Figure 5.2: The recreational activities and facilities of the Kerio Valley people.



Source: Field data

Among the household members interviewed, utilisation of the recreational facilities is regarded as the domain of youngsters. It was also observed that some old and young people spend their time in social interaction involving drinking of illicit brews. Out of the total of 110 respondents interviewed, 5.4% households said that at least one of the family members occasionally indulge in drinking of the local brews as part of their leisure. The adoption

of the mineral-based recreational facilities by the local people in Kerio valley tended to diminish with distance from the mine area such that the households in the adjoining areas used market centres as places for recreation. It was established that out of the total sample of 110 households interviewed, the households reported that market centres served as areas for recreation and shopping. Although the catchment of accessibility of the Mining Company's recreational facilities to most residents of Kerio Valley is confined to Kimwarer area and schools therein, the availability of these amenities provide opportunities for the local community to keep themselves occupied rather than concentrating in other undesirable social activities. Plates 5.4 and 5.5 shows the position of recreational facilities in Kerio Valley. In addition the Company recruits locally talented youths into their sports organization to play for the company against other related organisations, and in so doing the local representatives earn their living indirectly from KFC.



Plate 5.4: shows the playing-field at Kimwarer area which serve as the main recreational place for residents of Kerio Valley. The KFC canteen is situated at the background.



Plate 5.5: shows the position of additional sports facilities for indoor games at Chebutie area.

5.5 Development of Commercial and Trading Centres

Prior to the discovery of fluorite mineral and its subsequent development, the valley was originally occupied by simple herdsmen and others were engaged in subsistence farming on the fluorite bearing areas. With the advent of fluorite oriented industrial concern in Kerio Valley, employment opportunities were created, this called for the demand of housing and other services required by miners and therefore mushrooming up of the commercial and trading centres tailored to the needs of the employees of the mining company. Prominent among the centres which sprung up were Kimwarer, Kabokbok, Chepsirei and Muskut, trading centres. With the opening up of the 24-kilometre Kimwarer and Nyaru All weather road it stimulated the growth of other relatively small centres notably Turesia and Nyaru trading centres. Kimwarer is the dominant commercial centre which owes its genesis and growth to the influence of fluorspar mining activities. Other than Kimwarer, other centres in the mine area have not been planned and lack infrastructure such as schools, hospitals, electricity and water among others. In addition to the

growth of these commercial and trading centres, periodic markets dealing mainly with the sale of livestock, clothing, foodstuffs and other essential commodities occur at Kimwarer, Kabokbok, Chepsirei, Mogorua and Kapkono trading centres. The periodic market at Kimwarer area takes place within the mining company's premises.

The most significant contribution that fluorspar mining continues to play is the creation of demand for locally available goods and services in Kerio Valley. The mining company has opened up new dimensions in business and other related services necessary to sustain production operations. The type of business establishments identified in the major centres in the mine area include; Wholesale and retail trade; restaurants, butcheries, tailoring, workshops and carpentry, posho mill; shoe-making and the sale of second hand clothes. Some residents in Kerio Valley and employees of the mining company have set up their business in Kimwarer, Chepsirei and Kabokbok trading centres. Out of the 44 businessmen interviewed, 61.4 %, and 6.8 % respondents were Kerio Valley farmers and workers of the mining company respectively. In terms of the duration of business operation, 16%

of businesses were established between 1970 through 1979, and between 1980 and 1989, 30% of the total businesses were set up, while in the 1990 to 1996, 52% of the respondents ventured in to business in the mine area. This clearly indicates that since the inception of fluorspar mining in 1970, the business sector has been expanding tremendously and that fluorspar mining gave rise to existing business enterprises in Kerio Valley because of the fact that out of 44 businessmen interviewed, no business was reported to have been in existence in 1960's before the valley was surveyed for fluorite extraction.

The earnings accrued to the employees of KFC enter indirectly into the economy of the businessmen and the local community through the purchase of agricultural products such as livestock and groundnuts, among other essential goods. Out of the 44 business establishments 52.3% were run and controlled by the people living in the mine area and its environs, and 15.9% for businessmen from outside the mine area but within Kerio Valley, 4.5 % were owned by people from other parts of Keiyo districts while the rest 27.2 % were operated by businessmen from other districts in Kenya which include Kisii, Siaya and the neighbouring

districts of Uasin Gishu, Trans Nzoia and Baringo. The role of the mining company in promoting the business sector in the valley lies entirely in the provision of customers for business products in the valley. The main source of many customers to 44 businessmen interviewed was noted to be the mining company and that 54.5% of the respondents receive their customers from Kenya Fluorspar Company, 27.3% from the local people in the valley, 13.6 % from the other operating businessmen, and the rest, 4.6 draw their customers from institutions which include schools and a polytechnic. The fluorspar mining activity is therefore playing a leading role in creating indirect employment for the business owners and other people as well. The average number of people that one businessman employ in Kerio Valley is two per business establishment, and the average gross sale per month for all the 44 businessmen amounts to about 21,056 shillings per month. Other than generating income for the people living in Kerio Valley and other parts of Kenya, the County Council of Keiyo gets revenue directly from businesses which have emerged as a net result of fluorspar mining activities. The average revenue that the Keiyo County Council is getting from Kimwarer centre alone is over Ksh

16,700 per year (Keiyo, 1997.), therefore strengthening the council revenue base.

Although most of the permanent employees are housed by the company, shortage of houses is still a major problem. Some of the employees seek alternative accommodation from commercial and trading centres such as Kabokbok, Chepsirei and Kimwarer. The local people have responded positively to the inadequate company housing stock by the construction of more houses for renting to the mining company employees and businessmen. The average cost of renting out a housing unit is about 800 shillings per month, thereby creating additional source of income to other local residents. The improvement in building technology accompanied the demand for housing especially at Kimwarer area in that the local people make use of the stones obtained from the mine sites but abandoned by the miners. 21 per cent of the businessmen interviewed owned permanent business premises constructed out of stones from the mine area, at Kimwarer trading centre. The adoption of the mineral based building materials by the households was relatively lower as compared with the commercial and trading centres, for instance 3.6% of the total

households interviewed had permanent housing units constructed with stone material obtained from the mine area. Plate 5.6 shows a section of an upcoming human settlement at Kimwarer area.

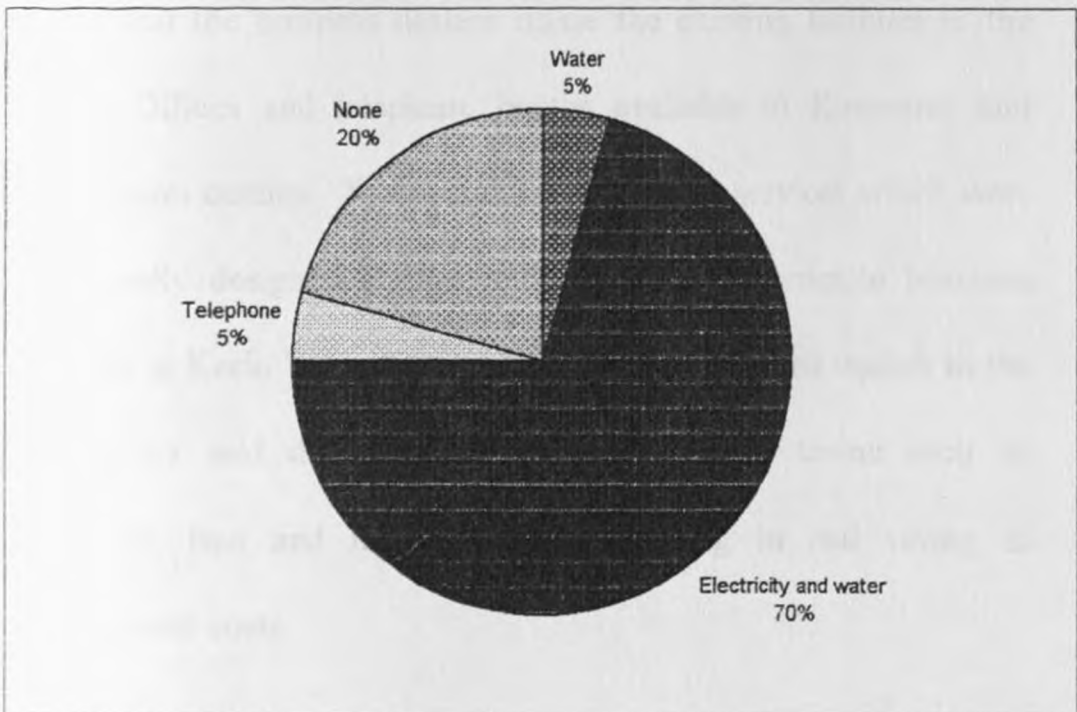


Plate 5.6: shows a section of an upcoming Human settlement near Fluorspar Mill.

The major infrastructural facilities have been put in place at Kimwarer, Kabokbok, and Chepsirei trading centres. Other than the development of water and electricity supply, Kimwarer and Kabokbok centres have secondary schools serving the centres and their catchments. The main post office is based at Kimwarer centre near the factory site. The businessmen at Kimwarer have

benefitted from free piped water supply by the mining company, and electricity supply from the Kenya Power and Lighting Company through the mining company's distribution line. The electricity and piped water has been adopted by 70.5 % of the 44 businessmen interviewed and 4.5% had accessed telephone services. Figure 5.3 shows the level of adoption of the main infrastructure services by businessmen in Kerio Valley.

Figure 5.3: The level of utilisation of major infrastructure services by businessmen in Kerio Valley.



Source: Field data.

The figure above indicates that a greater percentage of businessmen have piped water and electricity in their premises. This is due to the fact that water is essential for most business activities including hotels and butcheries, and also for domestic uses. The hot climatic conditions of Kerio Valley makes electricity important as a basic input for preservation of perishable commodities involving refrigeration. Electricity is also used in small scale workshops and for lighting. The low level of telephonisation of business establishments was attributed to the fact that the business dealers utilise the existing facilities in the Post Offices and telephone booths available in Kimwarer and Chepsirei centres. The postal and telephone services which were originally designed for the mining company, promote business sector in Kerio Valley through contacts made by the traders to the suppliers and distributors of commodities in towns such as Eldoret, Iten and Kabarnet, thus resulting in real saving in transports costs.

Kimwarer is the dominant trading centre which commands most of the customers from the mining company and the local

community. The catchment of this centre extends to include Muskut, Kabokbok, Chepsirei and Simit. The table below shows the distribution of commercial centres and the corresponding proportion of households utilising the centres.

Table 5.5: The catchment population of customers in the centres within and outside Kerio Valley.

Centre / Town	Number of Households	Percentage of the Total
Eldoret	7	6.4
Kimwarer	71	61.5
Kabokbok	18	16.1
Chepsirei	10	9.1
Muskut	1	6.9
Other	3	2.7
Total	110	100

Source: Empirical data.

It is clear that Kimwarer centre is dominating others centres in terms of catchment areas of its customers. Out of the total sample of 110 households interviewed, 61.5 % noted that Kimwarer centre acts as an urban centre since it provides a variety of goods and services not available in other centres in Kerio Valley. The percentage of the total households using Eldoret as

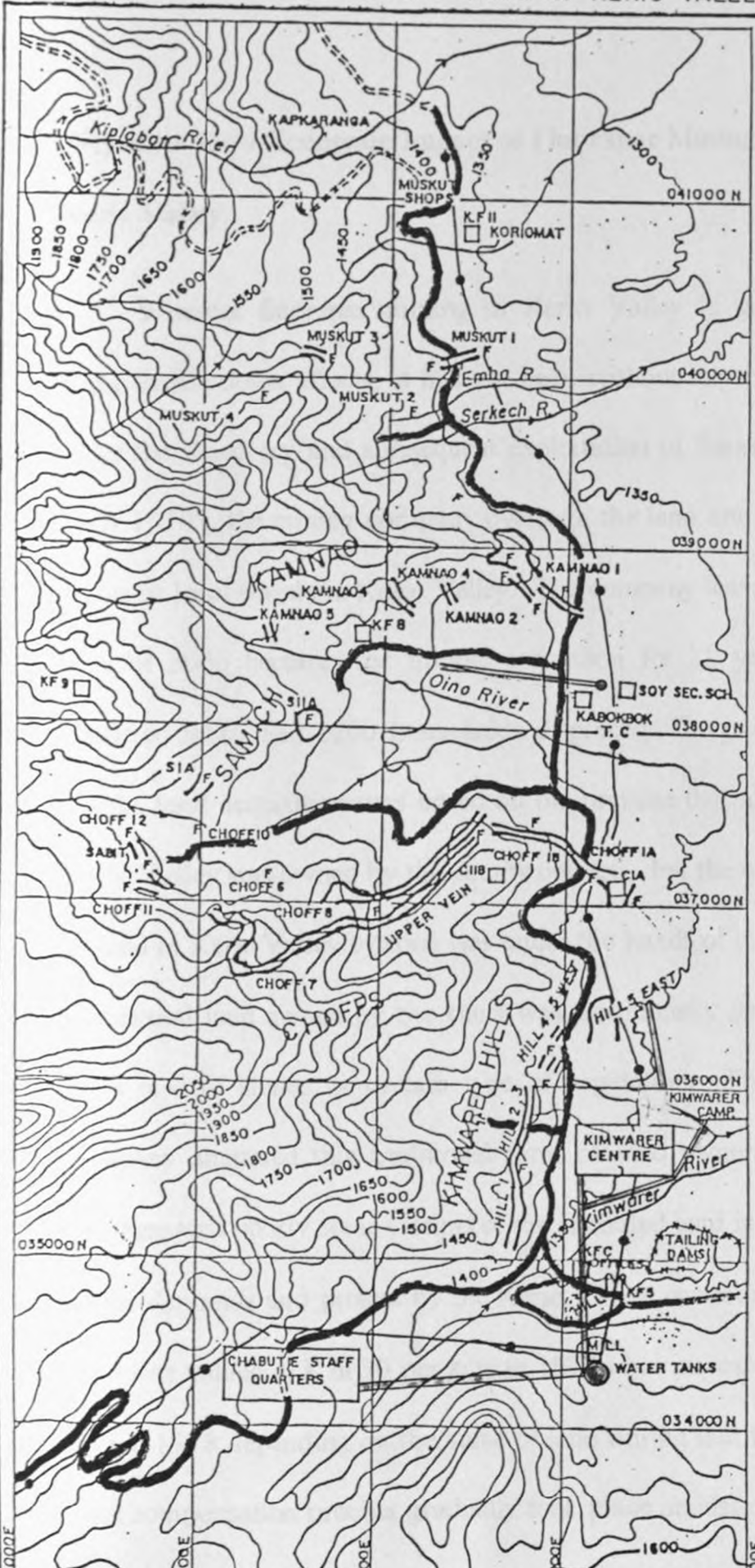
their centre was 6.4%. The periodic market at the mining company's premises provide an opportunity for the employees and the valley community to buy agricultural products drawn from highland and other commodities as well. Plate 5.7 shows a periodic open air market at KFC's precincts. The location of the periodic market at the company's premises was prompted by the availability of ready market from the company employees and secondly, as the destination of the common means of transport for transporting fluorspar besides serving as public transport. Map 5.1 shows the spatial distribution of the major mineral-based infrastructure. It was noted that the county council allocated the main site for the market at Kimwarer centre, but the site has been abandoned in favour of the mining company's site. The selection of the mining company's premise as a suitable site for the market was not good because there is a possibility that the fluorite dust particles emanating from the Mill may get into contact with food stuffs and other commodities being sold in the market thus posing a health risk. Therefore there is need to relocate this market to the original market place.



Plate 5.7: shows a periodic Open Air market within the precincts of the Mining Company. Notice the type of commodities sold and the likelihood of fluorite contamination.

The development of Kimwarer as the major commercial centre with most of the required infrastructure attributed to fluorspar mining operations, has the potential of expanding and of being designated as an urban centre in future, hence there is an urgent action for spatial planning of all the activities which have emerged from fluorspar mining operation in Kerio Valley.

MAP 5-1: MAJOR INFRASTRUCTURE UNITS IN KERIO VALLEY



KEY

- Power Line
- Water Supply Line
- K.F.C. Dispensary and School
- Road (KFC)
- Contour
- River/Stream
- Dam
- Ore Body
- K.F. Kenya Fluorspar

Scale:

0 6Km or

1 : 40,000

5.6 Negative Socio-Economic Impact of Fluorspar Mining in Kerio Valley

Whereas fluorspar mining in Kerio Valley is generating some trickle down effects, it has not been without any problems. After the discovery and subsequent exploitation of fluorite in the early 1970's, the mining company overrode the land and resource rights of local people in Kerio Valley. The company leased a total area of 3656 hectares for fluorite extraction for 21 years, and rendered more than 1200 households displaced. The justification for the land acquisition was based on the premise that all land in Kerio Valley was owned by the county council, but the ownership of land in Kerio Valley by then was under the hands of clans. The communal land owned by the clans was traditionally demarcated by a row of stones or certain type of vegetation. The mining company shattered this traditional form of land ownership, and compensated poorly some victims of the alienated land in response to the demands and protest by the Kerio Valley community. The land was valued at Ksh 30 per acre in 1970's but increased to Ksh 450 in 1978 depending on the value of land during that time. The cash compensation process gradually took place amidst opposition

and conflicts between the administrative officers who acted as the mining company agents to coerce the local people to accept unrealistic claims, and by 1991 the last group of the displaced households is said to have been compensated.

However the economic and social problems generated by fluorspar development have not yet been satisfactorily solved. For example there are still claims for compensation for alienated land, Map 5.2 indicates the size of the land claimed by KFC. There are allegations that instead of negotiators treating the clan as a whole, compensation was made to individuals. The powerful and articulate individuals were therefore better placed than illiterate and poor members. Although the mineral based land has got a long history of land disputes, many household heads could not estimate the exact size of land acquired by the mining company, but 48% of the total respondents interviewed claimed that they surrendered their land to the mining company. The average size of the land acquired from these households was 3.4 acres, and 20.9 % of the respondents noted that they received cash compensation of Ksh 450 per acre, while 17.3 % of the households interviewed

surrendered their land to the mining company without any compensation.

Owing to inadequate compensation of the acquired land, many households decided to continue living on the leased area simply because the compensation value of Ksh 450 per acre could not enable them to move and buy land elsewhere, thus they squandered all their money and remained as squatters in the land which they originally owned but now under the jurisdiction of the mining company. Some households moved out of the Kerio Valley and bought land and settled in other districts like Uasin Gishu and Trans Nzoia, thus cutting their social ties with Kerio Valley community.

In order to create more land for the extraction of fluorite, the company evicts the households living in those areas, and left to seek for other residential areas in the leased land. It was also observed that no precautions are taken in lease area against the effects of blasting fluorite ores.

The development of fluorite mineral did not come as a blessing to the people living in Kerio Valley. The Value of the

mineral deposits contained in their land was not taken into account in compensation for the alienated land. Other than the victims of displacement having their social setting disrupted they have also had their land, their livelihoods and even their lives destroyed to enable fluorspar mining company to exploit mineral deposits. There is therefore need to revisit and address the question of compensation of the alienated land with a view to providing a permanent solution to this long standing problem.

The other social effect associated with the fluorite mineral development in Kerio Valley is that the new cash economy has brought in the culture of alcoholism and drunkardness among some company employees and local people. It was also observed that prostitution could be increasing at Kimwarer centre near fluorspar factory, which is likely to threaten the Kerio Valley community.

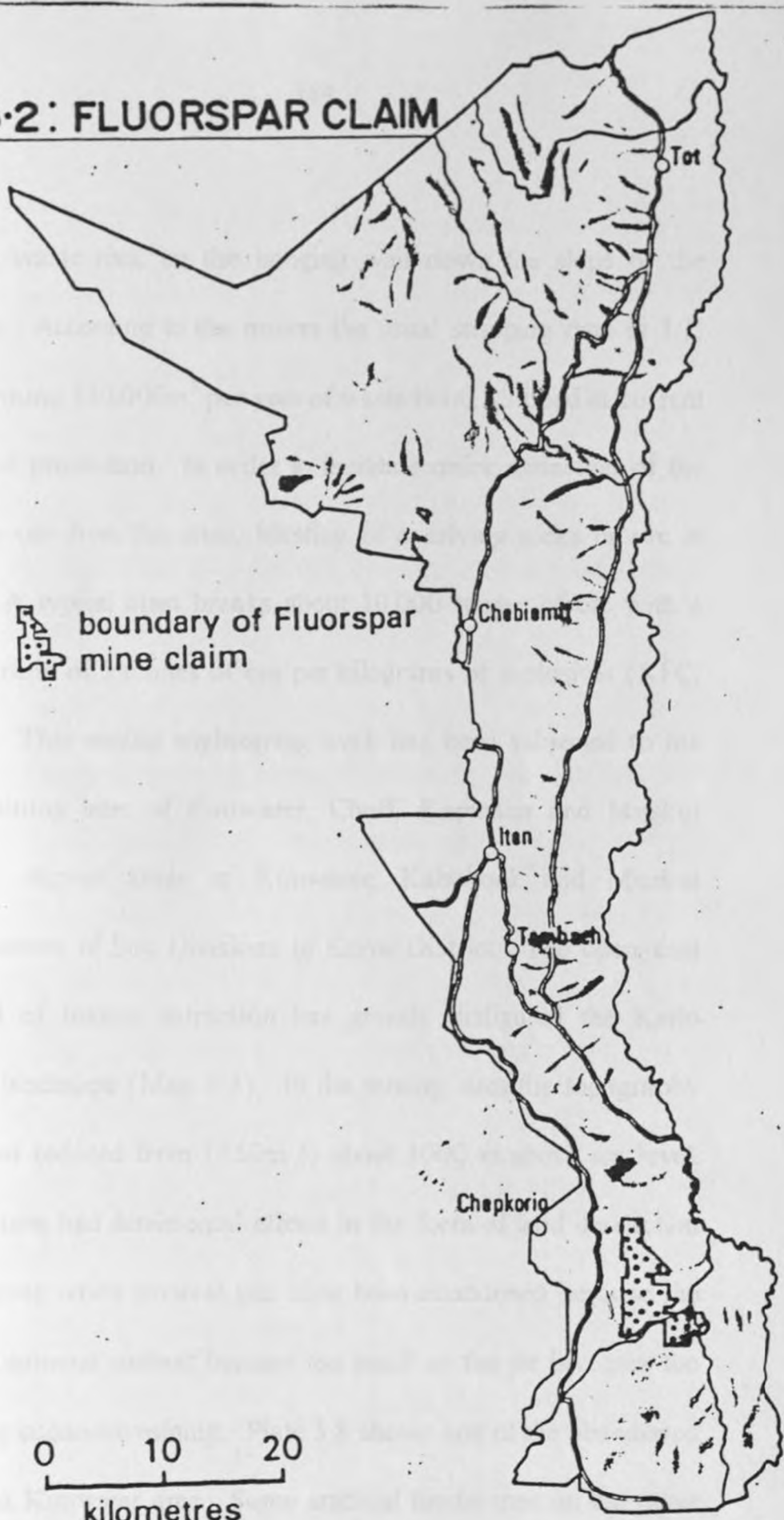
5.7 The Environmental Effects of fluorspar Mining in Kerio Valley

For any development in mineral production and processing industry, some environmental degradation is inevitable, and may even conflict with the priorities of other resources like water, forests and other land uses. Although fluorspar mining in Kerio Valley has a role to play in contributing to development of Kerio Valley region, its impact on the environment has already caused damage with regard to land, water and somewhat air and noise pollution. The environmental problems associated with this human venture are viewed in several levels akin to stages involved in mineral production, notably: mining (extraction), processing, and industrial solid and liquid waste management.

5.7.1 Aesthetic Degradation

The main environmental impacts which stem from fluorspar mining activity in Kerio Valley is aesthetic degradation which owes its genesis to the type of mining method. Mining is by open cast method, which simply involves the removal of the overburden, that is the earth or other rock bands lying above the fluorite bearing rocks. Overburden is removed by ripping and

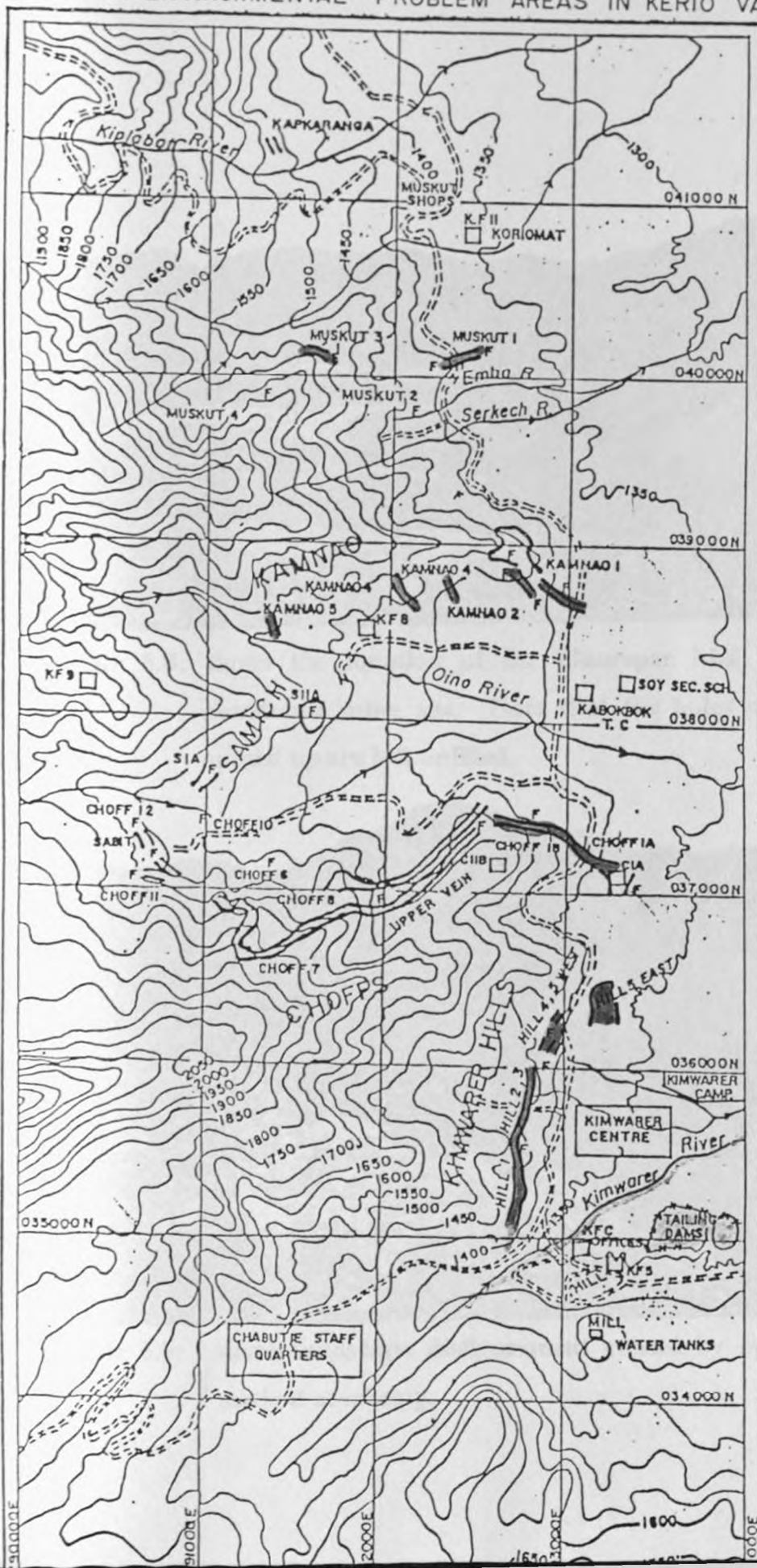
MAP 5-2: FLUORSPAR CLAIM



dozing waste rock on the hanging wall down the slope of the hillside. According to the miners the usual stripping ratio is 1:1, with around 150,000m³ per year of waste being stripped at current levels of production. In order to facilitate quick extraction of the fluorite ore from the sites, blasting of overlying rocks or ore is done. A typical blast breaks about 10,000 tonnes of ore with a power ratio of 5 tonnes of ore per kilograms of explosives (KFC, 1997). This mining engineering work has been subjected to the four mining sites of Kimwarer, Choff, Kamnaon and Muskut fluorite deposit areas in Kimwarer, Kabokbok and Muskut sublocations of Soy Divisions in Keiyo District. The open cast method of fluorite extraction has grossly disfigured the Kerio Valley landscape (Map 5.3). In the mining sites the topography has been reduced from 1350m to about 1000 m above sea level. These have had detrimental effects in the form of land dereliction in the sites where mineral pits have been abandoned because the fluorite mineral content became too small or the pit becomes too deep for economic mining. Plate 5.8 shows one of the abandoned mines at Kimwarer area. Some artificial landscapes on the other hand have emerged on the mine area consequential from

accumulation and deposition of wastes including overburden derived from the quarried sites. These heaps and pits on the earth surface contribute to ugliness and therefore destruction of beautiful scenery in Kerio Valley. The inability of the fluorspar mining company to reclaim the derelict land reflects the ruthless exploitation of this non-renewable natural resource without consideration for the future. If KFC continues to intensify its mining operations in Kerio Valley, many more hectares of land will be degraded. The KFC earmarks none of its earnings towards environmental conservation and reclamation. Although the Mining Act chapter 306 has provisions for restoration of abandoned pits, it appears that KFC is not addressing itself to the question of filling up the holes and pits as required by section 35 of the Mining Act. Plate 5.9 exhibits the extent of the environmental damage. KFC is therefore guilty of an offence since it has failed to protect the abandoned mine sites. There is need for stricter administration of laws and inspection of mines and quarries in order to avert further environmental destruction.

MAP 5-3 : ENVIRONMENTAL PROBLEM AREAS IN KERIO VALLEY



KEY



Land/River Pollution



Land Disfigurement

==...Road

~1600...Contour

~...River/Stream

~...Dam

F...Ore Body

K.F....Kenya Floors

Scale:

0 6Km or

1 : 40,000



Plate 5.8: shows the location of the Fluorspar Mill and an abandoned mine site. Note that the holes and pits opened up are left unfilled.



Plate 5.9: shows landscape disfigurement caused by open cast method of mining.

5.7.2 Devegetation and Soil Erosion

Fluorspar workings in Kerio Valley contribute to the transformation of vegetation and therefore the ecosystem in several ways. First, prior to extraction of the fluorite deposit, the mineral based site is explored and surveyed before the removal of the overburden including the vegetation. It was observed that the old and newly abandoned sites had no vegetation cover and might take too long for vegetation to regenerate given the severe climatic conditions of Kerio Valley. Secondly, the dumping of the industrial waste material including the reagents added to production processes and dust particles contribute to discolouration and scorching effect of the existing vegetation thus leaving a bare ground for soil erosion to set in. Plate 5.10 shows the effect of fluorite on vegetation. The vegetation of Kerio Valley serves as a natural habitat for the wildlife species such as birds and baboons which are found in the mine area and its peripheral areas. With the clearing of vegetation for mining activities, the wildlife habitats in Kerio Valley have been threatened.



Plate 5.10: The effect of Fluorite dust particles on vegetation.
 Notice the brown colour of the vegetation.



Plate 5.11 shows the depth of fluorite mineral extraction site. Note that water from fluorite bearing water table accumulates at the bottom of the pit.

The development of physical infrastructure impinges on the natural environment. Other than the fluorspar mining sites in Kerio Valley, large tracts of land have been cleared to build infrastructure. The KFC leased a total area of 3656 hectares of land of which the land use activities in the lease area include: residential, recreational, health, educational and transportation. The road from Nyaru through the escarpment to the mine area is a KFC property, and occupies a total area of 133 ha which represents 3.6% of the total surface area of the lease area.

5.7.3 Depletion of Ground and Surface Water Sources

The open cast method of mining in the mine area occasionally is executed to a level below the water table. The excavation of fluorite deposits which underlie productive aquifers and streams has a direct bearing in underdraining of the ground and surface water systems. The water from the boreholes and therefore in the water table in the mine area is commonly saline (Kenya, 1986). It was observed that the main constraint encountered in extracting fluorite from the ore is the collection and accumulation of water arising from the quarried fluorite bearing

water tables, thus making mechanical extraction difficult. Plate 5.11 shows the depth of excavated pit containing water derived from the water table. The miners circumvents the contaminated groundwater menace by drainage pumpage involving the mechanical channelling of water into river Kimwarer which is a tributary of the Kerio river thus increasing the level of fluoride and salinization. According to KFC, during the 1995 / 96 production period, the cost of drainage pumpage in the Kimwarer fluorite site amounted to Ksh. 26,579,000. (see table 4.2). After the removal of the flood water in the mine site, the muddy material which contains fluorite is scooped and loaded to subcontractors to transport to the factory for processing.

The depletion of water tables through fluorite extraction could be causing a drop in the level of groundwater and extinction of surface water streams leading to direct ecological damage, or a considerable worsening of the water supply position of the people living in the mine area and its environs in Kerio Valley region. It was noted that 20% of the residents interviewed in Kerio Valley used to obtain potable water for domestic use from the steams and springs in the escarpment, but with the introduction of fluorspar

mining activities; mechanical levelling of the water bearing landscapes have aggravated water supply crisis in Kerio Valley. In order to make ends meet in terms of water supply, many households travel for long distances to River Kerio to fetch water for domestic use and livestock production. There is need to accurately map out geologically the water tables before extraction and to protect ground water from cessation of drainage and other environmental damages. By doing so, losses of potable water resources could be arrested and therefore constant water supply position in the mine area and the peripheral areas.

5.7.4 Fluorite contamination

Water is always placed seriously at risk by the development of any industry involving production and processing. The mine area and its adjoining areas is drained by several rivers and streams flowing from Elgeyo escarpment to River Kerio in the Kerio Valley floor. These streams, together with Kerio River are the key resources in the Kerio Valley life support system. For any

negative influence directed to this hydrological resource, the entire ecosystem in Kerio Valley is likely to suffer.

Water for domestic use in the factory site is drawn from Kimwarer river and filtered, chlorinated and then distributed. Water for industrial purposes is diverted from the Mong river and pumped through a pipeline to the factory. Water is treated and filtered before use in the industrial processes. The current water consumption is approximately 700,000 gall/day (3200m^3). Therefore River Kerio is being deprived of this large volume of water diverted for industrial use only to be retrieved in scant quantities through the discharge of industrial waste water.

At the end of the industrial production stage, the flow of industrial waste water from the factory is about $3000\text{m}^3/\text{day}$. This waste carries all the waste minerals from flotation process, about 400-500 tons per day, plus parts of the chemicals added in the process, mainly about 5 tons of soda ash (Na_2CO_3). The pH of the initially untreated waste water is in the range of 9.5-10 and contains a very heavy load of fluoride of over 5000ppm of which over 2000ppm was soluble (K.F.C. 1996). The waste material is

channelled for storage in the tailing ponds before being discharged into river Kerio which flows into Lake Turkana.

In the tailing ponds, the industrial effluence is never treated but stored and later released into Kerio river twice on a weekly basis thus causing water contamination. Plate 5.12 shows the industrial effluence in the tailing ponds in the mine area. It was established that there has been a long standing bone of contention between the Kerio Valley residents and KFC over the question of disposal of industrial wastes. There are some allegations to the effect that fluorite contaminated water in Kerio river which is the key resource for Kerio Valley people could be contributing to miscarriages among the livestock in Kerio Valley. Although there are no scientific investigations done to support these allegations, a number of household respondents interviewed said that they were not happy about the activities of KFC in Kerio Valley. In particular, 64.5% of the total sample of 110 households interviewed blamed KFC for 'poisoning' or contaminating Kerio Valley through direct disposal of industrial wastes, and therefore threatening livestock production. Table 5.6 summarizes some of

the environmental problems of fluor spar mining as perceived by Kerio Valley residents.



Plate 5.12: shows the industrial effluence in the tailing ponds. Notice the colour of the waste materials which contribute to pollution of Kerio river.

Table 5.6: Perception of Environmental problems of Fluorspar mining according to the Valley residents.

Environmental Problems	Number of respondents	% Total
Fluorite contamination	71	64.5
Blasting / explosives	7	6.5
Dereliction / excavations	5	4.5
Stream drainage	22	20
None	5	4.5
Total	110	100

Source: Field survey

Subject to scientific analysis of the quality of water in Kerio river, the specific hypothesis formulated in chapter one that, 'there is no relationship between the quality of water and fluorspar mining activities in Kerio Valley', cannot be descriptively accepted because there is enough evidence that is based on the perceptions of the people living in Kerio Valley and the observed colour of surface water in Kerio river which clearly indicate that fluorspar mining could be increasingly causing fluoride contamination or pollution and therefore threatening the entire ecosystem in Kerio

Valley. However scientific analysis remains the only sure way of determining the surface water quality situation in Kerio Valley, and its attendant effects.

5.8 How the model fits fluorspar mining in Kerio Valley

In terms of the conceptual framework as described in Chapter One, mining is supposed to contribute to development of a given region through direct and indirect fiscal effects. The direct effects are forward and backward linkages which involve the use of resources as inputs for local industries, while indirect fiscal effects entails the acquisition of inputs required by the mines from local suppliers. The direct effect could include the generation of incomes and investment funds in the case of retained earnings, accumulation of foreign exchange with which to import capital goods for development, generation of employment, creation of skill workforce necessary to propel industrialization process and the development of infrastructure by providing economies of scale (Dawson, 1975, Morgan, 1982). Figure 1.1 in chapter One provides a summary of the conceptualized effects of mining on development.

As regards the real situation in Kerio Valley the effects of Fluorspar Mining on development correspond to those proposed in the previous model. However there are certain aspects which are not reflected in the conceptualized model and therefore peculiar to Kerio Valley environment. In the first place, the effects associated with fluorspar mining conform to those aspects of the conceptual model in that fluorspar mining has generated some positive socio-economic effects which are not only beneficial to the people living in Kerio Valley alone but to the entire nation. At the macro-level fluorspar mining contributes its part of 4% in terms of GDP that is accounted by both mining and quarrying. The earnings accrued from the exports of fluorspar together with taxes paid to the central government by KFC is channelled indirectly for development of Kerio Valley. The Keiyo County Council on the other generates Ksh 453, 675 annually in terms of revenue from KFC which is equally earmarked for development of Kerio Valley and other parts of Keiyo district. KFC uses its own mining equipments such as craters to construct and improve all roads in the mine area and thereby opening up Kerio Valley for development.

The mining complex has generated employment opportunities for the local people directly at KFC in semi-skill and unskill levels thus resulting in improvement of incomes and purchasing power of the local people because of the wages and salaries paid. The local community whose economy is dependent on livestock and subsistence production sell some of their agricultural produce directly to the people working in the mining sector. The development of infrastructure units which include: KFC's dispensary, a primary school, recreation facilities, water supply system, good road network, market centres and induced development of electrification and telephonisation services, have benefitted the local community and therefore making Kerio Valley more liveable.

Whereas fluorspar mining has brought about the development of social and economic infrastructure which have enhanced the quality of rural life in Kerio Valley, it has not been existing without problems. With the introduction of mineral workings in Kerio Valley, the land resource rights of the local community was overridden. About 1200 households were displaced so as to enable KFC to lease and exploit fluorite mineral

deposits. Although some households were given cash compensation, the amount compensated was inadequate and could not enable them to move and buy land elsewhere, thus many households decided to stay in the lease area as squatters. Therefore the mining complex has adversely disrupted the economic and social environments of the Kerio Valley community.

The environmental impacts of any mining venture are generally negative. Fluorspar mining is technologically offensive to the physical environment. The open cast method of extracting fluorite involves the use of explosives in blasting of the fluorite bearing ores which lead to loss of vegetation cover and landscape disfigurement as well as drainage of the underground water source. All the wastes generated from fluorspar processing which contain industrial chemicals are discharged directly into Kerio river thus creating fluorite contamination and therefore threatening the entire ecosystem in Kerio Valley.

The conceptualized model in chapter one is therefore modified so as to reflect the existing situation in Kerio Valley. The modifications include the isolation of positive and negative effects

of fluorspar mining complex. The negative effects are mainly environmental effects and displacement of 1200 households. The positive socio-economic effects include: employment creation and acquisition of technology, export earnings and revenue generation to the Central government and local authority which contribute directly or indirectly to the development of social and economic infrastructure and therefore improvement of the welfare of the local community. Figure 5.4 illustrates the real situation as it is in Kerio Valley.

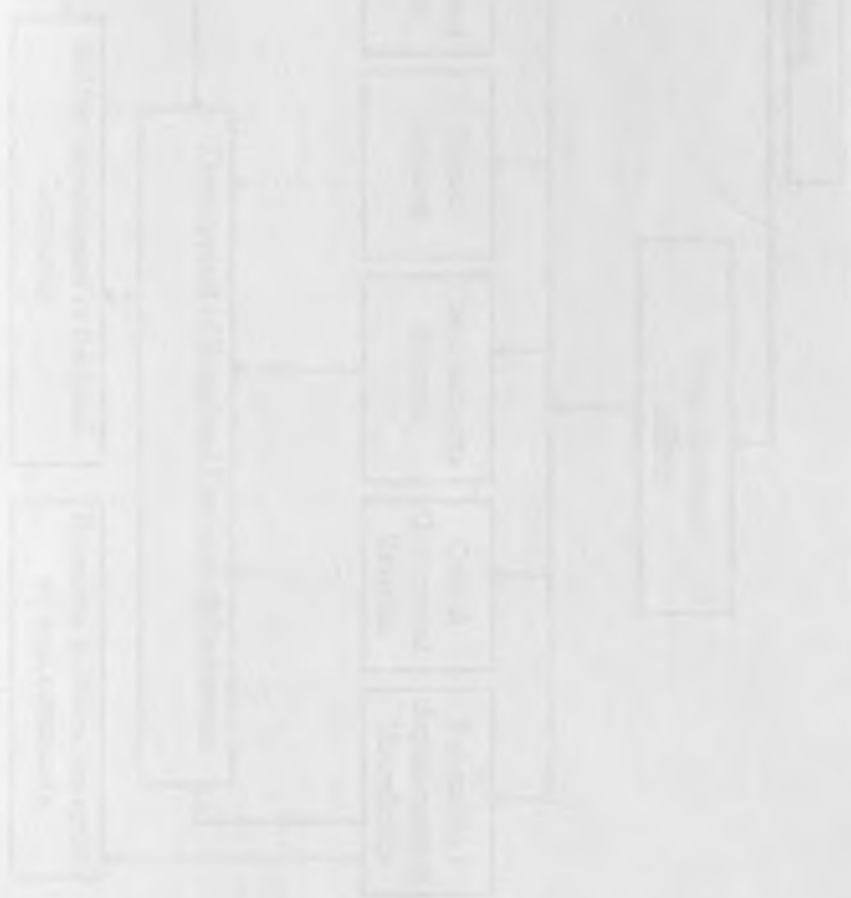
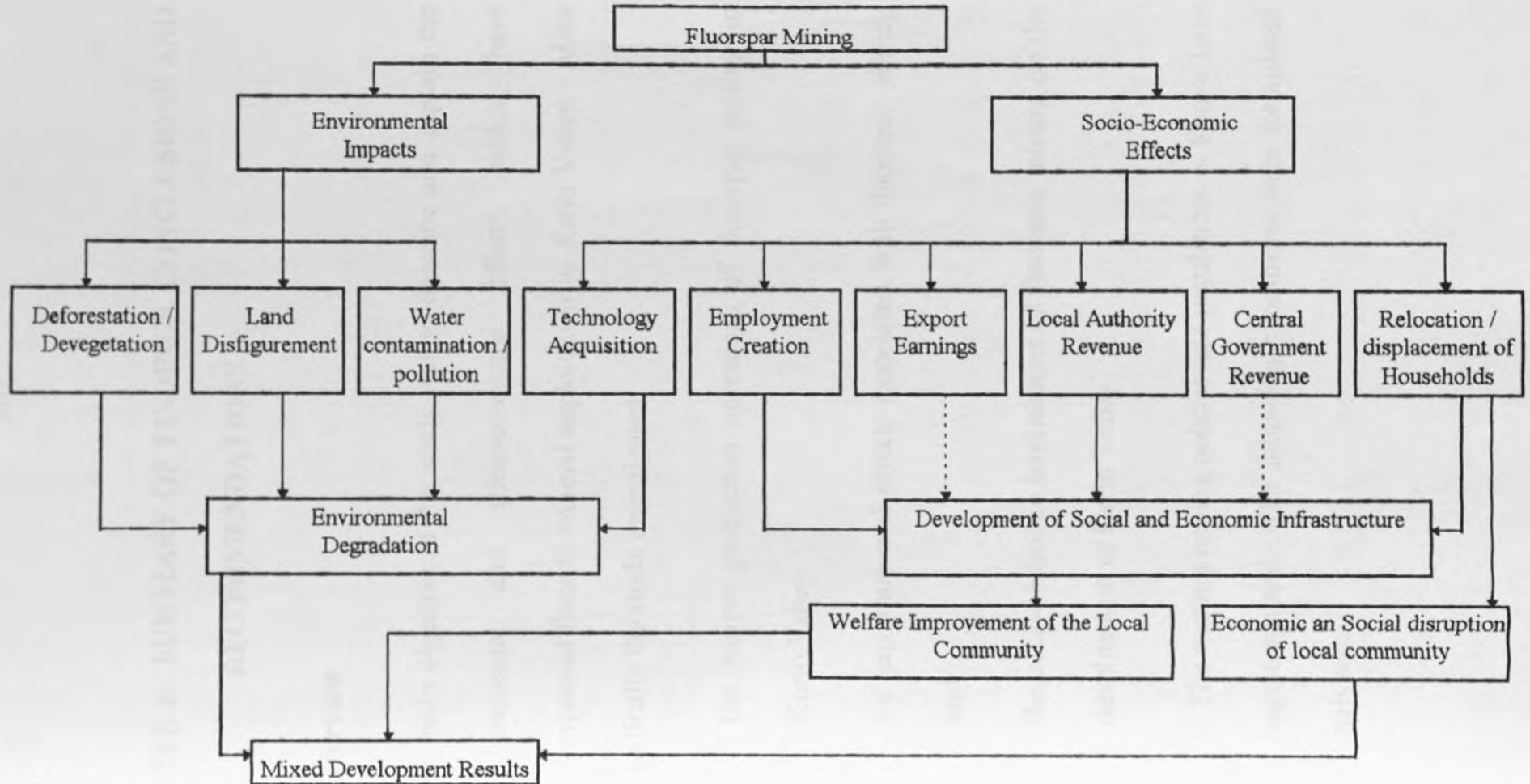


Figure 5.4: The Effects of Fluorspar Mining on the Development of Kerio Valley



Legend:

-> Weak or indirect effects
- > Strong or direct effects

CHAPTER 6: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

6.1 Overview

The main objective of the study was to describe and explain the environmental and socio-economic effects, which have accompanied fluorite mineral exploitation in Kerio Valley. More specifically the study investigated:

- (a) the current production operations of fluorspar mining in Kerio Valley
- (b) the environmental effects associated with fluorspar mining and
- (c) the socio-economic implications of fluorspar mining on the development of Kerio Valley.

The existing mining policies and regulations in Kenya have also been examined. The following hypotheses were formulated and analysed:

- (i) that there is a significant relationship between the employment trends, and the production and export earnings of fluorspar
- (ii) that there is a correlation between the socio-economic characteristics of the households in the mine areas and adoption and accessibility to the KFC based infrastructure
- (iii) that there is no relationship between the quantity of water discharged into Kerio river and fluorspar mining activities in Kerio Valley.

The statistical tools were used to test these hypotheses which involved regression and correlation analysis. The relationship between the quality of water discharged into river Kerio and fluorspar mining activities was descriptively analysed.

This concluding chapter summarises the major findings of the study as revealed and guided by the analysed hypotheses. Other important findings which were not hypothesized in the study, but were revealed by cartographic and other statistical analysis are also presented. The conclusions and recommendations arising from the study are also examined. The

suggested areas for future research in this important topic are outlined.

6.2 SUMMARY OF FINDINGS

6.2.1 Mining Policies and Regulations

Fluorspar mining occupies a unique position in the integration of the mineral sector into the national economy. In Kenya mining and quarrying has a role to play since it accounts for about 4% of G.D.P. The study established that mineral resource utilization has somewhat been divorced from a consideration of effective utilization of other national resources like manpower and agricultural resources. The existing mining policies and regulations owes its genesis to the 1933 Mining Ordinances of the British Colonial government. These mining policies and regulations inhibited rather than providing an enabling environment for mineral development. The adoption of colonial policy framework for mineral management with minor adjustments after independence under the Mining Act CAP 306 of the Laws of Kenya is deficient and does not provide for greater

weight on environmental protection from undesirable effects of mining. Since mineral resources are non-renewable, policies and regulations which address proper planning of mineral exploitation so that when the mines are exhausted and closed down, alternative opportunities are readily available, are non-existent in Kenya. Since Independence, the National Government policy has been to intensify geophysical surveys, training of personnel required for mining, and involvement of the private sector in mineral development.

6.2.2 Production operations of fluorspar

Fluorspar mineral is produced after subjecting the fluorite into several step wise mechanical and chemical methods involving open cast method of mining whereby the fluorite bearing rock is blasted using explosives. The milling process of fluorite is done at the site. It was established that there is a corresponding relationship between the amount of fluorspar produced and export earnings. For instance in 1996 the KFC produced 86,280 tonnes of fluorspar and accrued Ksh 436,581,860 from the sale of fluorspar. However the production cost of the mineral was found

to be many times higher than the real savings of the operating company. This is exemplified by the fact that out of the total income of Ksh 436,581,860, only Ksh 47,511,860 savings entered into the KFC treasury.

The study also established that there has been a continuous fluctuation in production, employment and export levels of fluorspar since its inception. This state of affairs is mainly explained by the following factors:

- (i) technical and mechanical problems involving breakages of mining machinery and equipment which occasionally paralyse mining operations.
- (ii) lack of market for fluorspar due to stiff competition with other principal producing countries such as India and USA, thus leading to the scaling down of production of fluorspar in Kerio Valley, and
- (iii) The decline in production and employment in the early 1990s was attributed to retrenchment and restructuring of the fluorspar mining operations.

In examination whether there is a significant relationship between the number of employees and production of fluorspar in tonnes, correlation coefficient result indicated that there exists a very weak but positive correlation between employment and production situation since r was 0.01. This therefore means that there is limited potential for increasing production as well as creating additional employment opportunities. While the output of the correlation analysis on the relationship between export earnings and production of fluorspar showed that there was a fairly strong but positive association between production variable being a function of exports generated by fluorite market, since the correlation coefficient r was 0.40. This implies that KFC has a fairly good potential for producing many more tonnes of fluorspar as well as increasing its corresponding export earnings. Therefore the future of fluorspar production and marketing is bright. The major constraint hindering intensification of fluorspar production is the inaccessibility of Kerio Valley due to poor road network attributable to extremely rough terrain. This aspect coupled with infrequent railage of fluorspar to Mombasa for export contribute to delays in the supply of fluorspar to the target customers. The

irregular supplies and delays are often subject to cancellation by the importers and therefore affecting the cash flow position of KFC.

6.2.3 Environmental Effects of Fluorspar Mining

The development of fluorspar production and processing industry has made some environmental degradation inevitable and conflicted with the priorities of other resources like water, forests and other land uses. The immediate environmental problems which arise from the mining operation include:

(i) **Impact on Vegetation and soil:**

devegetation and soil erosion which have been caused by clearance of vegetated tracts of land needed for mining and to build infrastructure at the mining site.

(ii) **Aesthetic degradation or landscape disfigurement:**

Open cast method of fluorite extraction and blasting of overlying rocks has resulted in the formation of

heaps and unfilled pits that have contributed to ugliness and loss of beautiful scenery of Kerio Valley.

(iii) Depletion of ground and surface water:

It was observed that open-cast method of mining underdrains the ground water systems. Contaminated ground water from fluorite pits is pumped out to river Kerio, thus increasing the level of fluoride in the surface water source. It was established that prior to the mechanical levelling of water tables in Kerio Valley, 21% of the households interviewed used to get potable water from the natural springs, but with the extraction of fluoride-based water tables these water sources were depleted and therefore worsen water procurement position by the Valley residents.

(iv) Fluorite contamination and pollution:

Other than pumping contaminated water from the quarries into River Kerio, all waste tailings generated by milling processes which contain reagents such as soda ash, oleic acid and mimosa extract, are

discharged into river Kerio, thus increasing fluorite levels in river Kerio, which serve as the key resource in Kerio Valley life support system.

The critical environmental problems associated with fluorspar mining, which was identified by the sampled respondents in Kerio Valley was fluorite contamination. 64.6% of the households interviewed noted that fluorspar mining activities in Kerio Valley "poisons river Endo", or discolours water in Kerio river thus making it unfit for domestic use. It is believed by the Kerio Valley people that contaminated water when taken by their livestock causes miscarriages. Other environmental problems cited by the target respondents included; blasting of ores using explosives which causes vibrations and results in development of cracks in their houses, dereliction or excavation of farms, and stream disappearance and drainage.

6.2.4. Positive socio-economic concomitants of fluorspar mining

The social and economic benefits accrued to the people living and working in Kerio Valley, from the establishment of fluorspar mining is considered to be the most powerful

contribution to development of Kerio Valley. In terms of contribution to local authority, fluorspar mining activities generate Ksh 453,675 annually to Keiyo County Council as revenue for development. Some local people have been employed and acquired skills in mining industry. It was established that out of the 110 households interviewed, 22.7% noted that at least one of the household members was working with the Mining Company. However the employment structure in the industry showed that the local people occupy unskilled and semi-skilled categories. This is due to the fact that the local people have low levels of education and therefore lack professional skills in fields like Engineering which are required in Mining Industry.

The study established that development of fluorite mineral working has been accompanied by the development of large numbers of infrastructure units which have brought about enormous benefits to the people living in Kerio Valley south and its peripheral areas. With the construction of the 24km All Weather private road from Nyaru to Kimwarer at a cost of Ksh 4 million by the Mining company, the distance between Kerio Valley and Eldoret Town as well as other places has been shortened.

besides opening up the formerly remote area for development. This was considered by most residents interviewed to be the most powerful impact of fluorspar mining in Kerio Valley.

Other than development of good road network, other social and economic infrastructure which were originally developed exclusively to the mines but have generated some trickle down effects to the Kerio Valley community include:

(i) Development of health and educational facilities:

Most of the employees and their families, and many Valley residents seek medical attention and primary school education services at nominal charges at KFC facilities. Out of the sampled respondents, 59.6% and 24.5% noted that they utilised health and educational services respectively at KFC facilities. The correlation result indicated that there was a very weak but insignificant association between accessibility of medical services at KFC being a function of household incomes and occupation of the household head.

(ii) Development of water supply system:

Water is treated and supplied to some residents of Kerio Valley and all the Company employees. 11.8% of the total households interviewed have benefitted from the Mining Company's clean water supply scheme. Once water pipes are connected by the residents in liaison with KFC, water is then supplied free of charge. The correlation output indicated that there was no significant relationship between the type of piped water connection and the incomes of the local people. The Pearson correlation coefficient of 0.00762 showed that water connection was not a function of the incomes of the local people. Other factors such as distance to the water supply points and free water supply also contribute to accessibility of water supply to the Valley people.

(iii) Development of electricity and telephone services:

Although the provision of electricity and telephonisation services entirely lies within the

domain of the private sector contribution, KFC was instrumental in bringing these services into Kerio Valley, which have been adopted mainly by the businessmen in the Valley. 72.1% of the total businessmen interviewed had adopted the use of electricity to enhance their business operations. However none of the households interviewed had access to electricity and telephone services. Electricity and telephone services were generally concentrated on administrative, and commercial centres as well as schools and other institutions in Kerio Valley.

(iv) Development of commercial and trading centres:

It was established that fluorspar mining activities have stimulated the mushrooming up of commercial and trading centres, notably, Kimwarer, Kabokbok, Chepsirei and Muskut centres. The development of fluorite mineral working has opened up new dimensions in business for the local people to venture

in. 52.3 % of the sample of 44 business establishments in Kerio Valley were run and controlled by the people living in Kerio Valley while the rest (47.7 %) businessmen hailed from other neighbouring districts but operated their enterprises in Kerio Valley. 54% of the entrepreneurs noted that most of their customers were mainly the workers of KFC. The local people whose economy is dependent on livestock occasionally sell their livestock through auctions at Kabokbok and Kimwarer centres in the mine area, to be slaughtered for beef in order to meet the nutritional demands of KFC employees. The Keiyo county council gets revenue directly through licensing of businesses in Kerio Valley. It was established that fluorspar mining keeps commercial and trading activities in Kerio Valley alive and that with the depletion of fluorite mineral in future, the business sector and other related activities would come to a standstill.

6.2.5 Negative socio-economic Effects of Fluorspar mining

The main tragedy of the fluorspar mineral development has been the overriding of land and resource rights of the local people. With the leasing of 3656 hectares of land rich in fluorite mineral resource, about 1200 households were evicted and disrupted from their economic and social situation in the valley.

Although the dispossessed were compensated with Ksh 450 per acre, the value could not enable them to move and buy land elsewhere, thus the victims of displacement decided to remain as squatters in the land which they originally owned, but squandered their cash compensation. Mineral development has therefore not been a blessing to some residents in Kerio Valley in that a new culture of landlessness and poverty coupled with drastic social disruption of the valley community has been set in. The operating company continues to evict some squatters in the lease areas so as to create room for fluorite extraction. The question of compensation for the victims of the mineral-based land still remains unresolved.

Finally, with the development of large scale fluorite extraction in Kerio Valley, this modern cash economy has brought about new dimensions in business and employment opportunities, together with other indirect ways of survival. It was noted that alcoholism and prostitution practices could be increasing in the centres in the mine area which were non-existent in Kerio-Valley.

6.3 CONCLUSIONS

Fluorspar mining in Kerio Valley has a role to play in development at national, district and Kerio-Valley South in particular. It contributes part of 4 % of GDP that is accounted by Mining and Quarrying in Kenya. Fluorspar mining generates a large portion of the total revenue of Keiyo County council that is earmarked for the general development of Keiyo district. The development of fluorspar mineral working in Kerio Valley has opened up the formerly remote region by providing social and economic infrastructure units which encompasses; transport facilities, electricity, educational, health, recreational services and water development which have been of great benefit to the people living and working in Kerio Valley and its peripheral areas.

However, it appears that the environmental and social-economic impacts of fluorspar mining in Kerio Valley seem to outweigh the positive contribution of mining to development at the local level. Fluorite contamination of river Kerio which is the key resource in Kerio Valley life support system, and the unresolved question of the displaced and poorly compensated 1200 households of the mineral-based land are more critical than positive contribution.

Since fluorite is a non-renewable mineral resource, its exploitation needs to be planned so that when the mine is exhausted and closed down, alternative sources of employment and income are readily available so as to keep the mineral-based development induced activities, services and infrastructure sustainable.

6.4 RECOMMENDATIONS

Based on the findings as stated in 6.2 above the study makes several recommendations with particular emphasis on

policy issues. These suggestions are made in the context of other objective discussed earlier. These recommendations cut across

- I. Mining policies and regulations
- II. Production operations of fluorspar
- III. Environmental effects of fluorspar mining, and
- IV. Socio-economic implications of fluorite mineral development.

6.4.1 Mining Policies and Regulations

Issue: Non-implementation and violation of mining policies and regulations:

Recommendation: The existing mining policies in Kenya and regulations were adopted with minor adjustments from the British colonial administration. The British mining policies and regulations were not only used to safeguard their interests in their spheres of influence but also addressed the question of management and exploitation of

huge mineral reserves in Britain. Since Kenya is poorly endowed with mineral resources, there is need to review the current mining policies and regulations with a view to providing for an enabling environment for exploiting the trace mineral resources which have been known to exist in various parts of the country. The new policies and regulations to be formulated should not relate to exploration and exploitation of minerals per se but to take cognisance of the prevailing socio-cultural and economic conditions and needs of the local people and the nation at large.

In Kenya, lack of qualified personnel in the field of mining is the main cause for improper implementation and violation of mining policies and regulations. The absence of mining oriented programmes, such as mining engineering programme in the Universities is a clear indication of lack of manpower policies on mining. The study therefore recommends that in order to effectively formulate sound mining policies and regulations, a training programme should at least be introduced within the

country with a view to generating a pool of qualified labour for sustainable management of the mineral sector.

Finally, in order to realise greater efficiency in the mining sector, the Kenya Government should include in the Mining Act (Cap 306) a provision which requires that the mining companies and other organizations dealing with mining to provide an in-depth training to local people especially those living in the mining areas rather than importing labour from outside the mineral-based areas. Participation of local people in mining could instil the community a sense of responsibility and ownership in protection of the environment and rehabilitation even after depletion of the mineral resources.

6.4.2 Production Operation of Fluorspar

Issue: Transportation bottlenecks of fluorspar

Recommendation: Accessibility is important for the economic survival of production operations of mineral ventures. Kerio Valley is generally remote with an

extremely rough terrain which present difficulties in development of good road network. In order to ease transportation bottlenecks of fluorspar, KFC opened up its private road which links up the mine area through Elgeyo escarpment to the highlands. The 24 km All-Weather steep meandering road used for transportation of fluorspar is prone to rockfalls and other associated geological problems which escalate the cost of maintenance of the road and transportation cost of fluorspar. Transportation cost is further increased by modal changes involved in transportation of fluorspar to its customers overseas. In order to overcome transportation constraints of fluorspar, the study recommends that possibilities of a railway line to link Kerio Valley to the Highlands should be seriously examined. By doing so, real savings on transportation of fluorspar could not only be realised but also other fluorite deposits and other minerals which exist in Kerio Valley could viably be exploited. The actors which should be involved in railway line initiation are, the Central Government , KFC, Kerio Valley Development Authority

(KVDA) and other resource user agencies in the region. It is also important to integrate the transportation system related directly to mineral production to the general transportation network of the Kerio Valley region.

6.3.4 Environmental Effects of Fluorspar

Issue: Land dereliction and aesthetic degradation

Recommendation: The use of the open cast method of mining using explosives and earth moving equipment has resulted in landscape disfigurement. It was observed that the pits and holes created after exhaustion of the mineral are never filled, yet the mining Act CAP 306 give provisions for rehabilitation of abandoned excavations. However, provisions are not made for actual environmental restoration or reclamation of the land to a vegetative level. This call for the need for stricter administration and enforcement of existing mining laws. Since the Department of Mines and Geology is charged with all matters dealing with mineral exploration and exploitation,

its powers should be decentralised so that Development Authorities like, KVDA and County councils should participate in all aspects of mineral development in their areas of jurisdiction, and more importantly is to ensure that all mining laws and regulation are adhered to by mining organisations.

As regards damage to the environment in Kerio Valley, KFC should possibly adopt the rehabilitation technique employed by Bamburi Cement Portland in transformation of quarries into parks which serve as tourist attraction sites for generation of additional revenue. Alternatively the fluorite -based excavations could be filled and restored up to a level whereby irrigation farming involving citrus fruits plantation or agroforestry becomes possible. This is because citrus farming thrive well in Kerio Valley which KFC could plant on the degraded tracts of land as an environmental rehabilitation measure. Development of agroforestry and irrigation farming on the abandoned excavations will not only improve the quality of

environment but also contribute to diversification of employment as well as enhancing energy supply position of the local community.

Issue: Fluorite contamination of surface water sources

Recommendation: The study established that surface water sources have been seriously placed at risk by fluor spar mining activities. The industrial effluence (tailings) generated is directly channelled to Kerio river which drains into Lake Turkana, thus increasing the level of fluorite in water. Fluorite contamination of river Kerio is aggravated by mechanical pumpage of contaminated water from deep mine pits into river Kerio. Since Kerio river is the key resource in Kerio Valley's life support system, any negative influence like contamination of water is likely to jeopardize the entire ecosystem in the valley. There is need to adopt appropriate methods of industrial waste management which should encompass treatment of effluence and recycling as pollution control mechanisms. In

addition, groundwater sources should be mapped out and protected from the consequence of fluorite extraction.

6.4.4. Socio-economic implications of Fluorite mineral Development

Issue: Inappropriate location of human activities

Recommendation: It was noted that several human activities conflicted with fluorspar mining operations. Such activities include the location of residential areas, trading centres and periodic markets in the mine areas and its environs which are not protected from the effects of blasting and dust pollution. The periodic market at KFC premises is prone to fluorite contamination. The study recommends that some human activities like the periodic market be relocated outside the mining area. There is a need for the formulation of development control regulations which take cognizance of spatial planning of human settlements in mineral based areas.

Issue: Displacement of households

Recommendation: The most tragic impact of fluorspar mining in Kerio Valley is the unresolved question of the displaced 1200 households who originally owned land. It was noted that some of the household elites were better placed than semi-illiterate and poor members in terms of compensation. The compensation value for the mineral based land was Ksh 450 per acre which was not enough to enable some displaced households to move and buy land elsewhere, consequently most of them decided to stay as squatters in the lease area. The ultimate effect of fluorspar mineral development in Kerio Valley has been social disruption of the Valley community. The study recommends that new mining legislations should be formulated which address the question of mineral ownership and land ownership. Mineral ownership should be separated from land ownership so that the occupiers of mineral-based land are compensated adequately. Although the Mining Act provides for adequate

compensation to the displaced inhabitants, there is need for a proper compensation and resettlement policy which should take cognisance of incorporation of the value of mineral, as well as other socio-cultural costs of displacement of communities in the mine areas. In particular, the KFC, Government and county council should work out a programme involving resettlement of households who still live in the lease area as squatters. Since mineral resources are non-renewable and damaging to the environment, the local people should be involved as stakeholders in the mining ventures so that they can realize the benefits accrued from mining and to find other alternative sources of employment and sustenance of infrastructure even after the mines are exhausted and closed down.

6.5 RECOMMENDATIONS TO RESEARCHERS AND POLICY MAKERS

The paucity of scholarly literature on mining in Kenya, makes the contribution of this study very significant. The findings

discussed in the study should be considered as some of the major contribution the thesis has made to the mining sector in Kenya. However owing to the complexity of this study coupled with confidentiality of information, it was not possible to examine all aspects of mineral development in Kenya. Mineral sector, like agriculture will continue to play a pivotal role in steering Kenya to achieve its prognosticated policy of industrialization by the year 2020. There is need for continuous and relevant information gathering which will assist policy makers to buy the idea of focusing more attention on mining. The Kenyan Newspapers have in the past reported the existence of some mineral deposits, especially oil in the ASAL areas. With the improvement of technology, and more recently, the use of computers in exploration, Kenya's mining industry is likely to be bright in the future. Therefore, there is need to concentrate on research dealing with mining of other minerals such as soda ash, limestone, amongst others. The outcome of such studies could help in formulations of comprehensive policies for sustainable mineral development.

Another specific area that requires detailed investigation is the study of the impacts of fluorspar mining on entire ecosystem in Kerio Valley. The study should capture the aspect of fluorspar mining as a health hazard. There are allegations that fluoride contamination of surface water is contributing to miscarriages among the livestock. Scientific investigation on this matter is the only way of disputing or confirming the allegations.

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APPENDIX I: HOUSEHOLD DATA ASSESSMENT QUESTIONNAIRE

UNIVERSITY OF NAIROBI
DEPARTMENT OF URBAN AND REGIONAL PLANNING

Declaration

The data to be collected in this questionnaire is strictly designed for academic purposes and will not be divulged.

Questionnaire No. _____
Sublocation _____
Village _____
Date _____
Name of interviewer _____
Name of Respondent _____ (optional)

Demographic characteristics

1. Name / family size	2. Relationship with Household Head	Sex	Age	Marital Status	Level of Education

2. Relationship with the Household head.
 - (1) Household Head (2) Spouse (3) Son (4) Daughter
 - (5) Mother (6) Father (7) Other (specify)
3. Sex _____ (1) Male (2) Female
4. Age _____
5. Marital status (1) Married (2) Unmarried (3) Widowed
(4) Separated (5) Other
6. Level of Education (1) No schooling (2) Primary
(3) Secondary (4) Post secondary
(5) Other

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 (4) Separated (5) Other
6. Level of Education (1) No schooling (2) Primary
 (3) Secondary (4) Post secondary
 (5) Other

Socio-Economic Data

7. What is your main occupation ? (1) Mining (2) Farming
(3) Business (4) Teaching
(5) Student (6) Other
8. Could you please state your total monthly income _____
(1) less than 3000
(2) 3001 - 6000
(3) 6001 - 9000
(4) 9001 - 12000
(5) over 12000
9. What is the total area of land that you own in acres?

10. How did you acquire this land? _____
11. Did the Mining Company acquire any part of your land for mining?
(1) Yes (2) No
12. If yes, what portion of your land was acquired in acres?

13. Give the details of compensation for the acquired land _____
(1) Cash compensation (2) Alternative land compensation
(3) Employment (4) Other (5) Not applicable
14. What type of crops do you grow in your land? _____
(1) Subsistence (2) Cash
15. What problems do you experience in crop production?

16. What efforts are you making to solve these problems?

17. Do you keep livestock? (1) Yes _____ (2) No _____
18. If yes, state the type and number of livestock that you keep.
(1) Cattle (2) Sheep (3) Donkey (4) Goats (5) Poultry
(6) Other
19. What problems do you encounter in livestock production?
(1) Lack of pasture and water
(2) Marketing
(3) animal diseases
(4) Other (specify)
20. What measures have you taken to solve them?

21. Where do you buy, your farm inputs and other household goods from? _____

- (1) Eldoret town (2) Soy trading centre
 (3) Kimwarer trading centre (4) Muskut centre (5) Kabokbok
 (6) Chepsirei (7) Other (specify) _____
22. What is the average distance to the buying centre? _____
23. What about centres where you sell your farm produce

24. Give the distance to places where you sell your farm produce

25. Could you please, give a breakdown of your household expenditure
 per month in Ksh _____
- (1) Food _____ (2) Health _____
 (3) Clothing _____ (4) Labour _____
 (5) Education _____ (6) Savings _____
 (7) Other (specify) _____
26. State whether the dwelling units are;
 (1) Permanent _____ (2) Semi-permanent _____
 (3) Temporary _____ (4) Other _____
27. State the type of building materials of the dwelling units
 (a) Roofing _____ (1) Iron sheets (2) Tiles (3) grass
 (4) Other (specify) _____
 (b) Floor _____ (1) Cement (2) Earth (3) Wood/
 timber (4) Other (specify) _____
28. Which of these construction materials were obtained from the mine
 area? (1) Grass (2) Stone (3) Brick (4) Other (specify)

INFRASTRUCTURE

29. What are the your main sources of domestic water ?
 (1) Pond (2) Streams / rivers (3) Borehole (4) Private water
 connection supply (5) Communal piped water supply (6)
 Other (specify) _____
30. State whether the piped water is
 (1) Connected to K.F.C. water scheme (2) Community water
 connection (3) Individual connection (4) Other (specify) _____
31. What is the distance to your common source of water in Km?

32. Do you experience any water problems? (1) Yes (2) No
33. If yes, state the water problems _____
 (1) Pollution / contamination (2) Water shortage
 (3) Long distance to the water point (4) Other (specify)
34. In your opinion, what could be the solutions to water problems in
 this area? _____
35. What are the common diseases in your household?

36. Where do you go for medication? (1) Eldoret District Hospital
(2) Iten District Hospital (3) Kenya Flourspar Dispensary
(4) Herbal Medicine (5) Other (specify)
37. State the schools to which your children go:
-
38. Why do you take your children to these schools?
-
39. What is the distance to the school(s)?
-
40. Are there any recreational facilities available for use in this area?
(1) Yes (2) No
41. If yes, state the type of recreational facilities that you utilise.
-
42. What are your sources of energy?
(1) Electricity (2) Gas (3) Kerosene (4) Wood / charcoal
(5) Other (specify)
43. Which modes of transport do you use for travelling and
transportation? _____ (1) Matatus
(2) K.F.C.'s lorries (3) Bicycles (4) Animal / carts
(5) Walking (6) Air transport (7) Other (specify)
44. What problems do you experience in the use of these modes?
-
45. Do you belong to any community development group(s)? (1)
Yes (2) No
46. If yes, what are the objectives of the development group that you
belong?
-
47. In your opinion what do you consider to be the most important
impact of fluorspar mining in this area? (rank them)
-
- (1) Employment creation (2) Foreign exchange
(3) Transportation (4) Electricity (5) Creation of market for
Agricultural products (6) Clean water supply (7) Health
services (8) Postal and telecommunication services (9)
Education
(10) Improvement in building standards (11) Other (specify)

SANITATION / ENVIRONMENTAL DATA

48. What are the main types of sewage disposal systems available?
-
- (1) Pit latrine (2) Septic tank (3) Main sewer
(4) Bucket latrines (5) Other (specify)

49. What methods do you use to manage your solid wastes?

-
- (1) Burning (2) Rubbish pits (3) Throwing away
(4) Other (specify)

50. Have you ever experienced any environmental problems emanating from Fluorspar mining in this area? _____ (1) Yes (2) No

51. If yes, state when and the nature of the environmental problems.

52. In your opinion what do you consider to be the most critical environmental impacts of Fluorspar mining?

53. What solutions can be put forward to deal with the environmental problems of fluorspar mining in Kerio Valley?

54. What other observations do you consider important but not covered in this questionnaire?

**APPENDIX II: BUSINESS DATA ASSESSMENT
QUESTIONNAIRE**

**UNIVERSITY OF NAIROBI
DEPARTMENT OF URBAN AND REGIONAL PLANNING**

Declaration

The information availed in this questionnaire will be used for academic purposes only and will not be divulged.

- Questionnaire No. _____
- Name of the centre _____
- Name of the respondent _____ (optional)
1. Type of business _____
 2. Age _____
 3. Education level _____ (1) No schooling
(2) Primary (3) Secondary (4) Post secondary
(5) Other (specify)
 4. State any other occupation of the owner of the business

(1) Farming (2) Mining (3) Civil servant (4)
Teaching (5) None (6) Other (specify)
 5. Where the owner of the business hails from _____
(1) Within the mine area (2) Outside the mine area but
within Keiyo District (3) Elsewhere in Kerio Valley (4)
Outside Kerio Valley (specify) (5) Other
 6. When was the business established? _____
 7. State whether the premise is _____ (1) Rented
(2) Individually owned (3) Other (specify)
 8. If rented, how much do you pay per month in Ksh. _____
 9. How much do you sell per month in Ksh. _____
 10. Could you please, estimate the average profit that you get per
month in Ksh. _____
 11. Where do you get your supplies from?
 12. _____
What modes of transport do you use to get your supplies?
(1) Matatu (2) Lorries (3) Animal (4) Bicycle
(5) Other (specify)
 13. Where do most of your customers come from? _____
 14. Which commodities / goods command high demand in this area?
 15. _____
Explain your answer _____

16. What about the commodities with least demand?

17. Did you get business loan? (1) Yes (2) No

18. If yes, state the type and amount in Ksh (1) Type _____
(2) Amount in Ksh _____

19. How do you spend your business earnings?

20. State whether the premise is (1) Permanent (2) semi-permanent
(3) Temporary (4) Other

21. Specify whether you utilise the following services and their corresponding payments per month:

Payment per month in Ksh

- | | |
|--------------------|-------|
| 1. Electricity | _____ |
| 2. Piped water | _____ |
| 3. Telephone | _____ |
| 4. Other (specify) | _____ |

22. How many employees do you have?

23. What problems do you face in your business undertaking?

24. What measures should be taken to iron out these problem(s)?

25. In your own assessment, how is the performance of your business?
(1) Improving (2) Average (3) Good (4) Other (specify)

26. Do you think fluorspar mining activity has in any way promoted your business? (1) Yes (2) No.

27. If yes, explain your answer _____

28. What role(s) does the Keiyo County Council play as far as your business is concerned?

29. How much do you pay for business licencing per year in Ksh? _____

30. What other comments do you have to make regarding business situation in Kerio Valley?

APPENDIX III: INTERVIEW SCHEDULE FOR THE MINING COMPANY MANAGEMENT

UNIVERSITY OF NAIROBI DEPARTMENT OF URBAN AND REGIONAL PLANNING

Declaration: Any information availed will be used for academic purposes only and not for any other purpose.

1. Name of the respondent _____
 Designation _____
 (1) General Manager (2) Administration Manager
 (3) Resident Mining Engineer (4) Mill Manager
 (5) Other
2. Briefly describe the history of mineral development in Kerio Valley.
3. What size of the land did the Company acquire for mining? Under what terms was the land acquired?
4. What problems did the Company face in acquiring the mineral based land? _____
5. Did the acquisition of land contribute to the eviction of the original owners of land? (1) Yes (2) No.
6. If yes, give the details of displacement and compensation.
7. What size of the land is used by the Mining Company for
 (1) Mining / quarrying
 (2) Residential
 (3) Industrial activities
 (4) Dumping
 (5) Other
8. What is the estimated amount of fluorite distributed in the mining site? _____
9. How long will these deposits be mined?
10. What is the size of labour force involved in mining?
11. Could you please, give the statistical trends in employment of the last ten or more years _____
12. What is the gender composition of the labour force? How many are:

	Male	Female
(1) Skilled	_____	_____
(2) Semi-skilled	_____	_____
(3) Non-skilled	_____	_____
(4) Casuals	_____	_____
(5) Others	_____	_____
13. Are there any foreign expertise? Yes _____ No _____
14. If yes, state the number and their qualifications? _____
15. Could you please grade and give the salary scales of all the company employees in Ksh per month.

1. Casual workers _____
2. Unskilled workers _____
3. Clerks and secretaries _____
4. Skilled workers _____
5. Foreign expertise _____
16. What are some of the benefits / incentives that you give to your employees? _____
17. How is the organisational structure of the mining company management? _____
18. What other costs are incurred in the production of fluorspar in Kerio Valley? _____
19. What is the production level of fluorspar in tonnes per month? _____ and per year? _____
20. Could you please, give the statistical trends of fluorspar production in tonnes for the last ten or more years. _____
21. State the current earnings of fluorspar in terms of foreign exchange. _____
22. Give the statistical export earnings of fluorspar for the last ten or more years. _____
23. What accounts for the fluctuations in fluorspar production and export earning over the years? _____
24. Which countries in the world are the chief importers of fluorspar?
25. What modes of transport are available for the transportation of fluorspar? _____
26. Could you please state all the assets and investment of the Mining Company. _____
27. What is the total payroll and expenditure of the fluorspar mining company? _____
28. What method(s) of mining is used in extracting fluorspar?
29. What are the advantages and disadvantages of these methods?
30. How does the Company rehabilitate the excavated sites?
31. How does the Mining Company manage its solid and liquid wastes?
32. Are there any other environmental problems associated with Fluorspar mining? (1) Yes (2) No.
33. If yes, enumerate these other environmental problems.
34. What efforts are you making to deal with these environmental problems?
35. How much money does the Mining Company incur on pollution control and other environmental restoration mechanisms?
36. What is the role of other Governmental and Non governmental organisations as far as fluorspar mining is concerned?
37. What developmental benefits have accrued to the people living in the mining area and its peripheral areas?
38. What are the problems that Fluorspar mining is facing in its attempts to operate in Kerio Valley?

39. How can these problems be solved?
40. What is the future of fluorspar mining in Kerio Valley and in Kenya in general?
41. What other observations do you find it useful but not covered in this questionnaire?

**APPENDIX IV: INTERVIEW SCHEDULE FOR THE KEY
INFORMANTS
UNIVERSITY OF NAIROBI
DEPARTMENT OF URBAN AND REGIONAL PLANNING**

Declaration: Any information availed will be used for academic purposes and not for any other purpose.

Name of the respondent _____ (optional)
Designation _____

1. Describe in detail the history of fluorspar mining in Kerio Valley

2. Since the mineral - based land was originally owned by the people in Kerio Valley, under what terms was their land acquired?

3. How many households were displaced? _____
4. Where is the present occupational area of the displaced households?
5. Could you please describe briefly their socio-economic status?

6. How many people from Kerio Valley are employed by the Fluorspar Mining Company? _____
7. Did the Mining Company use the displacement criteria to employ these people? (1) Yes _____ (2) No _____
8. Explain your answer. _____
9. In your opinion what do you consider to be the most important contribution of fluorspar mining to development in Kerio Valley?

10. What role does the Keiyo County Council play in Kerio Valley?

11. What in your view can be done to maximise the socio-economic benefits accrued to the people living and working in Kerio Valley?

12. Do you consider Fluorspar mining activities in Kerio Valley as a health hazard? (1) Yes _____ (2) No _____
13. Explain your answer _____
14. Could you please cite any present and past environmental problems of environmental effects associated with fluorspar mining in Kerio Valley (if any) _____
15. What other observations do you find it useful but not covered in this questionnaire?