THE PLASTICS PROCESSING INDUSTRY IN KENYA

BY

MWANGI, H. K.

Research Paper submitted to the Department of Economics, University of Nairobi, in Partial Fulfilment of the Requirements for the Degree of Master of Arts in Economics.

June, 1984

To my Mum, Family, all the Mwangi's and in Memory of my Dad.

This Research Paper is my original work and has not been presented for a degree in another University.

....

Mwangi, H. K.

This Research Paper has been submitted for examination with our approval as University Supervisors.

....

Dr. P. E. Coughlin

....

Dr. J. O. E. Odada

TABLE OF CONTENTS

CHAPTER Page

Acknowledgements

I gladly acknowledge with the deepest gratitude the help accorded to me by all those who made the completion of this research a success.

Special thanks goes to my supervisor, Dr. Coughlin, P.E. for 'pushing me a bit hard' with an intention of producing an enlightened economist. This not only made me aware about my scholastic obligations but also kept me on the 'move'. This research paper is thus the outcome of his very encouraging, demanding and scholarly advice.

I also wish to convey special thanks to my other supervisor Dr. Odada, J.O.E. for carefully reading the whole paper and making very worthwhile comments.

I gladly send deep appreciation to all those who were a source of inspiration: first and foremost to all friends who contributed towards my progress; (1) to all industrialists of different plastic firms for their co-operation, especially, a) Mr. Mahendra Shah of Pan Plastics Limited, b) Mr. Kumar of Eslon Plastics Limited, and c) Mr. Prem Prinja of Polycans Limited Mombasa just to name a few; (2) to my family for their co-operation, especially, my son Mwangi for his continued 'harassment' and my wife for typing this paper. Also special thanks go to Mrs. Elizabeth Ngamate for making the typing work complete.

Another vote of thanks goes to Kenyatta University College for their generous financial support of my graduate studies.

I wish to pay tribute to my mum for her encouragement, prayers and all the sacrifice she continues to make for my sake.

Lastly but important, the author gladly accepts full accountability for all the shortcomings in the ideas presented in this paper.

THANKS TO ALL

Herman Karanja Mwangi

May, 1984

List of Tables

Table | Page

List of Figures

List of Abbreviations

BTS	-	Birla Technical Services
ERP	-	Effective Rate of Protection
IRR	-	Internal Rate of Return
ISI	-	Import Substituting Industrialization
Kg(s)	-	Kilogramme(s)
K.Shs.	-	Kenya Shillings
K£	-	Kenya Pound
LDC's	-	Less Developed Countries
LDPE	-	Low Density Polyethylene
PE	-	Polyethylene
PVC	-	Polyvinylchloride
TPY	-	Tonnes Per Year
$	-	US Dollar

Abstract

The Kenyan Processing Industry produces inputs which are crucial for development for all economic sectors. To exemplify some of the problems less developed countries face during the development process, this research studied: (a) the importance of plastic material, (b) the growth of the Kenyan plastics industry (c) the degree and causes of capacity underutilization, (d) machinery and differentiation, (e) mould making facilities, (f) imports of final goods and (g) exports.

Empirical results show that the plastics industry has grown anarchistically and mainly produces packaging and consumer products rather than industrial components and parts. This asymmetric production prolongs import dependence on inputs and products.

The study also shows (a) that economic resources are grossly underutilized; (b) that much technically unnecessary machinery and product differentiation exist, and (c) that the industry lacks mould makers and is not training them.

This study further proposes several ways of reducing dependence on imported inputs and outputs in order to create jobs and save foreign exchange.

The measures proposed are: (a) non-fabrication of inappropriate products, e.g. plastic sandals and ropes, (b) instituting a national co-operative to obtain bulk purchase and transportion discounts, (c) re-cycling plastic waste, and (e) pelletizing PVC. Also two feasibility studies on polyvinylchloride and low density polyethylene are reviewed. Besides creating employment opportunities, these proposals save about Kshs. 390 million per year. The study also points to some possibilities for further exports.

CHAPTER I

INTRODUCTION

Less Developed Countries (LDC's) need to accelerate industrial development in order to reduce economic backwardness as compared to the industrial nations. To achieve this, LDC's have to solve the problems that accompany industrialization, such as: a) the chronic under-utilization of productive capacities; and b) impediments to the use of local sources of inputs. After reviewing the literature explaining plastics, and describing the Kenyan Plastics Processing Industry, this study examines the extent these two aspects prevail in the plastics industry in Kenya and suggests methods to alleviate these problems.

1.1. Goals of the Study

This study explores the plastics processing industry in Kenya inorder to exemplify some of the problems LDC's encounter during the process of industrialization. The study seeks to explain plastics and show their relative significance in a growing economy by focussing on: (a) economic linkages with the plastics processing industry; (b) the processes and products fabricated; (c) the growth of the plastics industry and its importance in the Kenyan manufacturing sector. The study further analyses the degree of utilization of plant, equipment, supervisory skills and labour force.

Here, we want to know whether human and capital resources are grossly under-utilized. In this research, we also attempt to isolate the causes of resource under-utilization in this industry. Those examined include: (a) insufficient and seasonal demand for plastic products; (b) difficulties over raw material supplies; (c) fuel shortages; (d) shortage of skilled manpower; (e) plant breakdowns and (f) difficulties in obtaining spare parts. Knowledge of the causes of resource under-utilization will enable us to suggest ways of raising the levels of capacity utilization. This study also examines some obstacles that hamper the establishment of backward linkages: (a) plastic machinery differentiation; (b) product differentiation; and (c) the lack of good mould making facilities.

Next, the possibilities for deeper import substitution by the establishment of domestic sources of inputs and by locally making the currently imported final goods are considered. Finally, the potential for the export of Kenyan plastic goods is briefly explored.

1.2 Significance of the Study

Though it uses imported inputs, the plastics industry in Kenya is a strategic economic sector which supplies inputs to many other industries. This is the first study of the Kenyan Plastics Industry. It is a comprehensive study and thus should be of relevance to economic planners, policy makers and researchers.

The government acknowledges the existence and importance of under-utilized capacity. For instance, the current Development Plan 1984-88 advocates optimal utilization of installed capacity.[1] However, the government lacks sufficient data at the plant level which is needed to consider ways to raise the levels of capacity utilization. This study provides estimates of utilization rates at the plant, process and industry levels. It also suggests some of the causes of capacity under-utilization.

This study is also one among many industrial studies conducted by the University of Nairobi's Industrial Research Project which will help to identify: (a) the errors made in planning industrial development, and (b) the opportunities present in many Kenyan industries. Thus, it contributes towards designing a comprehensive industrial policy for Kenya.

Finally, the study indicates various needs for further research.

1.3 Organization of the Study

Chapter II surveys the literature on: (a) plastics; (b) the measures, levels and causes of capacity under-utilization; (c) product differentiation; and (d) the experiences and results from import substituting industrialization in LDC's.

This chapter briefly explains plastics and throws light on some of the issues and problems facing LDC's during the process of industrial development.

Chapter III discusses the Kenyan Plastics Processing Industry with a view to defining the industry and assessing its growth and contribution towards the development of Kenyan manufacturing.

In chapter IV, the survey data is presented and analysed. This chapter briefly outlines the procedure of data collection and its limitations. Thereafter, the results are presented and discussed in the light of each operational hypothesis.

In chapter V, we examine imported inputs and the imported final plastics goods. In both cases, the potentials for further import substitution or cutting down on foreign exchange requirements are considered. Also, the exports of the Kenyan plastic goods are reviewed. Finally, chapter VI draws conclusions and provides recommendations.

CHAPTER II

LITERATURE REVIEW

In this chapter we survey literature on: plastics; capacity utilization; differentiation; and import substituting industrialization (ISI). First, plastics are defined and their characteristics, history, and fabrication methods are described. Next, the range of plastics products, their submarkets and significance to a developing nation are considered. The survey also covers: Measures , Levels and causes of Capacity Underutilization; product differentiation; experiences and results from ISI in Less Developed Countries (LDC's). The principal objective is to explain the plastics briefly and to throw light on some of the issues and problems which face many developing nations undergoing industrial development.

2.1 Plastics

2.1.1. Definition of Plastics

The term plastics[1] designates large molecular weight organic compounds or substances which can be formed through the application of heat and/or pressure and thus flows into various shapes. During their processing, they can be worked in solutions, mixtures, dispersions... e.t.c for processes such as foaming, laminating, coating, moulding and extrusion

2.1.2 Types and Classification of Plastics

"Plastics" denotes a wide range of materials with similar characteristics grouped into thermosets and thermoplastics and further reclassified by chemical properties/types[2].

Thermosets[3] are made of long chain molecules which are cross linked to neighbours making a three dimensional web. After curing, thermosets lose the ability to be formed by heat and/or pressure. i.e. thermoset mould becomes rigid, hard, insoluble and relatively unaffected by heat upto the decomposition temperature.

Thermoplastics are made of long linear chain molecules. Thus, they can be reshaped or remould several times subject to the limits of thermal fatigue and degradation. i.e. they retain the ability to be reformed by heat and/or pressure. This lends versatility to the processes by which they can be formed as well as allowing the recycling of scrap and trim.

These two groups could further be categorised by their physical, mechanical electrical or chemical properties. (Examples, see section 2.1.3). However, for simplicity, classification is normally based on chemical types. More than twenty five chemical types or major families of plastics are in commercial use today. They are usually compounded with a variety of additives to alter their properties. Thus, each chemical type could be varied from flexible to hard rigid solids. This alteration enables production of a variety of items from the same raw materials[4].

2.1.3 General Properties of Plastics

In this section, properties of plastics are illustrated. For a detailed discussion see Miner and Seastone[5]:

Appearance: plastics may have brilliant colours, luster, clarity and highly polished surfaces.

Density: plastics weigh less than other materials of construction.

Thermal properties: plastics have different values for coefficient of expansion, conductivity, specific heat, heat distortion temperatures, heat resistance and flammability.

Electrical Properties: at ordinary voltages and frequencies, plastics are good insulators and possess electrical resistivity, dietectrical constant, power factor, and arc resistance properties.

Mechanical Properties: among the valuable mechanical properties are; tensile, compressive, flexural and shear strength; impact resistance and toughness, rigidity, creep, dimensional stability, and durability.

Plastics are resistant to chemicals.

When considering certain applications of plastics, a combination of any of the above properties should be regarded.

2.1.4 Development of the use of Plastics

Plastics are of recent origin when compared to traditional materials (e.g. metals, rubber, natural fibres,ceramics etc). Simonds and church[6] notes that:

> "The modern plastics industry may be said to have started in 1930 when diversified products of plastics research laboratories first came into commercial use in appreciable volume. The commercial materials available that year included the nitrates, the phenolics, the acetates, casein and ureas, and the alkyds."

Polyvinylchloride, polystyrene and polyethylene, which dominate the plastics market in the less developed countries were introduced commercially in the 1930's and 40's. The progress in plastics development is shown in Table 1.

Table 1: Progress in Plastics Development
Approximate Dates Covering Introduction of Some Commercial Plastics

Year	Plastics	Typical Application
1870	Nitrates (Celluloid)	Eyeglass frames
1909	Phenolics	Telephone hand set
1909	Cold molded	Electric heater parts
1919	Casein	Knitting needles
1919	Vinyl acetates	Adhesives
1926	Alkyds	Molded electrical bases
1926	Aniline-formaldehyde	Terminal boards
1927	Cellulose acetate	Molded products
1928	Ureas	Lighting fixtures
1931	Acrylics	Brush backs, displays
1935	Ethyl cellulose	Flashlight cases
1936	Polyvinyl chloride	Raincoats
1938	Polyvinyl acetals	Safety glass interlayer
1938	Polystyrene	Housewares
1938	Cellulose acetate butyrate	Extended trim
1938	Polyamides (nylon)	Fibres
1939	Polyamide molding powders	Gears
1939	Melamines	Tableware
1939	Polyvinylidene chloride (saran)	Auto seat covers
1942	Allyl diglycol cabonate (CR-39)	Cast sheets
1942	Polyethylene	Squeeze bottles
1942	Plyesters	Laminated reinforced plastic boats
1943	Silicones	Motor insulation
1943	Polytetrafluoroethylene (Teflon)	Gaskets
1945	Cellulose propionate	Pen casings
1947	Vinyl organoscls and plastisols	Coatings, foams
1947	Epoxies	Potting compounds, adhesives

Table 1 Continued

Year	Plastics	Typical Application
1948	Acrylonitrile-butadiene-styrene (ABS)	Simulated leather for luggage, etc.
1949	Polychlorotrifluoroethylen (Kel-F)	Gaskets and valve seats
1953	Polyurethanes	Sheets and foams
1955	Polyurethanes	Coatings
1957	Methylstyrene*	Housewares
1958	Polyacrylamides	Adhesives
1958	Polyethylene Oxide (Radel)	Packaging
1958	Polyacetals (Delrin)	Automotive parts
1959	Chlorinated polyether (Penton)	Pump parts
1959	Polycarbonate (Laxan)	Housings
1959	Polypropylene	Luggage
1962	Polyallomers	Molded hinges

*Manufacture discontinued.

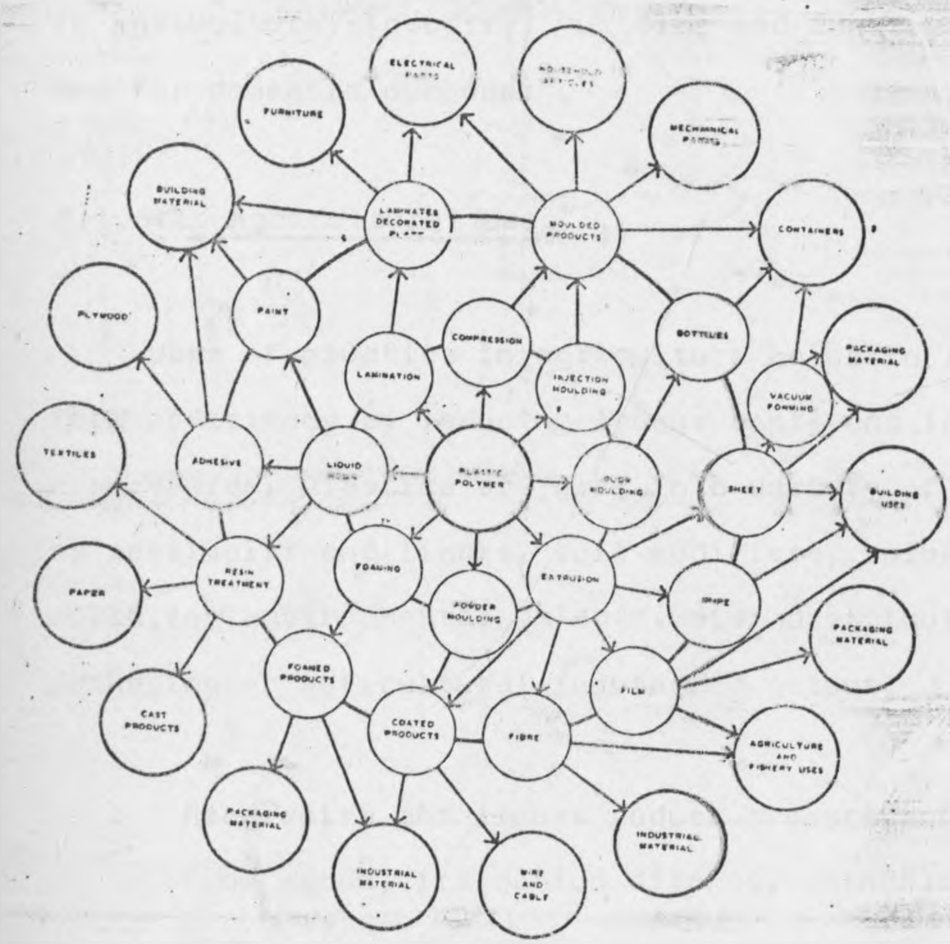
Source: Simonds, H.R. and J. M. Church, A Concise Guide to Plastics, (New York, Reinhold Book Corporation, 1968) p.l.

2.1.5 Fabrication Methods, Plastic Products and their Sub-markets

The principal methods by which plastic materials are processed into finished articles are: lamination, calendering, foaming, coating, blow moulding, compression moulding, injection moulding, extruding and thermoforming casting. Each method can be varied to produce different products. The particular method used depends on: the plastic, the design, the shape, size of the product and the desired end use of the finished item, e.g. extrusion is suitable for products such as film, pipes, sheets rods, profiles, fibres and extrusion coating.

Plastic products are numerous and could be grouped into broad classes according to their end use. In this paper, applications of plastics are categorised into: a) agricultural uses, b) industrial uses, c) building and construction, and d) consumer uses. These broad classes are referred to as plastic "submarkets". Demand for plastic products in the first three submarkets is derived demand. i.e. it depends on the contractions and expansions of these sectors. Whereas demand for plastics products in the last submarket depends on prices, consumers income, tastes and preferences. Fig. 1 gives a detailed account of the interrelationship between the methods of plastics processing, end products and their end uses. For instance, the inner ring of circles indicate different processing methods. e.g. extrusion, foaming and lamination. Likewise, the middle ring of circles shows products resulting from the processes. e.g. film, laminated decorated plate. Similarly, the outer ring of circles indicates the applications of plastic products. e.g. agriculture and fishery uses, packaging materials, and electrical parts.

Fig. 1 Interrelationship among methods of plastics processing, end products and applications.



Source: UN, Studies in the Development of Plastics Industries (New York, UN, 1969) p. [illegible].

2.1.6 The Significance of Plastics to a Developing Nation

The importance of plastic materials stems from the production of a wide variety of plastic products with numerous applications. Plastics are widely used in agriculture, industry, building and construction and for domestic purposes[7].

2.1.6.1 Agricultural Uses[8]

Uses of plastics in agriculture helps to improve farm efficiency by reducing labour costs and increasing crop yields. Plastics are used in a variety of ways; as reservoirs and liners, soil modifiers, animal shelters, mulch, for environmental balance, water distribution and packaging of agricultural inputs and output:

Reservoirs and liners reduce seepage and leakage from ponds, irrigation ditches, channels and 'water traps' in arid areas.

Soil modifiers maximize retention of fumigants volatiles by covering soil which has been treated with soil fumigants.

Animal shelters reduce fatalities among younger animals while tunnels and greenhouses are used for a variety of purposes including sheltering against heavy rains and winds.

Mulch reduces moisture evaporation, controls weeds, accelerates plants maturity, increases soil temperature and reduces nutrient leaching. Thus, plastics help to achieve an environmental balance.

Plastic pipes distribute water. Plastics are used extensively in packaging agricultural inputs e.g. fertilisers chemicals and outputs e.g. sugar, maize, onions etc.

2.1.6.2 Industrial Uses

Industries use plastics for appliance parts, tool and hardware items, automotive parts and packaging[9]. For instance, the following items could be made from plastics:

a) Appliance parts: television console, radio cassings, clocks, housing for electric knives, b) Tools and hardware: screw driver handles, dials c) Automotive parts: Calendered upholstery, mudguard extensions, radiator fan, arm rests, fuel tanks, steering wheels, bearing, battery, oil filter cap d) Packaging: moulded containers, plastic woven sacks, plain bags, and crates.

2.1.6.3 Building and Construction Uses

Plastics play a significant role in the building and construction industry. They are used in: signs and advertisements, building pannels, walls, windows, doors, floor covering, roof eaves and gutter; in plastic based coating such as paints, adhesives, resin treatment; and for insulation in electrical devices, lighting fixtures, laminated sheets, plumbing pipes and fixtures.

2.1.6.4 Consumer Uses

Plastic products are also made for domestic uses and familiar examples include: foamed products, coated fabrics, furniture, household ware such as washing bowls, buckets, brush handles and measuring jugs, toys, tooth brushes, shoes, pens, artificial flowers and storage boxes.

2.2 CAPACITY UTILIZATION

This section defines capacity and briefly examines the various concepts used. It also shows the levels and causes of capacity underutilization in LDC's.

2.2.1 Measures of Capacity Utilization

Various concepts and definitions of full capacity use different capacity parameters and thus result in different conclusions on the levels of utilization.

There are three possible approaches to measuring capacity. They are sociological, economic and technical approaches.

The sociological approach concentrates on the determinants of the supply of labour and manpower under-utilization.[10]

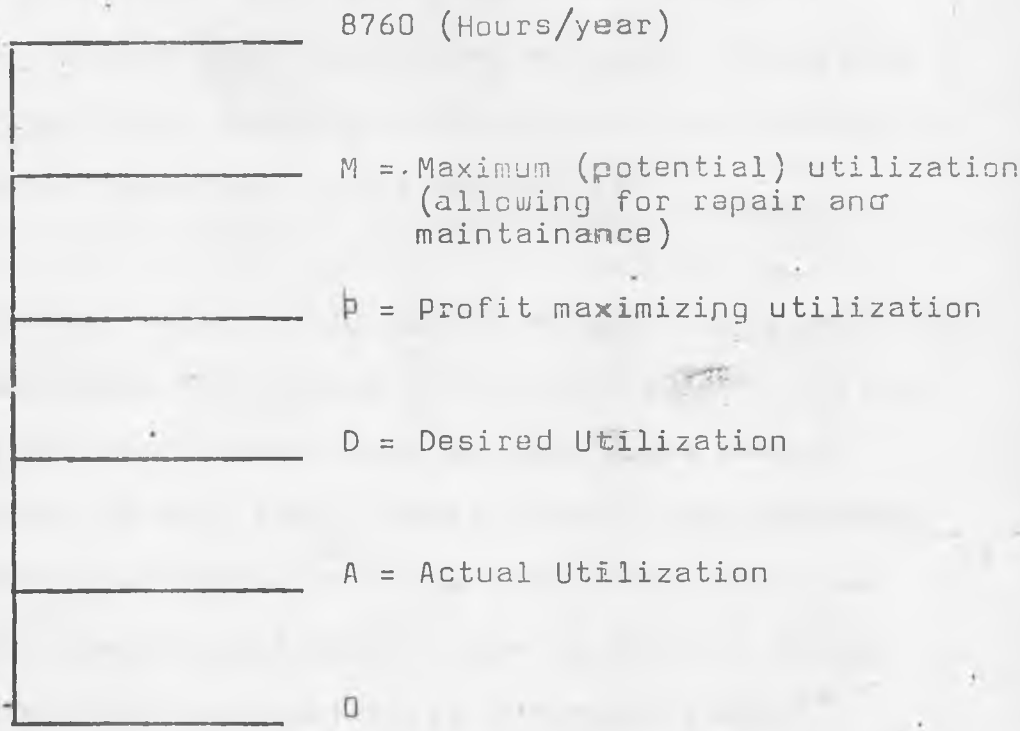
The economic approach to capacity measurement involves cost and the limitations imposed by interdependence of different sectors of the economy. In this case, the theoretical framework is developed in the theory of the firm and full capacity is defined as the output associated with full competitive equilibrium. Thus optimum capacity utilization corresponds to the minimum point of the average cost curve. Some of the shortcomings of this definition are: (a) difficulties in obtaining the cost data at the plant level; (b) difficulties in estimating the cost functions; and (c) the possibility that the cost curves will not be U-shaped in the long run. Nevertheless, Klein has explored some of the methods of capacity measurement in terms of cost function and in particular the properties of a probit total cost function.[11]

The technical approach considers capacity from the output side of the production process. The capacity index is given by the ratio of actual output to potential output. This approach assumes no supply bottlenecks and it is based on norms of various operational standards. When defined this way capacity is purely an engineering concept.

While actual output data may be available from a firm or an industry, potential output is always difficult to estimate.[12] However, it depends on:
(a) the productivity of the equipment per unit of time:
(b) the potential operating time of the capital equipment, and; (c) the balance of the investment on various machinery and equipment if several processes are involved. Hence, estimates of (a) and (b) for a given operational time period should be consistent with the prevailing conditions of production and thus represent the maximum achievable.

This time criterion of measuring capacity at the plant and industry levels is popular among researchers in LDC's.[13] It associates 24 hours a day and 365 days a year with 'full capacity' assuming a plant operates continuously throughout the year. Also it identifies at least five levels of plant utilization namely, actual, desired, profit maximizing maximum utilization levels and the maximum number of hours a plant is available in one year as illustrated below:

Fig.2 Levels of Capacity Utilization



This study also adopts this approach because it is easy to get the hours a plant or machine is operated and the potential operating time (M). " Full capacity " is defined as OM and actual utilization as OA. Thus, the rate of plant or machinery utilization is given by the ration OA/OM.

2.2.2 Levels of Capacity Utilization in LDC's

Excess capacity is pervasive and a deterrent to growth in LDC's.[14] In the United Nations Industrial Development Organization studies, it is estimated that on average, one third of the installed productive capacities are used in LDC's.

The Latin American Institute of Economic and Social Planning suggests that about 50% of the invested capital in productive capacities are used over a long period and Carry maintains that capacity utilization in developing countries hardly exceeds 20%.[15]

Lecraw, in his study of the manufacturing sector in Thailand shows that actual utilization is 28%, desired is 29% and profit maximizing is 65%.[16] The Kenyan foundries use only 23% of their capacity and the metal Engineering Workshops use only 34%.[17] The effective capital capacity utilization rate in Electric Motor Reconditioning and manufacture in Kenya is 29%.[18] Lim also shows that local firms use 65% of their capacities and foreign use 78% in the Malaysian Manufacturing Sector.[19]

In general, the productive capacities in LDC's are left idle most of the time. This not only wastes resources but also retards industrialization. To expand the evidence for Kenya, this study provides estimates of utilization rates at both the plant and process levels for the Plastics Processing Industry.

2.2.3 Causes of Capacity Under-Utilization in LDC's

Lecraw points out that extensive capital idleness in LDC's is a combination of: (1) Unintended idleness due to deficient demand, input shortages, technological failure or managerial error;

(2) desired idleness due to firms maximizing their profits given the available technology and the cost of their inputs and the price of the output over time; and (3) desired idleness due to some form of non profit-maximizing managerial behaviour, lack of information and control, and risk aversion.[20]

Winston investigated the importance of excess industrial capacity and the reasons for its existence in LDC's.[21] He identified four main characteristics of industry in West Pakistan related to the level of capacity utilization: (a) competing imports, measured as a percentage of total sales; b) export sales, measured as a proportion of total domestic product; c) capital-labour ratio ; and d) the average firm size. These are augmented by market power and labour productivity. He concludes that excess capacity largely reflected the widespread preference for working during day time.

Wangwe, in his study on Tanzanian manufacturing sector classifies causes of excess capacity into (1) supply factors; raw material shortage due to inadequate foreign exchange, transport, storage, credit facilities and shortage of complimentary factors such as electricity, water and technical services; and (2) demand factors: i.e. economies of scale, deficiency in demand etc. He concludes that supply factors are responsible for capacity under-utilization in Tanzania.[22]

In another similar study on the Kenyan manufacturing sector, Baily uses two behavioural models: (1) the shift differential model which assumes that there are extra costs associated with operating night shift when weighted off against the savings in capital costs gained by using capital more hours; (2) the minimum plant model which assumes machinery indivisibilities, thus in the case of deficient demand, the firm's actual output is less than the potential output of the capital if used the maximum number of production hours.[23] She concludes that excess capacity in Kenya is caused by the market size, inappropriate public transportation system, rising wages and the lack of well designed government policies.

Similarly, this study of the plastics industry seeks to identify some of the supply and demand factors explaining the under-usage of plant and equipment.

2.3 PRODUCT DIFFERENTIATION

This sector defines product differentiation and briefly shows its significance to a developing nation.

Product differentiation influences consumers tastes and preferences among the outputs of various producers. Chamberlin argues that differentiation:

> "..... is often conceived as describing the reprehensible creation by businessmen of purely fictitious differences between products which are fundamentally uniform."[24]

And Hunter maintains that product differentiation could be interpreted to mean that even physically similar goods are not economically the same to the consumer if there exists quite small qualitative variations.[25]

Product differentiation occurs in varying degrees through a) advertising by the use of mass media, trade names, labels, packing and retail services; b) printing and painting; c) quality of materials; and d) technical distinctions via design variation. Advertisement of plastic products through mass media is not common in Kenya. Printing of plastic bags and containers is needed inorder to distinguish the contents. The plastic raw materials (e.g. polyethylene or polystyrene) used by different firms are of the same quality. However, unnecessary design variation wastes foreign exchange as moulds are mainly imported (see section 4.3.9.1) and are also very expensive. Furthermore, inventories and equipment are tied up and hence available working capital is reduced. Thus, this study only examines category(d).

In order to domestically supply previously imported inputs, there is need to install good repair and maintainance facilities. These facilities could be used for the repair of imported models. Later when enough experience is acquired, they could be used for the fabrication of spares and parts and eventually the production of the final product previously imported. Marsden gives an example of an industry which successfully developed this way:

> "An Asian country which had formerly imported its sewing machines decided to promote its own machine building industry. A nucleus already existed in small workshops manufacturing replacement parts of imported models. Profiting from the temporary protection afforded by import restrictions, local entrepreneurial initiative quickly appeared to co-ordinate and expand the activities of these specialised workshops and to set up assembly units. In a few years the sewing machine industry equiped with general purpose lathes and drills (rather than muilt spindle boring machines and special jigs) was turning out models at 60% of the price of the previous imports. The local sewing machines had a more limited range of operations and were less accurate, but because of their lower price they had opened up a new market among small scale clothing and footwear establishments thus increasing their efficiency. In about four years import restrictions could be relaxed and the industry was strong enough to have established a thriving export trade to neighbouring countries"[26]

Nonetheless, few industries in LDC's develop this way due to the multiplicity of technically unnecessary designs. At the plant level, design variations increase inventory costs, reduce efficiency of equipment and hinder labour training. At the macro level, it impedes repair and maintainance, manufacture of replacement parts for imported models and consequently of the final product. Thus too many makes and models are undesirable as they hamper the establishment and growth of industries supplying inputs and increases the dependence on imported inputs and outputs.

Unfortunately, LDC's receiving consumption and production technologies transferred from developed countries often unnecessarily accept a wide range of makes and models in various economic sectors.

For instance , Kenya currently imports or assembles too many makes and models of trucks, cars, tractors, pumps, stoves, machinery and other equipment:

> "India with perhaps 60 times Kenya's population produces only two makes of cars in three models, but Kenya actually assembles more than 90 models of trucks and buses and has at least 60 makes of sedan cars in about 200 models on the streets. Kenya also imports more than 260 models of water pumps ...." The worst redundant differentiation is concentrated around low capacity water pumps. This is exactly the range of pumps that Kenya should and could begin quickly to make."[27]

Thus, to industrialize, Kenya must reduce the number ofmakes and models of diverse products to the technically required level.

To further exemplify this, the extent of product and machinery differentiation in the plastics industry in Kenya is examined.

2.4 IMPORT SUBSTITUTING INDUSTRIALIZATION (ISI)

This section considers the meaning, initiating factors and experiences from ISI in LDC's.

The meaning given to import substitution is the domestic production of what used to be imported.[28] Thus, import substitution refers to the process of reducing import dependence of an economy on a commodity or a group of commodities.

Hirschman identifies four distinct origins of ISI: wars, balance of payments; growth market (as a result of export growth), and official development policy.[29] Hence; import substitution is not a single process for instance an-industrialization emanating from export growth is different from that resulting from foreign exchange deprivation i.e. the former is less prone to inflationary development than the latter. Nixson notes that:

> "A variety of impulses have stimulated ISI, As noted above, ISI was initiated in many Latin American countries as a response to the disruption resulting from wars and international depression when there was either insufficient foreign exchange to pay for imports or when the imported goods themselves were not generally available."[30]

Newly independent states also import substitute inorder to be less dependent on their "mother" countries.

ISI has dominated a majority of the LDC's. ISI strategy as implemented by these countries exhibits characteristics which allow broad conclusions to be drawn. This experience can either be perceived from neo-classical or structuralist/dependence view points though they share some similarities.

The Neo-classicals advocate the encouragement of the free play of the market forces, low and rationalized protection rates and devaluation. Hence:

> "They argue that excessive protection permitting or encouraging the over development of ISI, violates the principle of comparative advantage and creates new, and aggravates existing, the distortions in the domestic factor and product markets. Labour is relatively overpriced, the domestic currency is over valued in terms of foreion currencies and capital is relativelv underpriced. Capital-intensive technologies are the result of such factor market imperfections and as a result unemployment is exacerhated ."[31]

On the other hand, structuralists emphasise the need for changes in the economic structure, namely, land redistribution, agrarian reform, income redistribution and the promotion of national interests. Thus, when viewing ISI they express their opinion from the results of operation of market forces. Thus;

> " ....they raise issues relating to the control of the means of production and the social relations arising from different ownership patterns and they are concerned with such problems as: the contemporary foreign penetration of the economy manifested largely through the operations of transnational corporations; technological dependence; the distribution of income and the balance of social forces within the economy."[32]

Experiences from ISI in LDC's has been analysed from these two points of view. For instance, Power views the weakness of ISI from its economic and technical inefficiency and from its adverse effects on savings.[33]

Economic inefficiency is said to result from liberal import policies regarding essential imported inputs and consumer goods which can distort the incentives in a free market.

This distortion impedes export expansion and/or the import substitution for inputs which is crucial to sustained growth.

Technical inefficiency is a result of a high rate of protection for an industry which leads to high factor incomes and/or relative inefficiency. i.e. protection of high cost industries. Note that protection of infant industries permits development of monopolistic and oligopolistic markets . Power continues to argue that dispersion of economic resources in a horizontal balanced growth sacrifices potential gains from economies of scale and stimulus to innovations.

He concludes that ISI strategy does not promise an easy path round the difficulties facing LDC's.

On very similar lines, Baer has summarized the arguments presented by the analysis of the Latin American ISI strategy.[34] Some market critics argue that ISI in Latin America has resulted in resource misallocation since these countries have a comparative advantage by specializing in the production of primary products. Other market critics acknowledge the need for import substitution but criticize the way it has been implemented i.e. leading to autarkic industrial growth which results into high cost industries biased against agriculture and export market. Market critics conclude that the net effects of ISI is dependency.

On the other hand, the structural critics blame ISI strategy for its: (a) failure to create direct employment opportunities (b) its perpetuation of an unequal distribution of income; (c) its neglect of the development of infrastructure , and (d) its strong regional concentration of industries.

Th ILO report on Kenya presents a critique of the ISI by pointing out views shared by the market and the structuralists critics.[35] The report argues that the ISI is likely to conform and strengthen unequal income distribution and lack of income earning power at the lower end of the income scale. Also ISI strategy results in high cost industries.

When analyzing ISI in the Tanzanian case, Kuuya points at the concentration of investments in non-durable consumer goods and in the processing of raw materials for export. Such industries have limited expansion possibilities and hence can not sustain growth:

> "It is the adoption of this type of import substitution which has led to the industries in other LDC's to be characterised by a) bias against capital goods industries, b) highly capital intensive technology, c) absence of or few linkages between the industries, d) lopsided production mainly luxury goods for urban and/or high income earners, and e) uncompetitive manufacturing industries which are protected by high tariffs with little or no effects being made to increase efficiency in order to lower costs[36]

To summarize his conclusions, Nixson notes that:

> "ISI has not, in practice, significantly alleviated the balance of payments constraint: it has led to a growing dependence on a largely imported, capital intensive technology and technological development; the process has been heavily dependent on foreign capital and has emphasized the establishment of consumer goods industries at the expense of investment and capital goods industries; it has led to what many would regard as undesirable redistribution of income and in general it has failed to generate a sustained process of economic growth."[37]

Despite difficulties faced by LDC's a satisfactory approach could be built around ISI. Viability of such a strategy is dependent on careful planning and implementation as Kuuya argues:

> "... the particular LDC should identify the structural distortions in its economy which would usually manifest themselves in form of a big gap between what is consumed domestically and what is produced domestically. Once this structural distortion has been identified; then an industrial strategy should be devised that aims at correcting these distortions. We believe that for such a strategy to be effective, it should take the form of a comprehensive plan that aims, not only at the perfection of the technical analysis within an operational framework, but also at sectoral consistency and interdependence of projects that would ultimately generate a chain of reaction in the production process of the whole economy."[38]

Similarily Power acknowledges the importance of ISI and says that:

> "....what is needed rather are rational choices, both between import substitution and export expansion among various potential import substitution industries."[39]

Bruton identifies the most pervasive effects of ISI policies as (a) distortions in the economy which rarely correct themselves; (b) creation of activities that are alien to economic and social environment of the community; and (c) creation of conditions that dampen productivity growth which is essential to a successful ISI. Thus, he advocates that specific policies should:

> "be appraised as to the extent to which they i) distort or undistort (SIC) the system, ii) encourage projects consistent with the other characteristics of the economy, and iii) encourage productivity growth."[40]

Though few, these examples demonstrate that a successful ISI like any other industrial development strategy entails comprehensive planning and selection of strategic industries in an economy bearing in mind the sectoral linkages. Such a process should systematically effect the required changes in the import orientation of the domestic economy and consequently the establishment of an industrial base for future development. Hence, ISI has a useful role to play in a developing economy.

Noting that the plastics industry is a strategic economic sector, this study identifies areas where further import substitution could be accomplished in Kenya (see chapter v).

CHAPTER III

THE KENYAN PLASTICS PROCESSING INDUSTRY

The plastics processing industry is a heterogeneous industry having many economic linkages with other sectors, and hence it is important for economic development. This industry was established after Kenya attained independence. At present, many installed processes use new machinery to fabricate a variety of plastic items. This industry has been developing very rapidly as illustrated by the growth of installed machinery and the importation and consumption of plastic raw materials. The industry also contributes significantly to the growth of the Kenyan manufacturing Sector in terms of value added, employment and usage of intermediate inputs. The processing plants are mainly owned by local Asians and subsidiaries of transnational corporations.

3.1 Definition of the Plastics Processing Industry

In this study, the plastics processing industry refers to firms fabricating items from moulding compound.[1] This definition is consistent with the One in the 4-digit version of the 1968 International Standard Industrial Classification (ISIC) of the United Nations.

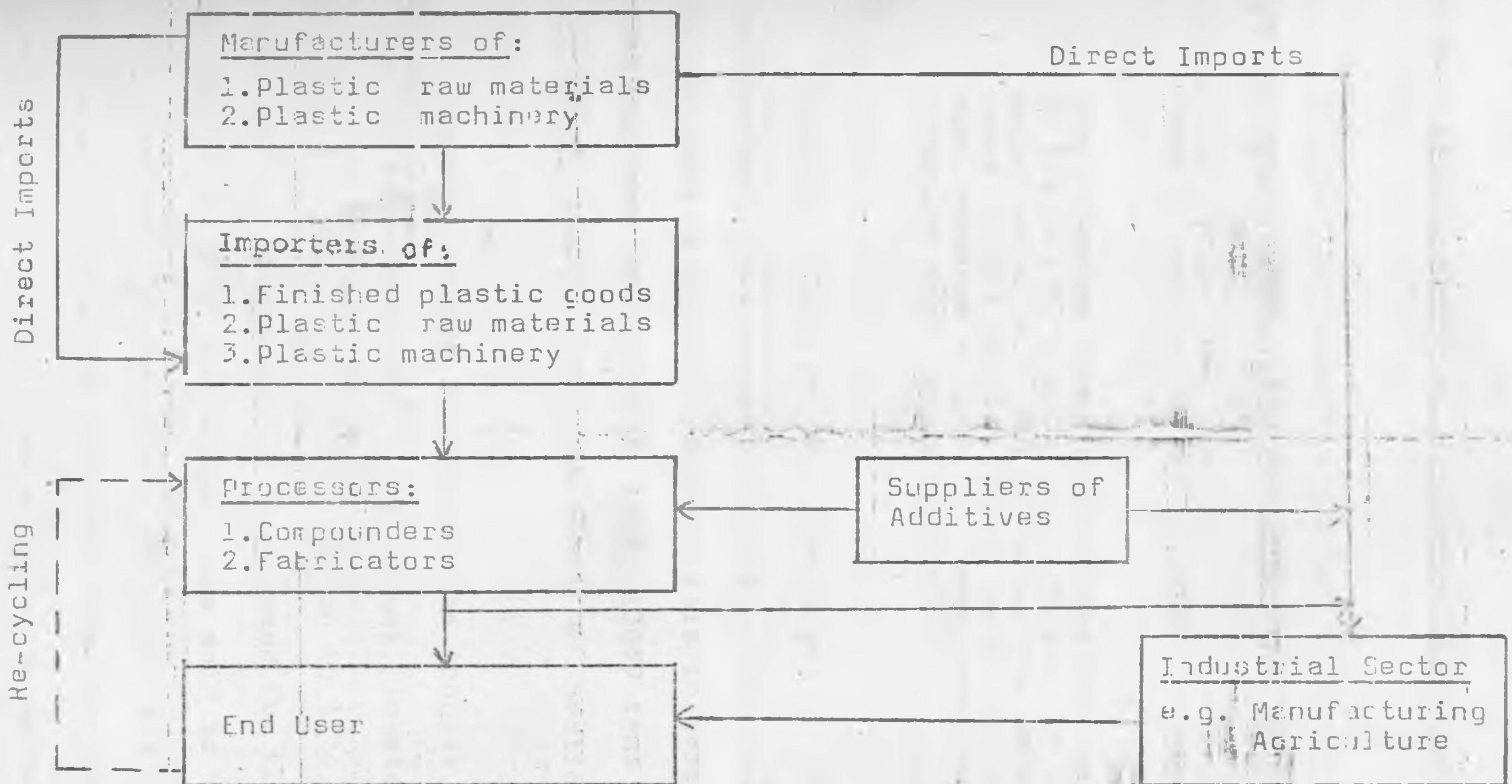
plastic products appear in four different groups: 3212, 3233, 3560 and 3909. 3560 is the main group. The plastics industry is defined as follows:

> "3560 manufacture of plastics products not elsewhere classified. - The moulding extruding and fabricating of plastic articles not elsewhere classified, such as plastic mat, synthetic sausage cassings, plastic containers and caps, laminated sheets, rods and tubes from purchased plastic raw materials, plastic components for insulation, plastic footware, plastic furniture; and plastic industrial supplies e.g. machinery parts, bottles, tubes, and cabinets. The manufacture of plastic house furnishings such as curtains or table cover is classified in group 3212 (manufacture of man made-up textile and goods except wearing apparel); the assembly of plastic toy and doll, athletic and sporting goods is included in group 3909 (manufacturing industries not elsewhere classified) and the manufacture of plastic luggage, handbags pocket books and similar goods is classified in group 3233 (manufacture of products of leather and leather substitutes.)" [2]

3.2 Linkages with the Plastics Processing Industry

Plastics processing industry is linked to: a) organizations researching and developing plastics polymers, b) manufacturers of plastics raw materials and plastics machinery, c) suppliers of additives, and d) the industrial and consumer users of plastics. See the flow chart in figure 3.

Fig. 3
Flow Chart of Linkages with the Plastics Processing Industry in Kenya



-34-

3.3 Establishment of the Plastic Firms in Kenya

This section presents a brief historical account of the plastics industry in Kenya. This industry was established after Kenya attained independence.

> "The plastics industry in Kenya was introduced in the mid 60's with the intention of outselling metal containers. The industry now enjoys a big share in the market, though metal containers have remained a firm line where some packaging standards have demanded them"[3].

However, plastics were fabricated on small scale before then. This is demonstrated by the importation of 254 tons of plastic raw materials in 1956 as compared with 2440 tons in 1964, 13859 tons in 1971 and 63440 tons in 1981 (See Table 6 Section 3.5.2).

Plastics Africa Limited is the longest established plastics firm in Kenya[4]. This plant, located at Ruaraka Nairobi, started production in 1946 and depended for its market on the demand for hula hoops in Kenya. In 1972, the company was sold to Metal Box Kenya Limited. At that time, the plant was producing blow moulded items and extruded film and pipes. Nonetheless, in 1976, blow moulding machines were sold to Pan Plastics Limited while film extruders were sold to Cosmo Plastics Limited. Thus, leaving Metal Box with only pipe extruders. In 1982, the Ruaraka pipe factory was moved to Thika[5].

The second company to start operation in Kenya is Metaplastics Limited. It was established in 1963 and extrudes plastic film. Many plastic firms were established in 1964 and the number continued to grow rapidly there after. For instance, our survey gives the following distribution over the period 1963-83:

Table 2: Establishment of Plastic Firms in Kenya:1963-83

Years	Number of Firms Established
1963	2
1964 - 66	8
1967 - 69	5
1970 - 72	2
1973 - 75	8
1976 - 78	10
1979 - 81	8
1982 - 83	3

Source: Own Survey .

3.4 Established Processes and Products Fabricated

Today many processes have been established and a variety of plastics products are being produced. Table 3 shows the existing processes which were identified during the survey and the products fabricated. Note that the following processes among others have not been established: low pressure lamination, slush moulding, dip moulding, spray coating and plastic welding.

Table 3 :

Processing Methods and Plastic Products in Kenya

Process	Products
1. Calendering	Vinyl Asbestos Floor Tiles
2. Coating	
Fabrics	A range of coated fabrics e.g.
Wire	Cables and Telephone Wires
3. Extrusion	
Conduits	Conduits
Film	Film
Pipe	Pipes
"Others"	e.g. Strappings, rods, hose pipes
Sheet	P.V.C. Floor Tiles
4. Foaming	Mattresses, pillows, and cushions
5. Lamination	Formica sheets (only high pressure Laminates)
6. Moulding	
Blow Moulding	Containers, bottles
Compression Moulding	plates, cups, ashtrays
Injection Moulding	Cassettes, ball pens, containers small bottles, caps, household ware; basins, backets etc.
Rotational Moulding	Silver cans, doff boxes, tote boxes dustbins, plastic cone-shaped road makers, tanks.
7. Vacuum Forming	Sanitary ware
8. Weaving	Polypropylene Woven Sacks.

Source: Own Survey

In some of the processes, only a few firms are established. For instance, calendering is done by one firm and so is fabrics coating, sheet extrusion, lamination, and vaccum forming. Two firms coat wire and another two do compression moulding. There are three producers of plastic pipes. For all the other fabrication methods, more than three firms are established per process. However, the most common processes are blow moulding, injection moulding and film extrusion.

3. 5 Growth of the Plastics Processing Industry

3.5.1 Growth of Installed Machinery

Blow moulding, extrusion and injection moulding are the processes taken to illustrate the growth rate of the processes since 1960. Primary data is used (Tables 4 and 5). Additional installed capacity is plotted against time (Figures 4 and 5). For total growth of the processes, accumulated machinery plasticity capacity is plotted against time. (Figures 6 and 7).

In Blow moulding and extrusion machinery plasticity capacity is given in Kilogrammes per hour while in injection moulding it is given in grammes per impression.

Three peak periods for investment in each process are observable in figures 4 and 5 . i.e.the peaks for blow moulding are 1965/8, 1971/3 and 1976/9. For extrusion, the peaks are, 1963/5, 1971/3, 1976/9 and for injection the peaks are 1963/5, 1970/2, 1976/7. Thus, the pattern for installing new machinery is similar for all the processes

Table 4 :
Additional Installed Capacity by Process

Year	Blow Moulding Kgs/Hr	Extrusion Kg/Hr	Injection Moulding Grams/Impression
1960	63	160	-
1961	-	-	-
1962	-	-	900
1963	-	370	300
1964	-	980	2,650
1965	150	-	390
1966	-	60	-
1967	116	-	85
1968	200	-	490
1969	-	210	-
1970	-	200	653
1971	-	110	5,530
1972	433	330	2,010
1973	-	-	325
1974	200	-	28
1975	100	250	2,071
1976	150	307	2,048
1977	-192	962	2,808
1978	642	740	4,675
1979	-	373	2.160
1980	200	412	480
1981	350	70	1,352
1982	-	150	100
1983	-	-	90

Source: Own Survey

Table 5

Blow Moulding, Extrusion and Injection Moulding
Accumulated Installed Capacity*

Process	Blow Moulding		Extrusion		Injection Moulding	
Year	Kg/Hr	Index**	Kg/Hr	Index	Grams per Impression	Index
1960	63	4	160	5	-	0
1961	63	4	160	5	-	0
1962	63	4	160	5	900	5
1963	63	4	530	18	1200	7
1964	63	4	1510	51	3850	22
1965	213	15	1510	51	4240	24
1966	213	15	1570	53	4240	24
1967	229	16	1570	53	4323	25
1968	529	37	1570	53	4813	28
1969	529	37	1780	60	4813	28
1970	529	37	1980	67	5466	31
1971	529	37	2090	70	10996	63
1972	962	68	2420	81	13000	71
1973	962	68	2420	81	13331	76
1974	1162	82	2420	81	13359	76
1975	1262	89	2670	90	15430	88
1976	1412	100	2977	100	17478	100
1977	1604	113	3939	132	20286	116
1978	2246	159	4679	157	24961	143
1979	2246	159	5052	170	27121	155
1980	2446	159	5122	172	27601	160
1981	2796	198	5534	176	28953	166
1982	2796	198	5684	191	29053	166
1983	2796	198	5684	191	29143	167

Source: Own Survey

(1) For a description of the survey coverage see Chapter iv

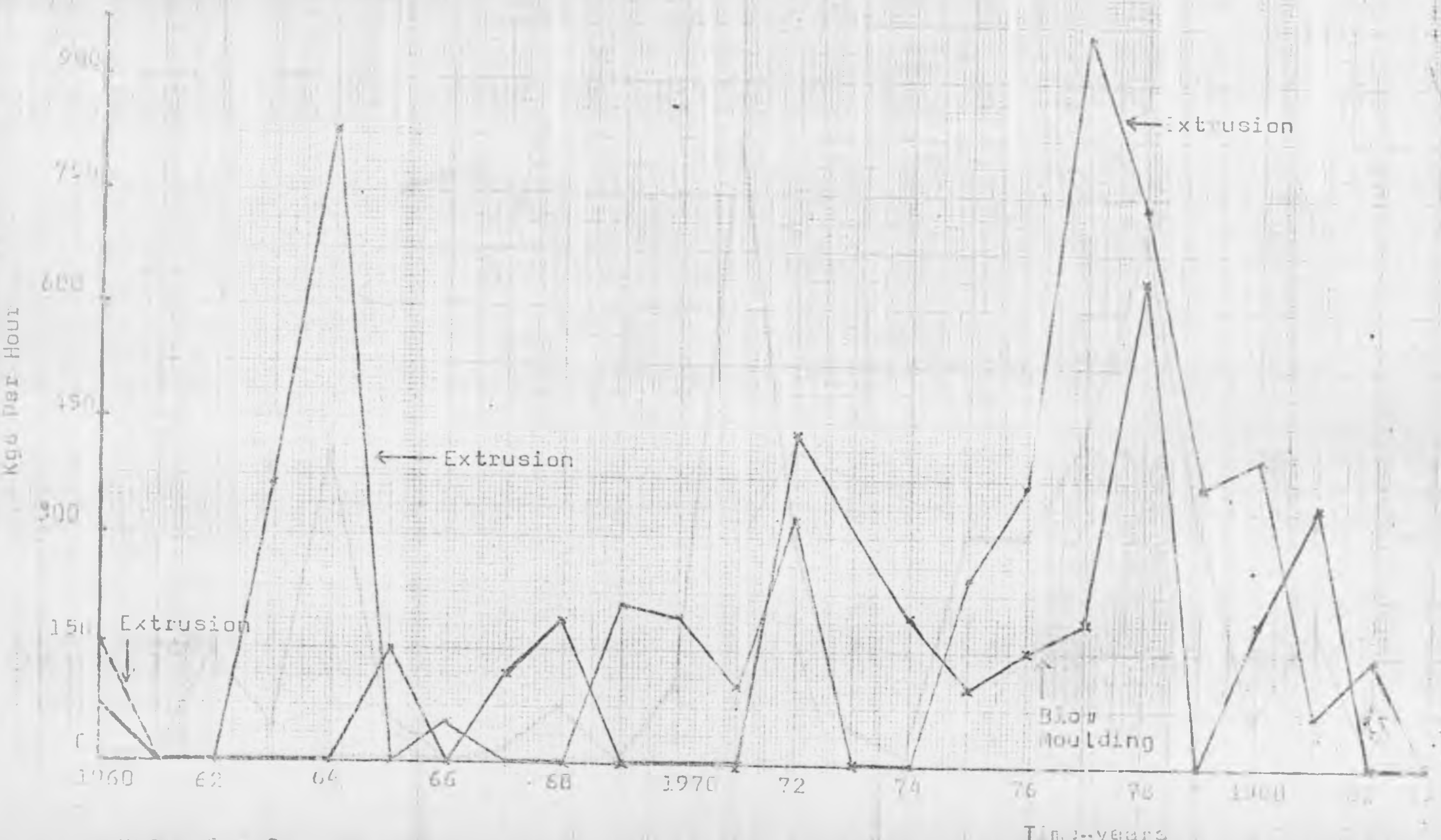
(2) *If machines ceased to function or were sold to unsurveyed firms inside or outside Kenya, then they would have been missed in the survey.

(3) ** Indexes use 1976 as a base year.

Fig 4

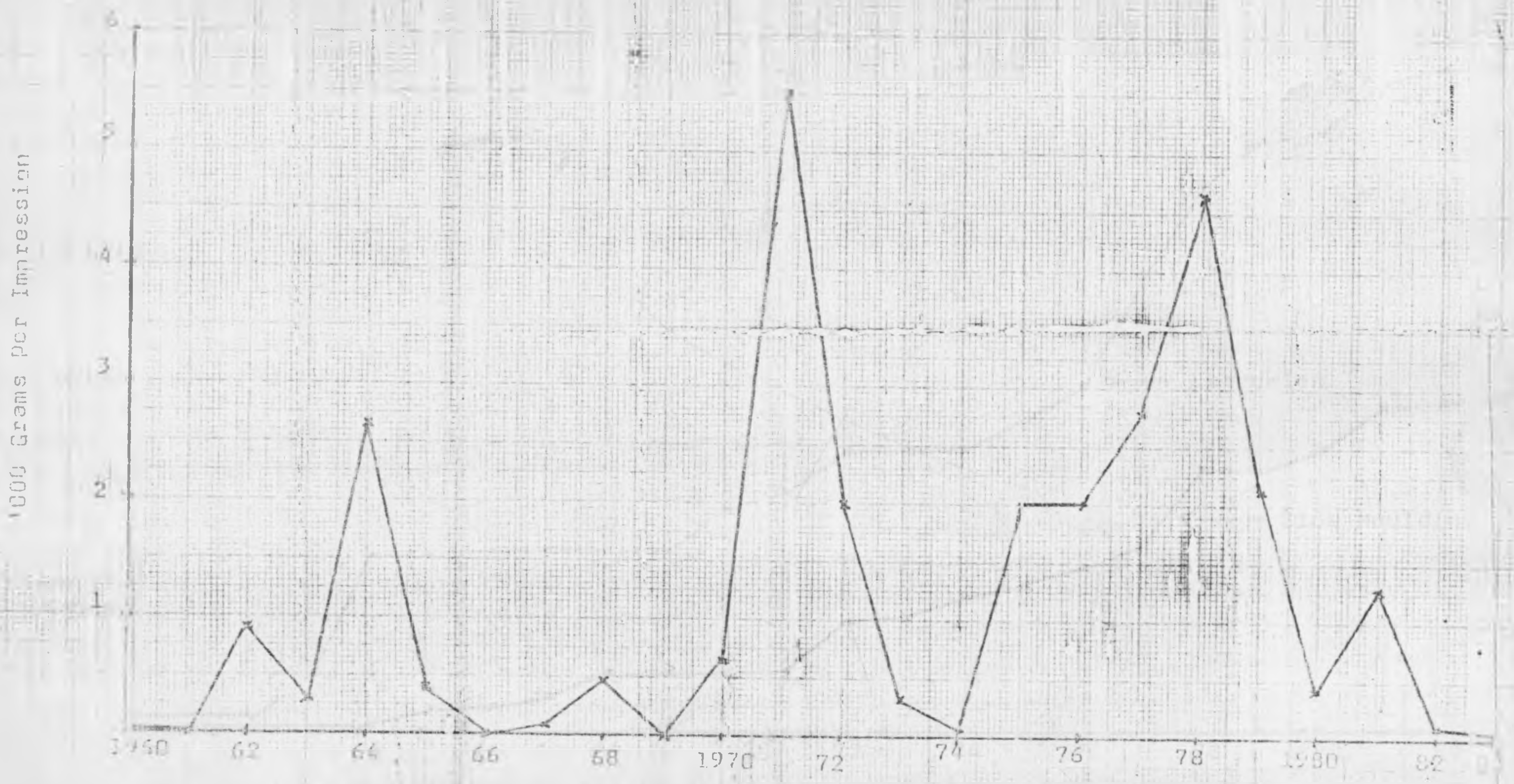
Blow Moulding and Extrusion

Additional Installed Machinery Plasticity Capacity in Kg/hr



Source: Own Survey

Fig 5
Injection Moulding
Additional Installed Machinery Plasticity Capacity in Grams per Impression

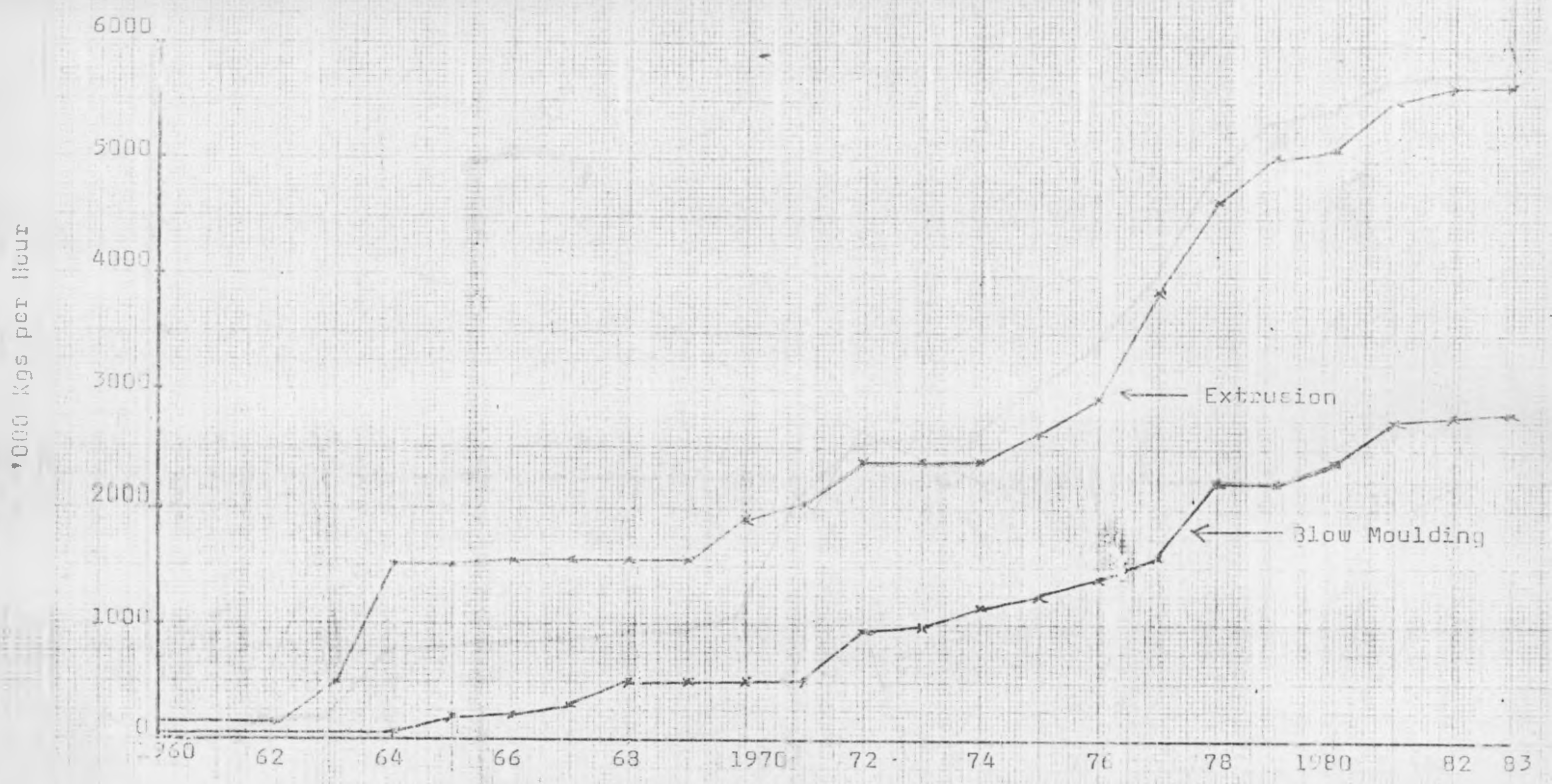


Source: Own Survey - See Table 4

Fig 6

Blow Moulding and Extrusion:

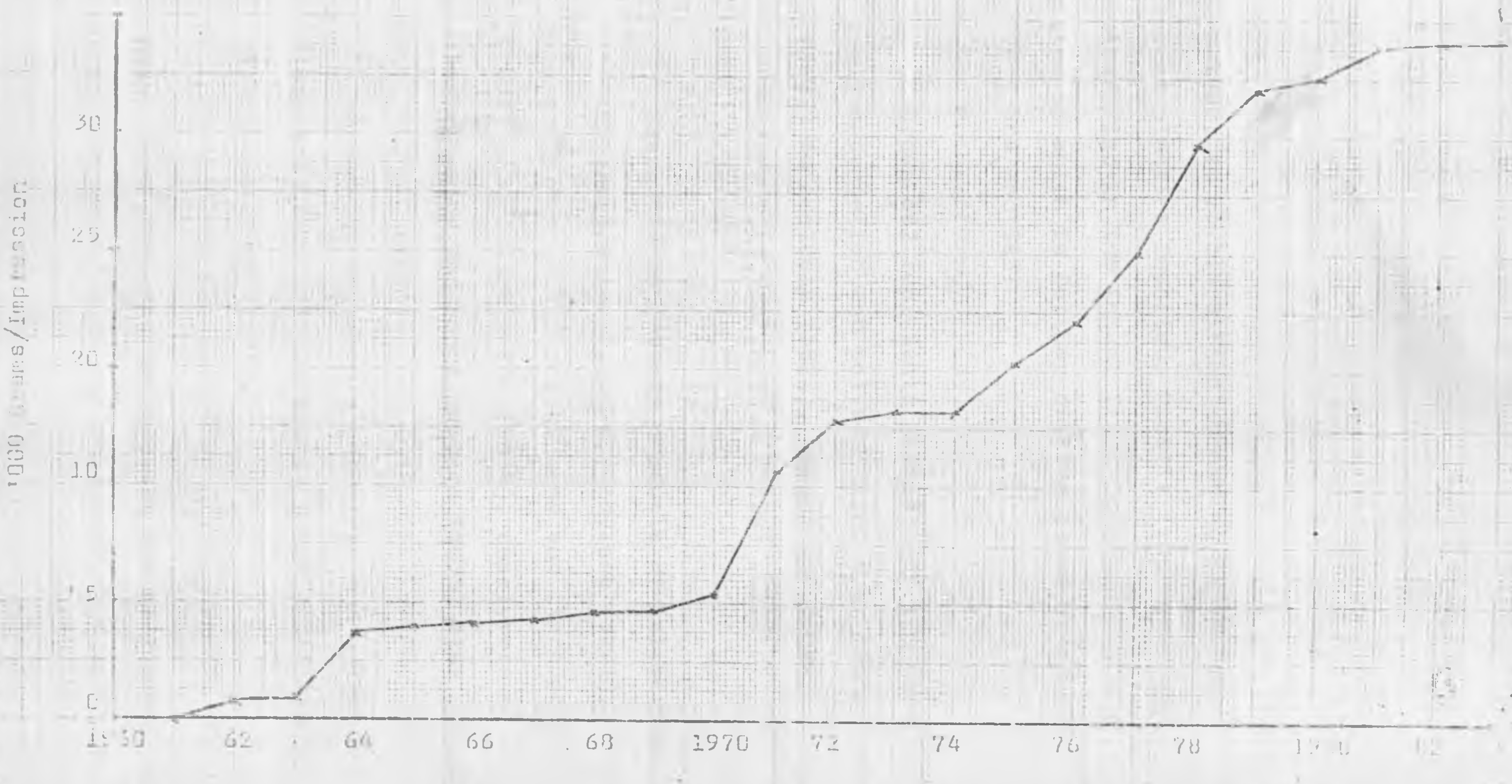
Accumulated Machinery Plasticity Capacity in Kg/hr



Source: Own Survey See Table 5

Fig 7
Injection Moulding

Accumulated Machinery Plasticity Capacity in Grams/Impression



Source: Gun Survey - [illegible] Table 5

3.5.2 Importation of Plastic Raw Materials

The data (Table 6 and Figure 8) on the importation of plastic raw materials covers the years 1964 - 1982. It is classified according to the main groups of plastics imported. Plastic raw materials are classified in the Annual Trade Reports[6] under division 58 which is further distinguished by groups 582, 583, 584 and 585:

Group 582 represents products of condensation, polycondensation and polyaddition. e.g. phenoplasts (5821) Aminoplasts (5822), alkyds and other polyesters 5823, polyamides (5824) ....etc.

Group 583 represents products of polymerization and coplymerization e.g. polyethylene (5831), polypropylene (5832) polystyrene and its copolymers (5833) polyrinylchloride (5834), copolymers of vinylchloride and vinyl acetate (5835) etc.

Group 584 represents cellulose and vulcanized fibre and group 585 represents other artificial resin plastic materials.

About 2% of the imported plastic raw materials is re-exported annually to the neighbouring countries.

Assuming that the rest is converted locally, then the trend of the importation of plastic raw materials is a good proxy for the growth of plastics processing industry. Note, however, that all the firms surveyed in this study used group 583 of plastics inputs.

In figure 8 , the total curve is an aggregation of groups 582, 583, 584 and 585 but is dominated by group 583. The industry developed gradually between 1964/71, the growth rate fluctuated between 1972/5, was rapid between 1975/80 and declined between 1980/2. This pattern of development can be associated with the expansion and contractions of the general economy since 1964. i.e. 1964/70 was an era of growth of raw manufacturing firms and import substitution. After 1976, the economy expanded as a result of the "Coffee Boom" but contracted after 1980 due to foreign exchange crisis.

This pattern of growth conforms with that in section 3.5.1 on growth of installed machinery. This conclusion is inferred from the comparison of machinery indexes (Table 5) with importation of group 583 index (Table 6) of plastic raw materials.

Table 6 :

Importation and Consumption of Plastic Raw Materials in Metric Tonnes by Group

Code	582		583		584		585		Total	
Year	Tons	Index	Tons	Index	Tons	Index	Tons	Index	Tons	Index
1964	886	25	1368	37	184	34	2	0	2440	13
1965	770	22	1966	48	232	43	11	0	2979	16
1966	724	20	1839	45	377	69	17	0	2958	16
1967	947	27	2412	59	251	46	36N	0	3574	19
1968	1917	54	3338	82	200	37	18N	0	5437	29
1969	2163	61	4329	107	186	34	99N	1	6580	36
1970	1746	49	6850	169	407	75	50N	0	9053	49
1971	2270	64	10999	270	590	108	0	0	13859	75
1972	1873	53	9625	237	410	75	10	0	11917	65
1973	2440	69	11839	292	531	97	293	3	15104	82
1974	2844	81	5708	141	1580	290	8519	83	18651	101
1975	2266	64	3753	92	630	116	4299	42	10947	59
1976	1964	56	4007	99	505	93	11525	112	18019	98
1977	6366	180	4423	109	499	92	15086	146	26373	143
1978	11330	321	13608	335	620	114	6398	62	31956	173
1979	9123	258	28501	702	1051	193	457	4	39131	212
1980	10267	344	28239	695	1127	207	488	5	40120	217
1981	9502	269	52711	1298	838	154	390	4	63440	344
1982	9567	271	25355	624	512	94	367	4	35803	194

Source: Kenya Government; Annual Trade Report 1964-1982

Note:

1) For certain years units of measurements were centals and quintals but were converted into Kilogrammes.

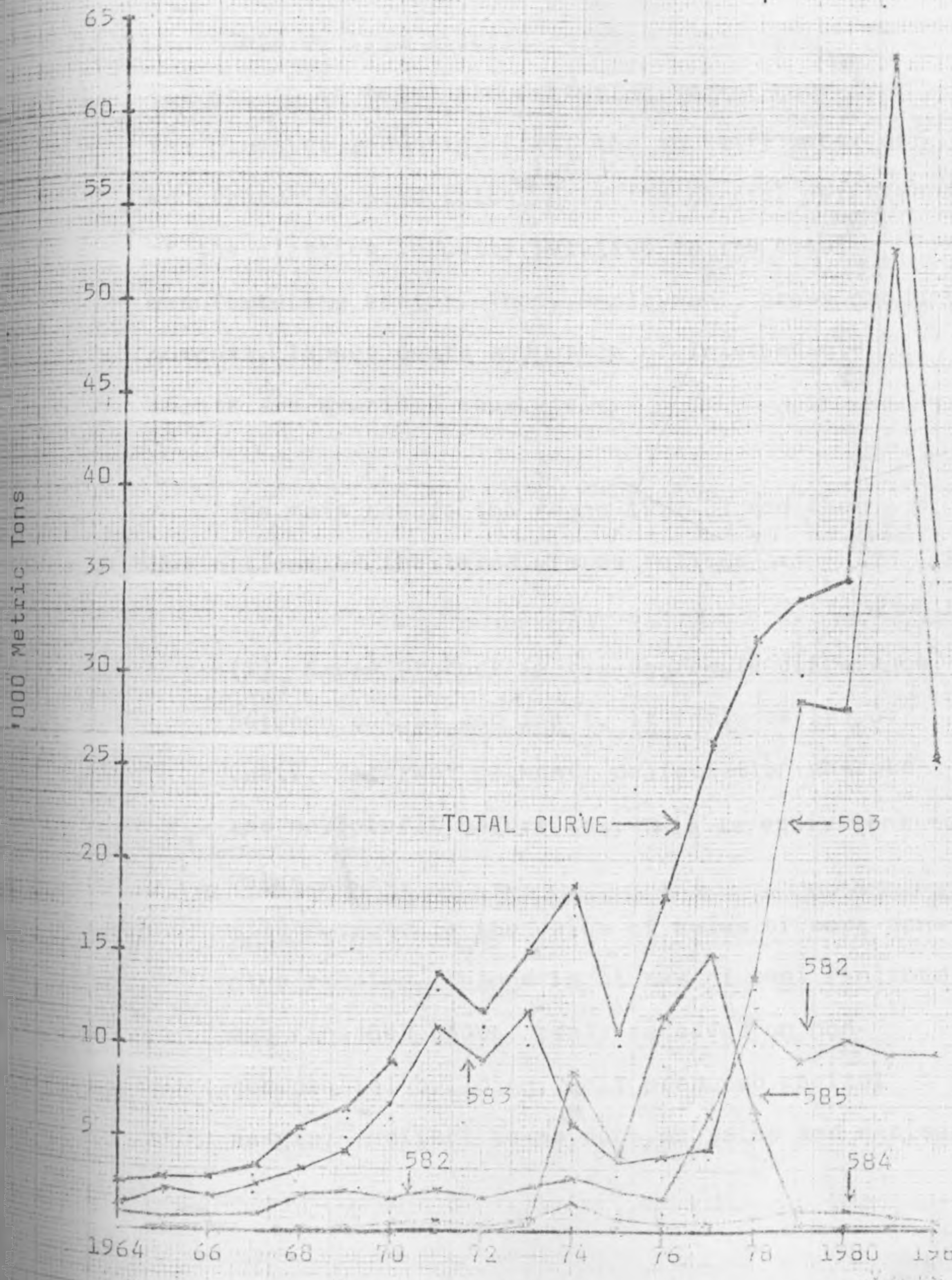
2) N Means re-export to Uganda or Tanzania.

3) The numbers were rounded to the nearest '000 Kgs.

4) The index uses the average of 1975, 1976 and 1977 as the base year.

Fig.8

Importation and Consumption of Plastic Raw Materials in Kgs by Group.



Source: Kenya Government The Annual Trade Reports 1964-19

3.6 The Significance of the Plastics Processing Industry in Kenyan Manufacturing

This section briefly reviews contribution to the growth of total manufacturing sector made by the plastics industry. First the quantity index of manufacturing production shows the general performance of the plastics industry relative to the total manufacturing sector. Then, employment, gross product, outputs, labour costs and usage of intermediate inputs are examined separately.

The data covers the years 1972-81 and the definitions of the terms are as follows[7] :

(i) Gross Product is the aggregate difference between output and input. It includes labour costs, interest payment, depreciation charges and net profit before tax. This is equivalent to value added.

(II) Outputs is the value of sales or work done plus resales, change in stocks of semi finished and finished goods, rents received on non-residential building, self produced capital assets, indirect taxes such as sales and excises.

(III) Labour Costs include salaries and wages paid in cash plus costs of other labour benefits.

(IV) Inputs includes industrial costs of goods for resale and overhead costs like rents, rates, water, stationery advertising expenses, transport, head office costs, insurance, audit fee, legal expenses etc. less change in stocks of raw materials, components, supplies, spare parts e.t.c.

The quantity index of manufacturing production (Table 8) shows that on average, plastics production has been growing at 24. % per annum while total manufacturing has been growing at 9% between 1972-81. Between 1978 and 1981 the production of plastics has been declining despite being higher than that of the total manufacturing.

Table 8 shows large scale firms (employing more than 50 workers) and the numbers of workers engaged in these firms (employment). We note that the unweighted average employment rate is higher in the plastics industry than in the total manufacturing. However, between 1976 and 1981, employment in the plastics industry displays a declining trend.

In Table 10 we note that the percentage growth in value added (Gross Product) is higher in the plastics industry than the total manufacturing. Table 11 shows a similar trend in the cost of labour and inputs. Thus, we conclude that the plastics industry has been growing at higher rates than total manufacturing. The unweighted percentage annual growth can be summarised as follows (see the last row in Tables 9-10):

Table 7: Unweighted Percentage Annual Growth

	Plastics Industry	Total Manufacturing
Employment	[illegible]	5.5%
Gross Product	38.8%	17.4%
Outputs	27.7%	22.2%
Labour Costs	17.4%	17.5%
Inputs	25.9%	23.8%

Source: Republic of Kenya: Statistical Abstract 1972-82

Table 8

Quantity Index of Manufacturing Production 1972/81 (1976 = 100)

Year	Plastics Industry		Total Manufacturing	
	Index	Annual% Growth	Index	Annual% Growth
1972	37.1		72.0	
1973	39.0	5.1	80.5	11.8
1974	58.8	50.8	88.3	9.7
1975	90.6	54.1	90.0	1.9
1976	100.0	10.4	100.0	11.1
1977	132.9	32.9	119.1	19.1
1978	179.0	34.7	[illegible]	17.1
1979	196.7	9.9	140.4	0.8
1980	207.7	5.6	147.7	5.2
1981	225.7	8.7	155.1	5.0
Average	-	23.6	-	9.1

Source: Republic of Kenya: Statistical Abstract 1972-82

Table 9

Large Scale Firms and Establishments and Numbers Engaged

Year	Plastics Industry		Total Manufacturing		Plastics Industry		Total Manufacturing	
	Firms	Annual% Growth	Firms	Annual% Growth	Numbers Engaged	Annual Growth	Numbers Engaged	Annual% Growth
1972	6	33	349	2	847	15.7	8807	12.6
1973	8	13	356	19	980	-14.0	95510	12.8
1974	9	0	422	2	843	9.4	107757	6.5
1975	9	0	429	6	922	11.0	100700	9.5
1976	9	33	404	0	1023	48.0	110242	1.8
1977	12	0	405	1	1514	12.8	112281	4.7
1978	12	8	410	4	1708	7.3	117541	10.4
1979	13	23	428	3	1833	-9.2	129774	0.0
1980	10	20	442	10	1665	-5.1	129781	7.6
1981	12		485		1563		139734	
Average	-	9.3	-	3.3	-	8.3	-	5.9

Source: Republic of Kenya: Statistical Abstract 1972-82

Table 10

All Firms and Establishments: Gross Product and Outputs in K£'000

Year	Gross Product				Outputs			
	Plastic Industry		Total Manufacturing		Plastic Industry		Total Manufacturing	
	GDP	Annual% Growth	GDP	Annual% Growth	Outputs	Annual% Growth	Outputs	Annual% Growth
1972	665	-	81906	-	2177	-	296582	-
1973	1333	100.5	99503	21.5	3476	59.7	357598	20.6
1974	1203	-9.8	129352	30.0	4535	30.5	528370	47.8
1975	1818	51.1	136899	5.8	5858	29.2	625848	18.4
1976	1776	-2.3	183576	34.1	6600	12.7	849487	35.7
1977	5041	183.8	195103	6.3	12379	87.6	1056340	24.4
1978	7736	53.5	230101	17.9	16416	32.6	1111919	5.3
1979	7271	-6.0	260801	13.3	20270	23.5	1162217	4.5
1980	4874	-33.0	288746	10.7	15768	-22.2	1360129	17.0
1981	5198	6.6	339120	17.4	15137	-4.0	1710062	25.7
Average	-	38.3	-	17.4	-	27.7	-	22.2

Source: Republic of Kenya: The Statistical Abstracts 1972-82

Table 11

All Firms and Establishments: Labour Costs and Inputs in K£'000

Year	Total Labour Costs				Inputs			
	Plastics Industry		Total Manufacturing		Plastics Industry		Total Manufacturing	
	Costs	Annual% Growth	Costs	Annual% Growth	Inputs	Annual% Growth	Inputs	Annual% Growth
1972	399	-	39277	-	1512	-	214676	-
1973	578	44.9	44016	12.1	2143	41.7	258095	20.2
1974	557	- 3.6	57189	29.9	3332	55.5	399018	54.6
1975	676	16.0	60400	5.6	4040	21.2	488949	22.5
1976	767	18.7	73073	21.0	4824	19.4	665911	36.2
1977	956	24.6	85193	16.6	7338	52.1	861237	29.3
1978	1359	42.2	95463	12.1	8680	18.3	881818	2.4
1979	1659	22.1	108526	13.9	12999	50.0	901416	2.2
1980	1415	-14.7	134160	23.6	10894	-16.2	1071383	18.9
1981	1509	16.6	164979	23.0	9939	- 8.8	1370942	28.0
Average	-	17.4	-	17.5	-	25.9	[illegible]	23.8

Source: Replic of Kenya: The Statistical Abstracts 1972-82

3.7 Ownership of Plastic Firms

During the survey entrepreneurs were asked who owns the firm? From their responses, the distribution in Table 12 was obtained.

Table 12

Ownership of Plastic Firms in Kenya

Form of Ownership	Number of Plastic Firms	% of the The Total Number of Firms
1. 100% Local:		
a) Government	1	2.3
b) Africa	3	6.8
c) Asian	23	52.2
2. 100% Foreign - Individual	1	2.3
3. Joint venture		
a) Local Government ......%)	a & b = 1	2.3
b) Local Private ....%)	b & c = 3	6.8
c) Foreign ....%)	a & c = 1	2.3
4. Subsidiary of TNC's	11	25.0
Total	44	100.0

Source: Own Survey

From Table 12 above, 52% of the firms are owned by local Asians, 25% by subsidiaries of Transnational Corporations(TNC's) and 11% are joint ventures.

CHAPTER IV

DATA AND EMPIRICAL RESULTS

This chapter describes the methodology and data weaknesses. The primary data is presented and analysed under three different categories: a) Human and capital utilization which examines plant, machinery, labour force, supervisory skills and production space utilization levels; b) Causes of economic resource under-utilization; and c) Factors hampering backward integration/linkages.

4.1 Methodology[1]

This study depends on both primary and secondary data. The following section describes the survey's coverage and the collection of data.

Primary data was collected between August and October, 1983 using a questionnaire (Appendix 6). A partial list of firms was compiled from the Directory of Industries.

This list comprised twenty one firms. Sixty-seven percent of them employed less than fifty workers (small firms) and thirty-three percent employed more than fifty workers (medium and large firms). More plastic firms were identified by asking firms who their competitors were. Also, the office co-ordinator of a plastic machinery consultant firm based in Nairobi furnished a partial list of their customers. In all, the augmented list identified fifty eight plastic firms (see appendices 7A & 7B) mostly located in Mombasa and Nairobi.

From the augmented list of firms, a majority of the small and all except one large firm were visited. Also Nairobi and its vicinities (Limuru, Redhill, and Thika) and Mombasa firms were visited.

Note that the survey covered only plastic firms using class 583 of plastic raw materials. i.e. products of polymerization and copolymerization e.g. polyethylene, polypropylene, polystyrene and polyvinylchloride (see definition in chapter III section 3.5.2.) as it is the dominant class.

Emphasis was primarily placed on the establishments processing plastics as their principal goods (primary products) though heavy consumers of plastic raw materials were visited even if their primary products were non-plastics.

During the interviews, Plant Managers were asked about their firms' activities, production, machinery, workers, shifts, mould making, repair and maintainance, recycling of plastics, imports, exports and the utilization of their productive capacities.

Secondary data on the importation of plastic raw materials were obtained from the Kenyan Annual Trade Reports and those on labour costs, input, output etc. were obtained from the Kenyan Statistical Abstracts.

4.2 Data Limitations

Not many data problems were encountered. Nonetheless, it was difficult to get an inventory of machinery from certain firms. Some Plant Managers considered that the information was too detailed and 'sensitive' while others do not let any 'visitor' tour their plants though they respond to general questions.

Forty-eight plastic firms were visited but the analysis was done with the results of forty-four firms. The results from four small firms were considered inadequate for analysis.

Three small and two large firms out of the remaining forty-four declined to give an inventory of their machinery, and hence these firms were omitted in Hypotheses 4 and 7.

HYPOTHESES

4.3.1. Hypothesis 1

Statement: Most Plastics Processing Firms operate their plants at rates below their potential utilization rates.

This section will first define the measure of capacity utilization at the plant and industry levels and then examine these statistics.

A Measure of Capacity Utilization

The capacity utilization index is expressed by the ratio of actual output to potential output. When data on actual and potential output are not available. they can be estimated by production hours (Machine or manhours) since the potential output of capital equipment depends on the productivity of the equipment per unit of time and the potential operating time.

Plant and industry level capacity utilization rates are estimated with a weighted average index on production hours[2]. This index is given by the ratio of actual to potential hours that a machine or a plant can be operated per week. In this study, we assume that potential production hours are equivalent to 154 inorder to allow 14 hours for repair and maintainance.

This definition assumes optimal employment of resources and no supply bottlenecks. However, in this industry, there is slack in use of factors of production. To account for this, the ratio is weighted by a measure of slack. This measure was obtained during the survey by asking the entrepreneurs how much additional production they could get; (a) holding all factors of production constant (including hours), and (b) varying the number of workers but holding other factors constant and by assuming that adequate demand were to exist. Also this definition of capacity assumes that productivity between shifts is constant. Nonetheless, plant and equipment in this industry are utilized more intensively during the day shifts than during the night shifts. To allow for this, the index was weighted by the ratio of the number of production workers (L_{is}) to the maximum number of production workers on any one of the shifts ($L_{is_{max}}$). All together these adjustments to the initial ratio yields a weighted average index at the plant level. The resultant rates are then weighted again by $L_{is_{max}}$ to give the rate of capacity utilization for the entire industry. The mathematical form of this index is presented below along with a detailed account of each variable and why it is used.

At the firm level, the rates of plant utilization (CU_{ij}) is given by:

$$CU_{ij} = \left[\sum_{S=1}^{K} \frac{H_{is}(L_{is}/Lis_{max})}{(1 + A_{ij})} \right] \Big/ 154$$

$$\text{For } L_{is_{max}} > 0$$

$$A_{ij} \geq 0$$

and at the industry level, the rates of plant utilization (CU_j) is given by:

$$CU_j = \frac{\sum_{i=1}^{n} (L_{is_{max}} \cdot CU_{ij})}{\sum_{i=1}^{n} L_{is_{max}}}$$

Where: $i = 1, 2, \ldots, n \equiv$ the number of plants.

$s = 1, 2, 3 = K \equiv$ the number of shifts a plant i is operated per day.

$j = 1, 2, 3$ gives three different measurers of plant utilization at both the firm and the industry levels obtained through changing the value for A_{ij}.

The indicator of slack in the use of labour are capital

$A_{i1} = 0$ (for j = 1 and it gives CU_{i1} and CU_1)
this implies zero slack.

$A_{i2} \equiv$ the percentage of additional production that could be attained at plant i without any additional employees, hours or plant and equipment. (j = 2 gives CU_{i2} and CU_2)

$A_{i3} \equiv$ the percentage of additional production that could be attained at plant i without additional hours or plant and equipment but with additional employees on the same shift. (j = 3 gives CU_{i3} and CU_3)

$(1 + A_{ij}) \equiv$ is an adjustment factor to reflect the slack in current use of labour and capital .

$H_{is} \equiv$ is the average production hours per week at plant i during shift s.

$154 \equiv$ is the number of production hours at which a plant would be considered as operating at full capacity if all the shifts have full contigents of workers.

Table 1[3] below shows the number of firms, shifts and productivity changes between shifts. Fifty-seven percent of the firms were operating 24 hours per day and another forty-one percent were willing to operate a second and/or third shift if plastic raw materials were available and demand existed. Hence, ninety-eight percent of the firms indicates that the plastic plants could be operated for 24 hours. Likewise entrepreneurs anticipated or observed that productivity between shifts would increase, remain the same or decrease. Seven (7%) percent of the firms anticipated or observed an increase, 63% a constant. and 30% a decrease. Thus, it was considered justified to assume that plastic processors could: a) operate a second and/or third shift and b) productivity would be constant between shifts.

Bearing these assumptions in mind, the maximum potential production hours were taken to be 154 (i.e. 168 - 14 = 154). Firms were assumed to need 14 hours per week for repair and maintainance. Although this is more than essential, it was deemed a conservative maximum.

Table 13

Number of Firms, Shifts and Productivity changes

	Firms operating							
	One Shift		Two Shifts		Three Shifts		Total	
	Number	%	Number	%	Number	%	Number	%
1. Firms operating 24 hours	-	-	10	23	15	34	25	57
2. Willing to operate a 2nd and/or 3rd shift	13	30	5	11	-	-	18	41
3. Not willing to operate a 2nd and/or 3rd shift	1	2	-	-	-	-	1	2
4. Total	14	32	15	34	15	34	44	100
Productivity changes								
1. Increase	0	0	2	5	1	2	3	7
2. Constant	11	25	8	18	9	21	28	63
3. Decrease	3	7	5	11	5	11	13	30
4. Total	14	32	15	34	15	34	44	100

Source: Own Survey.

L_{is} = is the number of production workers (total number of workers less office and security staff) at plant i during shifts.

$L_{is_{max}}$ = is the largest number of production workers actually on any one of the current shifts.

L_{is} and $L_{is_{max}}$ are used as scalars. The aim is to weight production hours by maximum potential value added in a plant. Since the production data was not available for all the firms, L_{is} and $L_{is_{max}}$ were deemed good indexes for value added and potential value added. However, at the plant level, firms operating for more than one shift often utilised the first shift more intensively. Thus, to reflect the slackness during the second and/or third shift the ratio of L_{is} to $L_{is_{max}}$ was used as a weight.

Note that the capacity utilization index would be deficient if $L_{is_{max}}$ is significantly less than the potential number of workers that could operate the existing machinery efficiently. However, the author observed that $L_{is_{max}}$ was always close to the maximum potential. Also the utilization index is indeterminate when $L_{is_{max}}$ = 0 i.e. when the processing firms have closed down. This case may be regarded as a utilization rate of zero.

Capacity Utilization Rates

The utilization rates for each firm and the average for the entire industry are presented in Tables 14 A - B. CU_{i1} gives the highest plant utilization rates since it assumes zero labour slack. CU_{i3} gives the lowest estimate since it considers both labour and machinery slack. However, attention is primarily focussed on CU_{i2} as the principal measure for plant utilization since it is an intermediate (moderate) measure which only allows for labour slack. This choice avoids exaggerating the outcome.

On the average, plastic fabricators use their plants half of the maximum time available for production (i.e 53%). Nairobi firms use their production capacities (53%) negligibly more than Mombasa firms (51%). Nonetheless, these rates are considerably below the potential utilization rates and so demonstrate the hypothesis.

Table 14A

Nairobi Firms

Rates of Capacity Utilization by Firm and Industry

FIRM CODE	SHIFT INFORMATION						SLACK VARIABLES		UTILIZATION RATES		
	SHIFT I		SHIFT II		SHIFT III		A_{i2} with nothing extra	A_{i3} with extra Man	CU_{i1}	CU_{i2}	CU_{i3}
	PW	APH	PW	APH	PW	APH	%	%	%	%	%
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	40	45	22	75	0	0	61.5	121.5	56.0	34.7	25.3
2	42	77	35	91	0	0	10	20	99.2	90.2	82.7
3	54	56	42	56	42	42	0	0	92.9	92.9	92.9
4	8	56	6	56	6	56	0	0	90.9	90.9	90.9
5	48	56	40	56	39	56	25	35	96.2	77.0	71.3
6	73	48	69	48	68	48	20	120	89.7	74.7	40.8
7	15	48	9	48	9	48	35	50	68.6	50.8	45.7
8	7	47.5	-	-	-	-	50	60	30.8	20.6	19.3
9	5	72.0	5	72.0	0	0	0	80	93.5	93.5	51.9
10	82	73.5	36	94.5	0	0	0	0	74.7	74.7	74.7

Table 14A Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
11	10	45	–	–	–	–	0	0	29.2	29.2	29.2
12	23	45	–	–	–	–	0	0	29.2	29.2	29.2
13	15	45	–	–	–	–	0	60	29.2	29.2	29.2
14	7	45	7	40	–	–	50	50	55.2	36.8	36.8
15	30	56	27	56	27	56	10	15	100.0	92.6	88.5
16	6	33	6	33	6	66	40	45	85.7	61.2	59.1
17	42	56	37	56	37	56	60	70	100.0	62.8	59.1
18	92	46.8	–	–	–	–	240	270	30.4	8.9	8.2
19	10	46.8	–	–	–	–	40	40	30.4	21.7	21.7
20	18	45.0	–	–	–	–	80	80	29.2	16.2	16.2
21	40	49.5	–	–	–	–	40	60	32.1	23.0	20.1
22	18	63.0	12	105	–	–	0	0	86.4	86.4	86.4
23	30	49.5	–	–	–	–	35	45	32.1	23.8	22.2
24	12	46.8	–	–	–	–	100	140	30.4	15.2	12.7
25	90	47.5	–	–	–	–	20	30	30.8	25.7	23.7
26	26	44.0	21	33	21	55	30	40	74.8	57.5	53.4
27	72	48.0	40	48	40	48	30	30	65.8	50.6	50.6
28	70	56	50	56	50	56	50	50	68.3	58.9	58.9
29	6	48	6	48	–	–	0	50	62.3	62.3	41.6

Table 14A Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
30	8	56	6	56	6	56	50	50	90.2	60.6	60.6
31	19	44	19	44	19	44	15.	45	85.7	74.5	59.1
32	103	48	68	48	68	48	30	30	72.3	55.6	55.6
33	31	84	30	84	-	-	50	70	100.0	71.6	63.1
					Weighted Average		36.4	54.7	67.2	53.4	48.7

Source: Own Survey

Table 14B

Mombasa Firms

Rates of Capacity Utilization by Firm and Industry

SHIFT INFORMATION*							SLACK VARIABLES		UTILIZATION RATES		
	SHIFT 1		SHIFT2		SHI.3		A_{i2}	A_{i3}	CU_{i1}	CU_{i2}	CU_{i3}
	PW	APM	PW	APH	PW	APH	%	%	%	%	%
34	18	45	-	-	-	-	40	120	29.2	20.9	13.3
35	5	44	3	44	3	44	0	0	62.9	62.9	62.9
36	55	56	35	56	35	56	15	15	82.6	71.9	71:9
37	264	56	75	56	75	56	30	30	57.0	43.9	43.9
38	11	56	6	56	-	-	0	75	56.2	56.2	32.1
39	15	48	14	48	14	48	0	0	89.4	89.4	89.4
40	6	44	-	-	-	-	90	90	28.6	15.0	15.0
41	4	40	-	-	-	-	50	50	26.0	17.3	17.3
42	10	60	10	60	-	-	50	50	77.9	51.9	51.9
43	5	17.5	3	31.5	3	35	100	100	37.9	18.6	18.6
X44	20	56	20	56	20	56	0	0	100.0	100.0	100.0
Weighted Average (Mombasa)							24.5	28.2	62.1	50.8	49.8
Weighted Average. (Mombasa and Nairobi)							33.4	48.1	65.8	52.7	49.0

Source: Own Survey

Notes to Tables 14A and 14B

1. * The term'NAIROBI' refers to those firms surveyed in Nairobi, Thika, Limuru and Redhill i.e. Nairobi and its vicinities firms.

2. **For a detailed distribution of shifts and workers over the number of firms, see Appendices 1A and 1B.

3. ***These firms operate two long shifts in a day and have three groups of production workers rotating but, the day shift is always larger than the night shift. Thus, for simplicity of computation, it was assumed that these firms operate 3 shifts in a day of equal duration.

4. By assuming that maximum number of hours that a plant can be used in a week is 154, a firm with a distribution of production hours aggregating to 168 may yield capacity utilisation rate over 100% in this case, 100% utilization rate is taken as the maximum.

5. PW $\equiv$ Production workers at plant i during shift S.

6. APH $\equiv$ Average production hours that plant i is operated during shift S per week.

4.3.2 Hypothesis 2

Statement: Most Plastics Fabricators are small under-utilized firms.

Capacity Utilization by Firm Size

The rates of capacity utilisation used below are the same as those in section 4.3.1. First, they are plotted in a scatter diagram (fig.9) against the number of production workers (firm size). Then, they are categorized into eight groups (Appendix 2) and a weighted mean computed for each class and for all the groups. The results are thereafter, summarized and presented in table 15 .

The following observations are inferred from figure 9 and table 15:

(a) i) 12 firms out of 44 employ less than 20 production workers and 11 of them operate at a rate below 20%.

ii) 25 firms out of 44 employ below 40 production workers and 21 of them operate at a rate less than 63%.

(b) In general:

i) The rate of utilization increases as the number of production workers goes up to 40.

ii) Between 40-70 production workers there seems to be no correlation between utilisation rate and firm size.

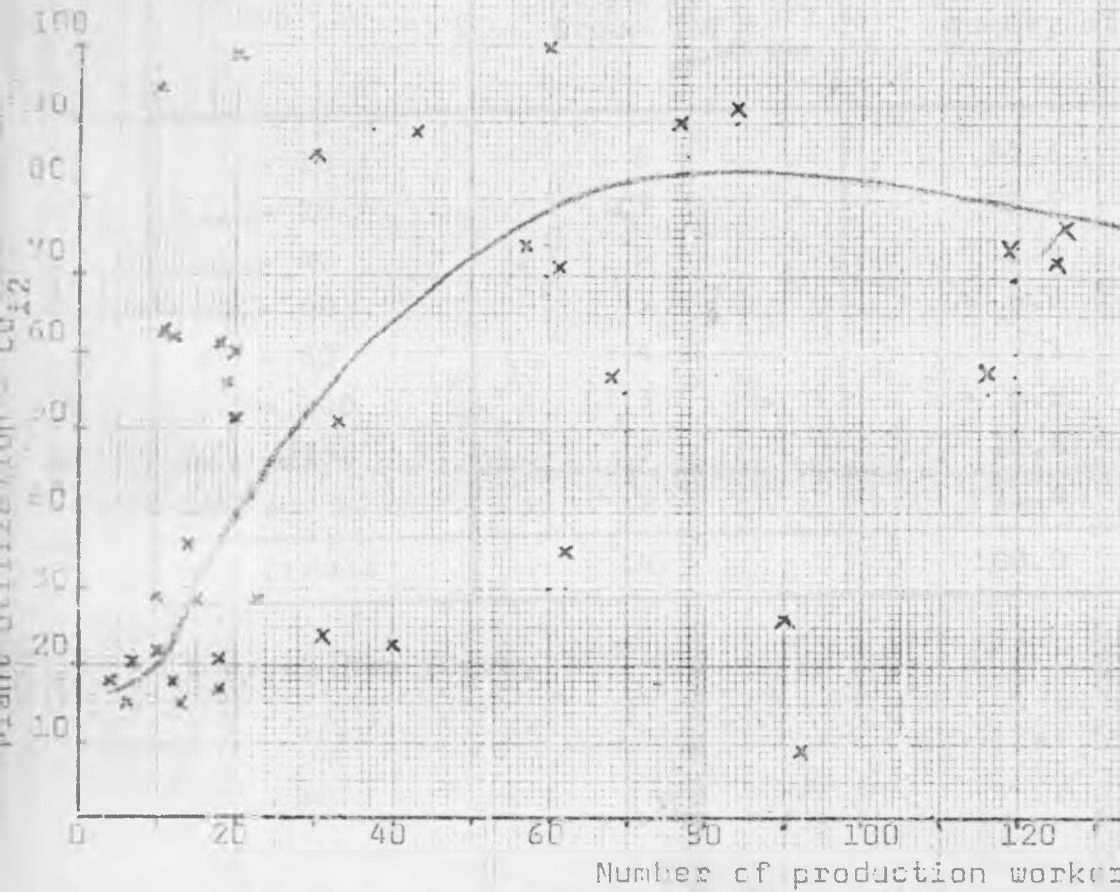
iii) The rate of utilization declines as the number of production workers goes beyond 70.

iv) Arguments i) through iii) give raise to the curve in figure 9 which was free hand fitted.

Similar results to those above can be obtained from table 15. Note that 13.6% of the firms employ less than 10 production workers and utilise their production capacity on the average at 30.5% only. Over 29.5% of the firms employ between 11-20 production workers and utilize their capacity on average at 39.1%. Likewise, 11.4% of the firms employ between 21 - 40 production workers and use their capacity, at 36.7%. Thus, 54.5% of the firms employ less than 40 production workers and on the average use their plants at a rate below 37%. Hence the hypothesis, is demonstrated.

Fig. 9

Plants Utilisation by Firm Size



Source: Own Survey
The curve was free-hand fitted

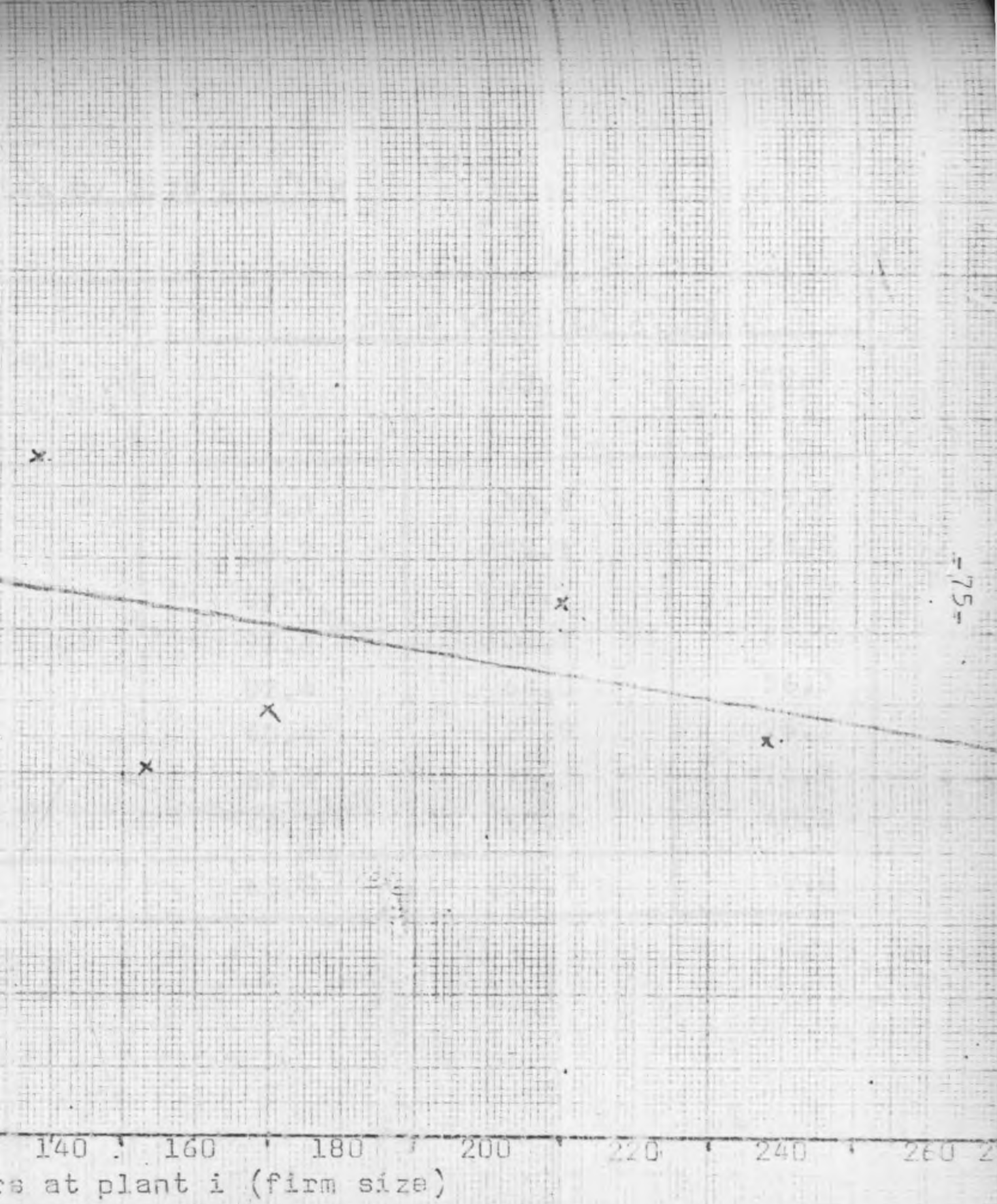

140 160 180 200 220 240 260 27
s at plant i (firm size)

Table 15

Plants Utilization Rates by Size of Firm

Firm Size "Group"	Number of Firms by Group (NF)	NF as a % of the Total Number of Firms	GROUP WEIGHTED AVERAGE		
			CU_1	CU_2	CU_3
1 - 10	6	13.6	37.0	30.5	25.3
11 - 20	13	29.5	50.2	39.1	33.4
21 - 40	5	11.4	43.7	36.7	34.8
41 - 60	3	6.8	92.0	88.1	82.7
61 - 80	4	9.1	82.4	64.0	56.3
81 - 100	3	6.8	40.4	27.9	26.1
101 - 150	5	11.4	87.2	76.3	74.7
150 +	5	11.4	68.7	52.5	48.2
All Groups	44	100.0	65.8	52.7	49.0

Source: Own Survey

4.3.2. Hypothesis 3

Statement: Plastic firms are operated at different rates for the various processes.

Capacity Utilization by Process

This section shows (for some of the causes see hypothesis 6) that the plants' utilization rates are associated with their fabricating methods. Also the range between the levels of utilization for the various processes is quite significant.

The data used here is the same as that in section 4.3.1. However, it is re-arranged according to firm and process. Then, a weighted average for each process is computed (see Appendix 3). The results are summarized and presented in Table 16 .

As asserted in the hypothesis, the range of capacity utilization (CU_2) by process is wide from 10% (foaming) to 76% (Extrusion of conduits). The average of all the process is 53%.

The processes whose utilization rates are very low have only one or a few firms. The survey revealed that either these firm(s) suffered from deficient demand (e.g. formed products) or stiff competition from imports (e.g. vacuum formed products or formica).

Table 16

Plants Utilization Rates by Process

Process	Examples of Products produced with this Process	Total Lismax "Weight" for each Process	CU_1	CU_2	CU_3
1. Blow Moulding and Injection Moulding*	Containers, bottles and caps	625	70.6	60.4	55.6
2. Calendering	Floor Tiles and Coated Fabrics	95	56.9	45.4	45.4
3. Coating	Insulated Wires	12	47.7	29.2	29.2
4. Compression Moulding	Cups, plates	34	78.6	65.4	62.2
5. Extrusion:					
Conduit	Conduits	11	89.2	75.9	55.2
Film	Film	142	83.0	62.0	55.2
Pipe	Pipe	124	90.1	65.0	63.8
Floor Type	Tiles	10	29.2	29.2	29.2
6. Foaming	Mattresses	102	30.4	10.2	9.5
7. Injection Moulding*	Cassettes	140	58.2	52.3	47.2
8. Lamination	Formica	15	29.2	29.2	29.2
9. Rotational Moulding	Tote Boxes Bulk Tanks Dust Bins	7	30.8	20.6	19.3
10. Vacuum Forming	Sanitary Ware	18	29.2	16.2	16.2
11. Weaving	Plastic Woven Sacks	134	76.7	59.5	57.3
12. "Others"	Pen Assembly	96	30.7	25.0	23.2
ALL PROCESSES (Weighted Average)		1565	65.8	52.7	49.0

Source: Own Survey

*"Blow Moulding and Injection Moulding" (row 1) refers to plants having both processes and "Injection Moulding" (row 7) refers to firms having only Injection Moulding and hence no overlap.

4.3.4 Hypothesis 4

Statement: Most of the Plastic Processors use their Machinery (Classified by Process) at rates below their potential utilization rates.

There are many plastic fabricating methods e.g. casting, calendering, coating, extrusion, lamination, vacuum forming, blow moulding, compression moulding and injection moulding. However, the machinery plasticity utilization rate (MU_j) is measured for just the major processes in Kenya. i.e. blow moulding, injection moulding and extrusion.

Measures of Machinery Utilization by Process

MU_j is measured at the plant level (see appendices 4A-D) and at the industry level with help of two different indices based on machine hours of production. This ratio (MU_j) is similar to that in section 4.3.1 as it is based on the same principle. But the weights are different and the formula has no slack variable because production is machine paced. These plant and industry rates have both weighted and unweighted versions expressed at the plant level as follows:

$$MU_{ij} = \left[\frac{1}{\sum_{d=1}^{m} W_{id}} \right] \left[\sum_{d=1}^{m} W_{id} \left(\frac{H_{id}}{154} \right) \right]$$

and at the industry level as:

and at the industry level as:

$$MU_j = \left[\frac{1}{\sum_{i=1}^{n} \sum_{d=1}^{m} W_{id}} \right] \left[\sum_{i=1}^{n} \left(\sum_{d=1}^{m} W_{id} \right) MU_{ij} \right]$$

Where: i = 1, 2, ..., n is the number of plants

d = 1, 2,........, m is the number of machines at plant i.

j = weighted (W) or not weighted (N)

W_{id} = is plasticity capacity of machine d at plant i. For blow moulding and extrusion, W_{id} was estimated as the maximum kilogrammes per hour while for injection moulding W_{id} was estimated in maximum grams per impression. Note that the machines are normally operated less than maximum possible, thus, these weights are biased.

or W_{id} = 1 which means that all machines are weighted the same regardless of size.

H_{id} = is the average hours a machine d is operated per week at plant i.

154 = is the maximum machinery production hours per week at plant i giving allowance for repair and maintainance.

Machinery Utilisation in Blow Moulding

Blow Moulding is suitable for products such as bottles and other containers. The results for MU_{ij} for each plant and the average for the industry are displayed in table 17

Table 17

Blow Moulding

Machinery Plasticity Capacity Utilisation by Firm and Industry

Firm Code	W_{id} Kg/Hr	MU_N (Unweighted) %	MU_W (Weighted) %
1	300	40.9	33.7
2	454	64.1	63.2
3	165	92.2	92.0
6	250	26.0	26.0
7	200	46.8	46.8
34	100	0.0	0.0
36	469	68.2	63.7
37	333	100.0	100.0
42	125	77.9	77.9
Total	2396		
	MU_N and MU_W	57.3	63.8

Source: Own Survey

Machinery Utilisation in Injection Moulding

Injection Moulding is suitable for products such as caps for blow moulded containers; beer, soda, milk and bread crates; ball points; conduit fittings; soles of shoes cassette and radio casings . The machinery utilisation results are presented in table 18.

Table 18 : Injection Moulding

Machinery Plasticity Capacity Utilisation by Firm and Industry

Firm Code	W_{id} Grams/ Impression	MU_N (Unweighted) %	MU_W (Weighted) %
1	600	77.9	77.9
2	370	65.2	68.3
7	380	77.9	77.9
21	1730	32.1	32.1
23	370	28.6	28.6
31	4900	57.1	57.1
34	2800	13.0	3.7
35	1200	77.9	77.9
36	8740	41.9	52.9
37	830	66.2	68.2
38	2068	90.0	85.5
39	1850	100.0	100.0
42	505	77.9	77.9
44	9050	66.2	57.0
Total	35393		
	MU_N & MU_W	62.4	56.1

Source: Own Survey

Machinery Utilisation in Extrusion

Extrusion is a continuous process designed to fabricate products such as pipes, films, conduits, hoses, rods, profiles, fibres, sheets, strappings, sheets and wire coating. In this study, extrusion is categorised into film, pipe and "other products", machinery utilisation rates are measured for each group at the plant and industry level. (Tables 19 - 21.).

Table 19: Film Extrusion

Machinery Plasticity Capacity Utilisation by Firm and Industry.

Firm Code	W_{id} Kg/Hr.	MU_N %	MU_W %
1	1617	71.9	58.6
15	945	65.5	68.3
22	173	93.5	93.5
32	320	80.5	86.2
33	150	60.4	60.4
Total	3205		
MU_1 and	MU_2	74.4	86.3

Source: Own Survey

Table 20: Pipe Extrusion

Machinery Plasticity Capacity Utilisation by Firm and Industry

Firm Code	W_{id} Kg/Hr.	MU_N %	MU_W %
15	697	41.5	41.9
28	875	60.4	60.4
29	605	30.3	36.1
Total	2177		
MU_N and	MU_W	44.1	47.7

Source: Own Survey

Table 21: Other Extruded Products

Machinery Plasticity Capacity Utilisation

Firm Code	H_{id}	W_{id}	MU_N	MU_W
15	40.0	25	26.0	
36	0.0	75	0.0	
30	36.0	90	23.4	
11	42.5	20	27.6	
-	120.0	80	77.9	
-	40.0	75	26.0	
33	40.0	55	26.0	
	Total	420		
	MU_N and	MU_W	29.6	20.0

Ource: Own Survey

Table 22 summarizes the outcome of unweighted and weighted machinery plasticity capacity utilization by process for the entire industry.

Table 22

Machinery Utilization by Process

Process	MU_N% Unweighted	MU_W% Weighted
Film Extrusion	74.4	86.3
Injection Moulding	62.4	56.1
Blow Moulding	57.3	63.8
Pipe Extrusion	44.1	47.7
Extrusion of Other Products	29.6	20.1

Source: Own Survey

Levels of machinery utilization varies between firms and fabricating methods. Using the unweighted index, machinery utilization rates can be ordered from high to low as follows: film extrusion, injection moulding, blow moulding, pipe extrusion and extrusion of other products. These results show that apart from film extrusion which has moderately high rates of machinery utilization (i.e. MU_N = 74% and MU_W = 86%) the other processes under-utilize their machinery.

4.3.5. Hypothesis 5

Statement: Most plastic processors use their labour force, supervisory skills and production space at rates below their potential utilization rates.

The level of labour force, supervisory skill and production space utilization (LSP_u) is measured by:

$$LSP_u = \frac{1}{1 + x_j}$$

x_j is the percentage weighted average slack variable given by:

$$x_j = \sum_i^n L_i S_j / \sum_i^n L_i, \quad \text{for } j = 1, 2 \text{ and}$$

$$x_j = \sum_i^n (L_{is_{max}}) S_j / \sum_i^n (L_{is_{max}}), \quad \text{for } j = 3,$$

Where:

l = 1, 2, 3, ..., n is the number of plants

S_j = the slack variable for

j = 1, SV is labour force

j = 2, SV is supervisory skills and

j = 3, SV is production space

L_i = is the number of production workers at plant i. Utilization of labourforce depends on the size of the firm, thus, L_i is used as a weight because it is a good proxy for the size of the firm.

$L_{is_{max}}$ = is the largest number of production workers at plant i on any one of the current shifts. Note that the amount of production space (e.g. Factory floor) available determines the level of output and the maximum number of production workers that a plant i can hold during shift s. Hence, $L_{is_{max}}$ is used to weight slackness in use of production space.

Weighted average slack variables are shown in Tables 23A - B and the weighted average utilization rates are given below:-

Utilization of Labourforce:

$$\text{Nairobi Firms} = \frac{100.0}{100.0 + 36.4} = .733 \text{ or } 73\%$$

$$\text{Mombasa Firms} = \frac{100.0}{100.0 + 24.5} = .803 \text{ or } 80\%$$

$$\text{Nairobi and Mombasa} = \frac{100.0}{100.0 + 33.4} = .750 \text{ or } 75\%$$

Utilization of Supervisory Skills :

$$\text{Nairobi Firms} = \frac{100.0}{100.0 + 34.3} = .745 \text{ or } 75\%$$

$$\text{Mombasa Firms} = \frac{100.0}{100.0 + 16.9} = .855 \text{ or } 86\%$$

$$\text{Nairobi and Mombasa Firms} = \frac{100.0}{100.0 + 29.9} = .770 \text{ or } 77\%$$

Utilization of Production Space:

$$\text{Nairobi Firms} = \frac{100.0}{100.0 + 20.3} = .831 \text{ or } 83\%$$

$$\text{Mombasa Firms} = \frac{100.0}{100.0 + 16.9} = .855 \text{ or } 86\%$$

$$\text{Nairobi and Mombasa Firms} = \frac{100.0}{100.0 + 19.4} = .838 \text{ or } 84\%$$

Mombasa Firms use their labourforce, supervisory skills and production space at higher rates than Nairobi Firms. For the entire industry, labourforce is utilized at 75%, supervisory skills at 77% and production space at 84%. Thus, usage of labour force and supervisory skills is moderate and the utilization of production space is high. Note that most of the plastic firms intensively use their small production space.

Table 23 A

Nairobi Firms

Weighted Average Slack Variables

WEIGHTS			SLACK VARIABLES		
Firm Code	L_i	$L_{is_{max}}$	Labour I %	Supervision II %	Space III %
1	62	40	61.5	40	10
2	77	42	10.0	60	2
3	138	54	0.0	70	0
4	20	8	0.0	30	0
5	127	48	25.0	40	30
6	210	73	20.0	10	0
7	33	15	35.0	80	8
8	7	7	50.0	20	10
9	10	5	0.0	200	20
10	118	82	0.0	0	10
11	10	10	0.0	30	40
12	23	23	0.0	100	0
13	15	15	0.0	133	10
14	14	7	50.0	40	5
15	84	30	10.0	33	20
16	18	6	40.0	50	20
17	116	42	60.0	20	40
18	92	92.	240.0	57	20
19	10	10	40.0	187	5
20	18	18	80.0	130	10
21	40	40	40.0	10	5
22	30	18	0.0	20	10
23	31	30	35.0	25	49
24	12	12	100.0	50	30
25	90	90.	20.0	50	5
26	68	26	30.0	20	40
27	153	72	30.0	0	70
28	170	70	50.0	30	0
29	12	6	0.0	83	50
30	20	8	50.0	60	5
31	57	19	15.0	50	5
32	239	103	30.0	20	50
33	61	31	50.0	30	25
Total	2185	1152	-	-	-
Weighted Average			36.4	34.5	20.3

Source: Own survey

Table 23B

Mombasa Films

Weighted Average Slack Variables

	WEIGHTS		SLACK VARIABLES		
Firm Code	Lis	Lis_{max}	Labour I %	Supervision II %	Space III %
34	18	18	40	30	10
35	11	5	0	17	20
36	125	55	15	10	10
37	414	264	30	10	10
38	17	11	0	16	30
39	43	15	0	26	60
40	6	6	90	60	100
41	4	4	50	100	80
42	20	10	50	40	35
43	11	5	100	80	50
44	60	20	0	40	40
Total	729	413	-	-	-
Weighted Average: Mombasa			24.5	16.9	16.9
Weighted Average: Nairobi and Mombasa			33.4	29.9	19.4

I = A_{i2} = The percentage of additional production at plant i without additional employees, hours, or plant and equipment. Hence, A_{i2} gives slackness in labour usage.

II = Potential percentage increase in supervisory load.

III = Potential percentage increase in use of production space.

4.3.6 <u>Hypothesis 6</u>

Statement: To an individual processor, both the inadequate supply of inputs and insufficient demand for its products explains the under-usage of plant and equipment.

Hypothesis 1 through 5 have demonstrated the under-usage of economic resources in this industry. This hypothesis examines some of the factors constraining the use of capacity.

The entreprenuers were asked to rank inorder of importance the factors which constrained full use of capacity in 1982/83. Ranking was as follows:

A. Very important

B. Important

C. Somewhat important

D. Not important

Seven causes considered to be important in this industry were suggested

(I) Seasonal demand

(II) Insufficient demand

(III) Difficulties over raw material supplies

(IV) Fuel shortages

(V) Shortage of skilled manpower

(VI) Plant breakdown

(VII) Difficulties in obtaining spare parts

The results are presented in Tables 24A - B. The sign x indicates a response for a certain cause against its rank.

Reasons (i) and (ii) could be grouped as demand factors and (iii) through (vii) as supply factors. For Nairobi and Mombasa firms; reason (iii) is very significant; reasons (i), (ii) and (vii) are significant; reasons (iv), (v) and (vi) are insignificant. For all the firms the ranking of the causes of capacity underutilization as important or very important was as follows: Seasonal demand 46%, insufficient demand 55%, inadequate supply of plastic raw materials 91%, lack of spare parts 49%, fuel shortages 6%, shortage of skilled manpower 18% and plant breakdown 9% of the firms. Thus, both demand and supply factors appear to explain the under-usage of plant and equipment. However the poor supply of plastic raw materials plays a key role.

Reasons (i) is significant since the demand for plastics products is mainly derived e.g the expansion and constraction of the economy influences the level of utilisation of plastic firms.

Reasons (ii) demonstrates the existence of insufficient demand for plastics products. When this research was conducted a foreign exchange crisis was prevailing. This caused difficulties in procuring plastics raw materials (reason (iii))and spare parts (reason (vii)) due to a lack of import licences and foreign exchange.

Reasons (iv), (v) and (vi) are not significant constraints on capacity utilisation because: a) electricity is the principal source of power and it is readily available, b) the basic skill requirement in this industry is for machine operation and it is easy to learn, and c) in most cases, the plastics machinery is new and has few break downs.

Note that these results reflect the individual entrepreneurs perception and thus may not agree with a sectoral interpretation of the causes of capacity under-utilization.

From a macro perception, the prime causes of productive capacities under-utilization on the demand side seems to be: a) those arising from the expansion and contraction of general economy[3],b) the skewed income distribution and the concentration of wage and salary earners in urban areas leading to plastics being consumed by only a small proportion of the society mainly in the

c) competition from imported goods similar or identical to those produced locally, d) insufficient demand for Kenyan exports into the neighbouring countries due to a shortage of foreign exchange in these countries, e) high prices for Kenyan manufactured good in the export market as compared with the prices of other countries exporting to the Kenya's neighbours[4], f) lack of initiative to promote plastic products for export, and f) previous hardships at the Uganda and Tanzania boarders. All these causes would be interpreted at the plant level as either seasonal or insufficient demand. On the supply side, excess capacity exists because of lack of proper planning of investments in machinery and new plants leading to severe competition in most of the processes.Also difficulties in procuring imported inputs at the sectoral level seems to be motivated by import licensing difficulties caused by a shortage and/or rationing of foreign exchange or bureaucratic obstacles and delays.

Table 24A

Nairobi Firms

Some Causes of Capacity Under-Utilization

Firm	RESPONSE																											
	I				II				III				IV				V				VI				VII			
Code	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
1				X				X	X						X					X			X				X	
2				X				X	X						X			X				X				X		
3		X						X	X					X				X					X			X		
4			X				X		X							X				X				X			X	
5				X		X			X							X		X				X			X			
6		X			X				X				X				X						X			X		
7				X				X		X					X				X				X			X		
8	X					X				X						X			X					X				X
9			X					X	X							X				X			X				X	
10		X					X				X					X			X				X			X		

Table 24A Continued

Firm Code	I				II				III				IV				V				VI				VII			
	RESPONSE																											
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
11				X				X	X						X					X				X			X	
12			X		X					X						X				X				X		X		
13			X			X			X						X					X			X				X	
14		X					X		X						X					X			X			X		
15				X				X	X						X			X						X		X		
16		X					X	X			X					X				X	X					X		
17	X				X				X							X				X			X					X
18			X			X			X							X				X				X			X	
19		X			X				X							X				X			X				X	
20		X			X				X							X				X			X				X	

Table 24A Continued

Firm Code	I A	I B	I C	I D	II A	II B	II C	II D	III A	III B	III C	III D	IV A	IV B	IV C	IV D	V A	V B	V C	V D	VI A	VI B	VI C	VI D	VII A	VII B	VII C	VII D
21	X					X			X							X			X				X				X	
22				X				X			X					X				X			X				X	
23	X				X				X							X				X					X			
24				X	X					X						X			X					X			X	
25		X						X	X							X				X			X			X		
26		X			X				X							X				X			X		X			
27				X	X				X							X				X			X					X
28				X	X				X							X				X				X	X			
29		X						X	X						X					X				X				X
30		X						X	X							X		X					X				X	

Table 24A Contined

Firm Code	RESPONSE																											
	I				II				III				IV				V				VI				VII			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
31				X				X	X							X				X			X			X		
32				X				X	X							X				X			X				X	
33				X		X			X							X				X			X		X			
Total	4	11	5	13	10	6	3	14	26	4	3	0	1	1	8	23	1	5	5	22	1	2	21	9	5	11	13	4
Total (A+B)	15		-		16		-		30		-		2		-		6		-		3		-		16		-	
%Total (A+B)	45.5%		-		48.5%		-		90.9%		-		6.1%		-		18.2%		-		9.1%		-		48.5%		-	

Source: Own Survey

Some Causes of Capacity Under-Utilization

Firm Code	I				II				III				IV				V				VI				VII			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
34	X				X				X							X				X	X					X		
35		X				X			X							X				X		X				X		
36				X		X			X						X					X	X					X		
37				X				X	X					X						X		X			X			
38				X		X			X							X		X					X				X	
39		X						X			X					X		X						X				X
40				X	X				X							X			X		X				X			
41				X				X	X							X				X			X			X		
42	X				X				X							X				X		X			X			
43			X		X				X							X			X					X			X	

-99-

Table 24B Continued

Firm Code	RESPONSE																											
	I				II				III				IV				V				VI				VII			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
44	·	X			X				X				X							X				X	X			
Total	2	3	1	5	5	3	0	3	10	0	1	0	0	1	1	9	0	[illegible]	2	7	3	3	2	3	4	4	2	1
Total (A+B)	5		-		8		-		10		-		1		-		2		-		6		-		8		-	
% Total (A+B)	45.5%		-		72.7%		-		90.9%		-		9.1%		-		18.2%		-		54.5%		-		72.7%		-	
Nairobi and Mombasa Firms																												
Total	6	14	6	18	15	9	3	17	36	4	4	0	1	2	9	32	1	7	7	29	1	5	23	12	9	15	15	5
Total	20		-		24		-		40		-		3		-		8		-		9		-		24		-	
%Total (A+B)	45.5%		-		54.5%		-		90.9%		-		6.8%		-		18.2%		-		20.5%		-		54.5%		-	

Source: Own Survey

4.3.7 Hypothesis 7

Statement: The plastics processing industry in Kenya is characterised by unnecessary machinery differentiation .

The machinery listed in tables 25A - D is grouped by processes (i.e. Blow Moulding, Injection Moulding Pipe and Film Extrusion) and by make, model and capacity.

The results indicate that: a) Blow Moulding has 13 makes of machinery which are dominated by Bekum and Kautex ; b) Injection Moulding has 26 makes dominated by Anker,Battenfeld, Engel, Nissei, R.H. Windsor, Storkneld and Tatming; c) Pipe extrusion has 3 makes dominated by cincinnati; and d) Film extrusion has 17 makes dominated by Crespi and Samafor.

Assuming the number of makes is to be reduced to popular ones, i.e. 2 for Blow Moulding, 7 for Injection Moulding, 1 for Pipe Extrusion and 2 for Film Extrusion, then there are many redundant makes. However, most of the machines are modern and relatively new and hence despite the widely different machinery, repair and maintainance is not a short term problem in this industry.

Table 25A

Blow Moulding

Machinery Make, Model and Capacity

Number of			Make	Model	Capacity Kg/Hr.
Makes	Models	Machines			
1	1	4	Bekum	BM001	45
	2	4	Bekum	BM005	30
	3	1	Bekum	BM006	70
	4	1	Bekum	BM007	180
2	1	2	Comec	CS5000	83
	2	1	Comec	B5000	83
3	1	1	Fischer	-	63
	2	1	Fischer	60/200	63
	3	2	Fischer	FBZ1000	60
4	1	1	Grambu	651	-
5	1	2	Haysen	-	75
6	1	2	Hesta	B40	100
7	1	1	Hesten	-	100
8	1	1	Kautex	B3/S60/4	100
	2	1	Kautex	B13III	50
	3	1	Kautex	-	110
	4	1	Kautex	-	180
	5	1	Kautex	KEB4	31
	6	2	Kautex	V8	200
9	1	2	Hageco	B13	50
	2	1	(Kautex)	B30	63
	3	1	(Kautex)	B60	100
10	1	1	Krupptautex	V8	200
11	1	2	Moi	MG30	58
		1	Moi	-	-
12	1	2	Omea	L30	45
13	1	3	Rana	-	Idle for 3 Years
14	1	1	Uhora	-	Idle for 3 Years

Source: Own Survey

Table 25B
Injection Moulding
Machinery Make, Model and Capacity

Makes (1)	Models (2)	Machines (3)	Make (4)	Model (5)	Capacity Grams per Impression (6)
1	1	1	ANKER	A17-55	100
	2	1	"	A36-150	500
	3	1	"	DV10	300
	4	1	"	15-30	80
2	1	1	Arburg	-	50
3	1	1	Battenfeld	900	400
	2	3	"	600	260
	3	1	"	170	100
	4	1	"	-	600
4	1	1	Bipak	450	1100
5	1	1	Demag	D80	140
6	1	5	Dr Boy	BOY 50	500
	2	6	"	BOY 15	50
7	1	1	Eckert & Ziegler	Monomat 50	3300
	2	1	"	K/M	100
8	1	1	Engel	ES750/3000AS	2000
	2	3	"	-	200
	3	1	"	650/25	480
	4	2	"	400/125	375
	5	2	"	180/90	250
	6	1	"	ES50	100
9	1	1	GBF	V55	50
	2	1	"	175	200
10	1	1	HPM	600	2000
11	1	1	Insa	PB140	140
	2	1	Insa	PB85	190
	3	1	"	55	50
12	1	1	Jettmaster	JM45	1000
13	1	2	Metal Meccania	14SRE	140
	2	1	"	90SR	100
14	1	1	Mipak	"8 stations"	400
15	1	1	Negri Bossi	V7-9FA	500
16	1	2	Nissei	-	284
	2	1	"	FS-700	4000
	3	1	"	FS-350	1500

Table 25 B Continued

(1)	(2)	(3)	(4)	(5)	(6)
-	4	1	Nissei	FS-150	300
	5	1	Nissei	FS-100	200
17	1	1	R. H. Windsor	RS-130	340
	2	1	"	SP130	170
	3	1	"	AP125	400
	4	1	"	AP1544	300
	5	1	"	SP8	80
	6	3	"	SP1	100
18	1	2	Sandretto	P155/V	80
	2	1	"	GV/31	80
	3	2	"	GV/6	150
19	1		Sanpak	Mark I	350
20	1	4	Solpak II	-	500
21	1	4	Storkneld	-	250
	2	1	"	-	500
	3	1	"	-	1000
	4	6	"	-	180
	5	2	"	-	100
22	1	1	Stubbe	-	70
23	1	1	Tatming	-	170
	2	1	"	TM141/2	128
	3	4	"	TM1/10	284
	4	1	"	150	150
24	1	1	Toshiba Menekal	IS125	-
25	1	1	Trusioma	-	0
26	1	1	Unipak	"8 Stations"	

Source: Own Survey

Table 25C

Pipe Extrusion

Machinery Make, Model and Capacity

NUMBER OF			MAKE	MODEL	CAPACITY KG/HR.
Make	Models	Machines			
1	1	1	Anger	A482C	210
	2	1	"	-	110
2	1	1	Bandera	-	60
3	1	2	Cincinnati	CM80	500
	2	1	"	A/280	210
	3	3	"	CT111	300
	4	1	"	EGX250	420
	5	3	"	CM55	150

Source: Own Survey

Table 25D

Film Extrusion

Machinery, Make, Model and Capacity

NUMBER OF			MAKE	MODEL	CAPACITY KG/HR.
Make	Models	Machines			
1	1	1	Barmage	-	-
2	1	1	Bandera	45	100
	2	1	"	80	250
3	1	1	Bezkolon	560IAK12	45
4	1	1	Bielioni	-	80
5	1	1	Brimco	-	140
6	1	1	Covena	TR-60	120
7	1	1	Crespi	HMAT	-
	2	1	"	60	90
	3	2	"	-	70
	4	1	"	GT12	-
	5	2	"	-	-
8	1	1	Derthona	GLT	-
9	1	1	Francis Show	-	45
10	1	1	Frigorapid	-	80
11	1	1	GT	45	100
12	1	1	Man	45	80
	2	1	Man	60	130
13	1	4	Paul Kefel	500	90
	2	3	"	1000	130
		2	"	1500	130
14	1	1	Polycare	1500	160
15	1	1	Rotary	45	100
16	1	2	Samafor	-	130
	2	1	"	-	60
	3	1	"	-	40
17	1	2	Yamaguchi	F50B	120
18	1	2	Yei-Machinery	-	-

Source: Own Survey

4.3.8 Hypothesis 8

Statement: Plastics processing firms are characterised by unnecessary product differentiation[6].

In plastic moulding, the shape and size of the product is determined by a mould. Variations of designs of plastic products entails investments in different types of moulds. Moulds are expensive, thus, technically unnecessary design variation wastes money (usually foreign exchange) on redundant moulds and also tie up inventories and equipment.

This hypothesis explores the extent to which product differentiation prevails in this industry. The existence of differentiation is demonstrated through the example of half litre containers (bottles)[7].

Similar designs were grouped together and by assuming that each group could be represented by a single design the redundant moulds were counted and then the percentage of redundant moulds computed.

The results are shown in Table 26. Assuming that the percentage of redundant moulds is equivalent to the percentage of over-investment in moulds, then about 81% of the investment in half litre moulds is unnecessary.

This example should be typical of the over investment in containers below 2 litres and in household goods. Thus there exists excessive and unnecessary product differentiation.

Table 26

Designs and Percentage of Redundant Moulds

Group	Packaging Contents	Mould Designs			Percentage of Redundant Moulds
		Total	Desired	Redundant	
I	Liquid paste	2	1	1	50.0
II	Liquid chemical	12	1	11	92.0
III	Powder chemicals	5	1	4	80.0
IV	Baby Powder	3	1	2	67.0
V	Motor Oils	5	1	4	80.0
		27	5	22	81.4

Source: Own survey

Note:

1) The designs counted do not exhaust the total number of designs in the industry because not all firms were covered. However, the more the number of designs, the higher the percentage of redundant moulds.

4.3.9 Hypothesis 9

Statement: There exists a shortage of good mould making facilities.

Moulds determine the shape and size of a product. Hence, the development of moulded plastic products and consequently of the whole industry is dependent on the availability of mould making facilities[8]. This section surveys the sources and repairers of moulds/dies.

The data are tabularized (Table 29) and the following observations are made .

4.3.9.1 Sources of Moulds

A detailed analysis of the sources of moulds in Table 29 is presented in table 27 below:

Seventy-one percent (71%) of the fabricators only use imported moulds, 18% make and also import moulds, 6% use imported and customers' moulds, 3% obtain their moulds from commercial local machineshops only, and 3% use moulds from customers and local commercial machineshops.

Though perhaps having other sources too, 94% of the firms use imported moulds and 6% use moulds from ... (for more details see

Table 27

Sources of Moulds for the Kenyan Plastic Fabricators

Source	Importing			Making		From Commercial Machineshop		Customer Moulds		Row Total	
	Response	Number	%	Number	%	Number	%	Number	%	Number	%
Importing	Yes	24	71	6	18	-	-	2	6	32	94
	No	10	29	28	82	-	-	32	94	2	6
	Total	34	100	34	100	-	-	34	100	34	100
Making	Yes	6	18	-	-	-	-	-	-	6	18
	No	28	82	-	-	-	-	-	-	28	82
	Total	34	100	-	-	-	-	-	-	34	100
From Commercial Machine-shops	Yes	-	-	-	-	1	3	1	3	2	6
	No	-	-	-	-	33	97	33	97	32	94
	Total	-	-	-	-	34	100	34	100	34	100
Customer Moulds	Yes	2	6	-	-	1	3	-	-	3	9
	No	32	94	-	-	33	97	-	-	32	91
	Total	34	100	-	-	34	100	-	-	34	100
Column Total	Yes	32	94	6	18	2	6	3	9		
	No	2	6	28	82	32	94	32	91		
	Total	34	100	34	100	34	100	34	100		

Source: Own Survey

Note (Table 27):

1. The dash sign - means zero firms.

2. Importing/importing means the only sources of moulds are the foreign suppliers. Making/Making means private mould fabrication by the plastic firm itself is the only source .... etc.

3. Row and column totals are the overall results for a given source of moulds e.g. the column total for importing (32 firms) implies that 94% of the plastic fabricators import moulds though they also obtain moulds from other sources.

4. From table 29, only one firm obtains its moulds by importing, making, and from customers (i.e. from more than two sources). This firm does not appear in Table 27 as it would not fit in that two-dimensional layout. Nevertheless, the results are altered negligibly.

5. The Table is symmetrical about the main diagonal.

Hence, moulds/dies are mostly imported but some are made locally. Unfortunately, the data does not allow a calculation of the percentage of total moulds which are imported. However, based on the author's observation and queries it would appear that about 90% or more are imported.

4.3.9.2 Repair of Moulds/Dies

Table 29 indicate that four different groups repair moulds/dies:

a) Private Repair by Processing Firm

Twenty six percent(26%) of the fabricators have not experienced the need for major repairs due to the newness of most of the plastic machinery and the long life of dies before they need major repairs. However, only 29% of the firms do major repairs while 73% do minor repairs.

b) Repair by Local Commercial Machineshops

Twenty eight percent (28%) of the firms do their repair in domestic commercial machineshops.

c) Moulds Repaired Abroad

At least eleven percent (11%) of the processors send moulds abroad for repair (see notes to Table 29).

d) Repair by Other Fabricators

Seven percent (7%) of the processors with sister Plastic Companies in Kenya having well established machineshops send moulds to them for repair.

Note that non-related plastics firms do not help each other to make and repair moulds.

The plastic processors who make moulds were asked if they would consider making and repairing moulds commercially, they responded as follows:

Table 28

A consideration of Making and Repairing Moulds/Dies Commercially.*

Firm Code	Response: Yes	Response: No.	Reason
3		✓	The clients fear that their designs would be copied thus their products launched by their competitors.
8		✓	"
16		✓	"
23	✓		No explanation
28		✓	Similar response to that of firm 3, 8 and 16
35	✓		No explanation
44	✓		Yes, if its for export

Source:Own Survey

Note:* Most of these machineshops are equipped with modern machines and tools. Also the author observed during the research that the plastic firms and domestic commercial machineshops can confidently make a small range of moulds but all complicated moulds are imported. Furthermore, for that range, domestic moulds are cheaper than identical imported ones.

Entrepreneurs claimed they opt for imported moulds because commercial mould makers: a) have no mould testing facilities, and hence delay in delivery; b) leak our information when they are given designs for new products;and, c) cannot make complicated moulds and often use poor quality steels.

These reponses reveal an unwillingness by plastic processing firms to interact among themselves on a commercial basis. Also few rely on commercial machineshops for making and repairing of moulds.

Thus, individual firms mostly depend on themselves and foreign suppliers for the provision of moulds.

Only 28% of the firms rely on domestic commercial machineshops for the repair of moulds.

These results also show that there is little co-operation between the various agents making and repairing moulds. This hampers the growth of the mould making and repair industry.

Table 29

Sources of Mould/Dies, Repair and Maintainance*

Firm Code	SOURCES OF MOULD/DIES							REPAIR OF MOULDS				
	Import	DOMESTIC									MACHINE SHOP	
		D	D/M	M	MM	CM	C				Own	Commercial
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1	+	-	-	-	-	-	+	+	-	-	+	-
2	+	-	-	-	-	-	+	+	-	-	+	+
3	+	+	+	+	+	-	+	+	+	-	+	-
4	+	-	-	-	-	-	-	-	-	+	-	-
5	+	+	-	-	-	-	NA	+	-	-	+	-
6	+	-	-	-	-	-	-	+	-	-	+	+
7	+	-	-	-	-	-	-	+	-	-	-	+
8	+	+	-	+	+	-	-	+	+	-	+	-
9	+	-	-	-	-	-	NA	+	NE	-	+	-
10	-	-	-	-	-	+	+	-	-	-	-	+
11	-	-	-	-	-	+	NA	+	NE	-	-	-

Table 29 Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
15	+	-	-	-	-	-	NA	-	-	-	-	NR
16	+	+	+	-	+	-	-	+	+	-	+	-
17	+	-	-	-	-	-	NA	-	NE	-	+	-
20	+	-	+	-	-	-	-	+	-	-	-	-
21	+	-	-	-	-	-	-	+	NE	-	+	-
22	+	-	-	-	-	-	NA	+	NE	-	-	-
23	+	-	+	-	+	-	-	-	-	-	-	+
24	+	-	-	-	-	-	-	+	-	-	-	+
26	+	-	-	-	-	-	NA	+	-	-	+	-
28	+	+	-	+	+	-	NA	+	+	-	+	-
30	+	-	-	-	-	-	NA	-	-	+	-	-
31	+	+	+	-	-	-	-	+	+	-	+	-
32	+	-	-	-	-	-	NA	+	NE	-	-	-
33	+	-	-	-	-	-	NA	-	NE	-	-	-

Table 29 Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
34	+	-	-	-	-	-	-	-	-	-	-	NR
35	+	-	+	+	+	-	-	+	+	-	+	-
36	+	+	-	-	-	-	-	+	+	-	+	-
37	+	+	-	-	-	-	-	+	+	-	+	-
38	+	-	-	-	-	-	-	+	+	-	-	-
39	+	-	-	-	-	-	NA	+	+	-	+	-
41	+	-	-	-	-	-	NA	+	NE	-	-	-
42	+	-	-	-	-	-	-	-	-	-	-	+
43	+	-	-	-	-	-	NA	+	NE	-	-	-
44	+	+	+	+	+	-	-	+	-	-	+	-
Total (X)	33	9	7	5	7	2	4	26	10	2	18	9
%Total(X)	94.2%	25.7%	20.0%	14.2%	20.0%	6.7%	19%	74.3%	28.6%	6.7%	51.4%	28.1%

Source: Own Survey

Note: Table 29

1. Firms not using moulds (e.g. those that produce foamed, laminated and calendered products) are excluded from this table.

2. Plus sign (+) indicates a positive response.

3. Minus sign (-) indicates a negative response.

4. D ≡ Designers

   D/M ≡ Designers/Makers

   Some firms design moulds and send the designs either to local machineshops or abroad for making.

   M ≡ Makers

5. MM ≡ Mould Making

   CM ≡ Local commercial machineshops

   C ≡ Customer moulds

   OPF ≡ Other processing firms

   OWN ≡ Processing firms having machineshops

   NA ≡ Not applicable: i.e. customers do not provide fabricators with dies.

   NE ≡ Firms that have not experienced the need for major repairs.

   NR ≡ Question not answered

6. Although not indicated in the table, some processors send moulds abroad for major repair. Others abandon the defected moulds and import new ones. (This aspect was not well documented but the author noted that at least 11.40% of the firms send moulds abroad for major repair.)

CHAPTER V

IMPORTS AND EXPORTS FOR THE KENYAN PLASTICS INDUSTRY

Most LDC's suffer from a shortage of foreign exchange and hence they need to utilize local sources of inputs to substitute for imported inputs and final production. Most inputs for plastics processing are imported but there are several ways these imports can be reduced. Kenya should: (a) avoid fabricating inappropriate products, (b) institute a national co-operative to obtain bulk purchase and transportation discounts on imported plastic raw materials, (c) re-cycle plastic waste, (d) pelletize PVC, (e) consider manufacturing raw materials, and (f) import-substitute plastic parts and goods. Also the imports of final goods should be reduced and the exports promoted.

5.1 Sources of Inputs

The Kenyan plastics industry is dependent on imported inputs. The most crucial inputs include: (a) moulds, machinery and spare parts (see sections 4.3.7 & 4.3.9), (b) mould makers, and (c) plastic raw materials.

5.1.1 Sources of Mould Makers

Mould making is a highly specialized craft and usually good mould makers need long experience. Table 29 section 4.3.9 shows that only 20% of the surveyed firms that use moulds have mould designers and makers. Furthermore, almost all mould makers are expatriates of Asian origin. The experience of Asian mould makers ranges from 10 to 25 years. However, inspite of this dependence on expatriate mould makers, there is no institution in Kenya offering training in mould making. Most of the industrialists expressed the desire of offering basic training in mould making so that experience can be acquired on the job.

5.1.2 Sources of Plastic Raw Materials

Plastic raw materials are imported from several chemical companies. At present, the imports are not centrally organized and purchasing is done by individual firms. Nevertheless, consumption of most specific plastics is very low but the recurrent import bills are often large.

Plastic raw materials are imported from Europe, America and Middle East. They are supplied by chemical companies such as Hoechst, Bayer, Basf, Dawa Chemicals, Shell Chemicals and Imperial Chemicals. These companies have agents based in Kenya. Plastic firms order their raw materials seperately. For instance, 71% of the surveyed firms, which account for 75% of the total production, import plastic raw materials directly. A proforma is issued by a Kenyan agent for a chemical supplier and then the plastic processors seperately apply for import licenses. The agents for chemical suppliers also import plastic raw materials and then distribute to 18% of the surveyed plastic firms. These firms are small and account for 10% of the total production. Also 11% of the firms accounting for 15% of the production obtain their materials from their mother companies.

The importation and consumption of plastic raw materials varies between specific plastics. This is illustrated in Table 30 which shows in tonnes the popular plastics imported and converted between 1979-82. One notes that polyethylene and polyvinylchloride dominate the plastics market. The consumption of aminoplasts and polyurethanes has been constant. Demand for polyamide has been increasing while that for polystyrene has been declining.

Table 30

Importation & Consumption of the Popular Plastic Raw Materials in Metric Tonnes:

SITE CODE	PLASTIC	1979	1980	1981	1982
5822	Aminoplasts	1,449	2,639	1,291	1,128
5823	Alkyds & other Polyesters	2,154	3,457	3,103	2,946
5824	Polyamides	364	510	901	1,866
5825	Polyurethanes	2,174	2,029	2,009	2,883
5831	Polyethylene	12,503	14,314	6,632	10,068
5832	Polypropylene	1,226	3,094	2,906	3,863
5833	Polystyrene & its copolymers	943	919	913	686
5834	Polyvinylchloride	12,864	8,700	13,479	9,884

Source: Kenya Government, Annual Trade Reports 1979-82

Note:

(1) SITC refers to the Standard International Trade Classification.

(2) Other plastics not included in this table are consumed in very small amounts. They appear in aggregated form in Table 6 section 3.5.2.

Overall, the demand for plastics is increasing with the introduction of new areas of application. For example, Tetrapak's new Kenyan factory to make polyethylene coated milk packaging paper and other industrial laminates will increase the demand for low density polyethylene (LDPE) by another 2,000 TPY.[1] Subramanian[2] provides a detailed market survey of LDPE in Kenya and suggests some of the areas of increased applications.

The import bills for the raw material are recurrent and often high. This can be demonstrated in Table 31 which summaries the import bill for PVC and PE for the years between 1979-82. For these years the average importation of PVC was 11,232 metric tonnes per annum worth Kshs. 78,856,000. The average for PE was 10,904 metric tonnes worth Kshs. 96,613,000. Thus, just for these two major items alone, Kenya is spending about Kshs. 175 million annually.

Table 31

Tonnes and Values of imported PVC and PE 1979-82

YEAR	PE		PVC	
	Tonnes	'000 Kshs	Tonnes	'000 Kshs
1979	12,503	100,399	12,864	89,830
1980	14,314	131,590	8,700	74,778
1981	6,632	64,518	13,479	83,630
1982	10,068	89,946	9,884	67,478
Average	10,904	96,613	11,232	78,856

Source: Republic of Kenya, Annual Trade Reports for 1979-83

5.2. Inappropriate Plastic Products

Kenya produces many inappropriate products and uses "throw-away" technology which increases demand for imported raw materials and reduces employment opportunities.

The term "inappropriate product" refers to an item made from imported inputs but which has close substitutes that could be made from local inputs. It also designates a product which is designed to be disposed of after being used only once though it could still have alternative uses. "Throw-away" products are inappropriate for Kenya. At present there are several plastic items that are thrown away. The BIC ballpen is a typical example. If ink in the refiller gets finished or backflows, the pen is thrown away. But if cheap refillers could be purchased from retailers, then the outer case need not be thrown away. This would reduce the number of outer cases needed and also reduce the raw material required to make pens.

Fabrication of the inappropriate products reduces employment apportunities. This is best illustrated by the example of plastic/clothsline pegs. The process of making wooden pegs is labour intensive. These pegs are made by one machine which cuts small logs and shapes the pegs. Two people haul logs, two cut them into smaller pieces, two shape the pegs and four select the non-defective pegs. In all, the process requires 10 people. On the other hand, plastic pegs are produced by an injector machine which is operated by one person. In both of these processes, the output per unit of time is about the same. Hence, substituting plastic for wooden pegs eliminates nine jobs. This is typical of what happens when plastic production replaces a labour intensive economic activity.

Kenyan industrialists have the liberty to make any product and hence may select profitable but inappropriate products. Thus Kenya needs to control the production of inappropriate products. This could be done by setting up a body or using an existing institution to continuously survey the inappropriate products and to eliminate them. Below is a short list of examples of inappropriate plastic products identified during the survey: sandals rope,small hand baskets, carrier bags,woven floor mats, knife handles, dishes, clothsline pegs, coat hangers and throw-away bottles.

Hence Kenya should eliminate inappropriate products and reduce dependence on imported inputs and avoid decreasing employment opportunities.

5.3 National Co-operative to Import Raw Materials

With large amounts of raw materials whose importation is decentralized, opportunities exist to set up a central import co-operative controlled by the firms in the industry. However, there are possible conflicts arising from the establishment of such an institution because decentralized importation allows firms to transfer funds abroad through overinvoicing their imports. Thus the

Government should insist that such a cooperative be formed and then monitor its performance.

5.3.1 Functions and Control of an Import Co-operative

Instead of importing raw materials separately, an import co-operative could be established to import plastic raw materials centrally and to distribute them to the various plastic firms. The co-operative would be obliged to ensure plastic firms receive the correct grade of raw material required and at the specified time. The co-operative might also import common spares and parts.[3] The principal objective of the import co-operative would be to save large amounts of foreign exchange albeit other benefits might result from its existence. The co-operative should be controlled by the industrialists themselves. This form of control would ensure that the quality and quantity of the raw materials imported are of the required specification. It would also motivate the entrepreneurs to promote efficiency in the cooperative.

5.3.2 Social Benefits of an Import Co-operative

The benefits of bulk purchasing could be categorized into those that pertain to foreign exchange savings and others.

Various overseas manufacturers of chemicals have different prices for the same grade of plastic raw material even though the range of price variation might be small, perhaps 5-10%.[4] In shopping around, one may gain in several ways: (a) though price differences are small, the savings can be big for bulk orders; (b) quite often, chemical manufacturers require payments to be made in "hard" currencies such as the Deutschmark and Pound Sterling and hence an importer may loose if the currency appreciates in value before the suppliers' credit is repaid; shopping aids in locating a supplier who requires payment to be made in a stable currency; (c) also shopping enables an importer to buy from a supplier with good terms of repayment (eg credit facilities) and trade discounts.

Freight and bulk order discounts could be obtained by the cooperative. For instance, thirty two per cent (32%) of the respondents felt bulk order and transport discounts would range from 5% to 10%. The import co-operative would replace the middle men who increase the cost of raw materials due to mark ups. It would also eliminate over invoicing of imported inputs which are ordered directly by local processors.

There are several other benefits of an import co-operative. Among them are: (a) reduction of capacity underutilization caused by difficulties in procurement of raw materials which would be possible by ensuring that both large and small firms receive raw materials quickly; (b) reduction of the overall stock levels in the industry,[5] and (c) identification of when to establish local sources of inputs by surveying the markets for the various inputs.

5.3.3 Possible Conflicts Between Social and Private Benefits.

Individuals or a group of persons benefiting from the decentralized purchase of imports may resist the initiation of an import cooperative. For example, those who overinvoice imports may resist.

There are four forms of overinvoicing: (a) direct overinvoicing of raw materials, (b) unrecorded bulk discounts, (c) overpriced recycled materials; and (d) overpriced machinery.

Imported plastic raw materials are often overpriced by Kenyan plastics processors. For instance, an officer in a leading multinational plastics firm figured that overinvoicing in this industry is about 25% but "the minimum overinvoicing on raw materials and spares is 15%."[6] Another factory manager admitted that they overinvoice their materials by 20%.[7] If this is the case, a minimum overinvoicing of 15% on polyethylene and polyvinylchlride alone costs Kenya at least Kshs. 23 million per annum in foreign exchange.

Plastics firms buying raw materials in large quantities also get quantity discounts but allegedly the suppliers put the money in a foreign bank accounts for the customers.

> "The suppliers will give you quantity discounts and also transfer them to your account outside ... even if you don't ask, the supplier will tell you how to do it."[8]

The suppliers of raw materials recycle plastics and then sell the grannules at a lower price than that of virgin materials. Importers order the recycled materials but are invoiced for the price of virgin materials and get the difference deposited abroad.[9]

The fourth form of overinvoicing is by overpricing an imported machine as illustrated by the following evidence. In a certain plant "A calendering machine whose cost was Kshs. 2.5 million was quoted as Kshs. 5.5 million .... also a roller printer whose value is Kshs. 212,000 was priced at

Kshs. 717,100." [10] At another plant an officer admitted with trepidation that a machine costing Kshs. 800,000 was priced at Kshs. 16 million.

Hence, those benefiting from overinvoicing may resist the establishment of an import co-operative. For example, when a co-operative was suggested to processors, 20% thought it was not needed. For import licenses, industrialists' with contacts may also resist the extablishment of an import co-operative. With the rationing of import licenses, small and medium firms without contacts with highly placed officers have also been suffering.[11]

> "I consume all my stocks and then go to beg larger companies to sell to me some raw materials because I can't get a license. Sometimes they sell at a higher price other times they do not even agree to sell." 12 .

Using their contacts, large firms able to get import licenses sell some of their stocks only to non-competing producers. Small producers are unable to purchase materials from large competitors for similar product lines.

The establishment of an import co-operative would reduce this discrimination. Efficient distribution of raw materials would result in the reduction of governmental corruption and encourage more competition. From this perspective those that were benefiting from their contacts would resist the launching of an import co-operative.

Due to the probable resistance, the government should make such a co-operative compulsory and then deny import licences to those not complying with its requirements. However, the government should let the industrialists control the co-operative but should guide and monitor its progress.

5.4 Recycling of Plastic Waste in Kenya

Owing to ecological, economic and supply constraints on the raw materials, recycling plastics will become increasingly important. This section explores the extent 'factory' and 'outside-factory' waste is recycled in Kenya. The study found that (1) PVC factory waste from pipe manufacturing should be used to fabricate PVC/woodflour composites for the building industry, and (2) the re-use of outside-factory waste is profitable and could save much foreign exchange.

5.4.1 Re-use of Factory Waste

Non-PVC fabricators regranulate and re-use all their thermoplastic waste but the scrap resulting from the manufacture of PVC pipes cannot be re-used to make pipes. The amount of this waste depends on the rate of machinery utilization but normally it ranges between 1-3 tonnes per machine per month on a one-shift basis. Thus with eleven machines in Kenya a minimum of eleven tonnes of waste which could replace virgin material worth Kshs. 115,500 foreign exchange are thrown away every month. This waste could be used together with woodflour to produce a variety of PVC woodflour composites for extruded[13] profiles e.g. window frames, door frames, floor tiles, panels.

The percentage of woodflour in such composites can vary between 33%-50%. The composite combines the good properties of wood and PVC. Thus, overall, composite compound has a cost advantage over the normal compound.

5.4.2 Recycling of Outside Factory Waste

Outside factory waste refers to "throwaway" plastic products. There are two methods of re-utilizing this kind of waste. A throw-away product may assume a new function (e.g. plastic containers for packaging corn oil are commonly re-used in homes for storing kerosine or its raw material may be recycled and formed into a new product. This paper is concerned with the second category. The main objective is to demonstrate that recycling and reforming could be profitable and that considerable foreign exchange which is spent on the importation of virgin plastic raw material could be saved.

Kenyan industrialists seldom recycle plastic though this would be profitable. Only two plastic processors are re-utilizing "throw-away" plastic products. One recycles deformed crates e.g. beer, bread, milk and soda. The other, recycles used ballpens. But the experience of the Salvation Army Makadara Community Centre, Nairobi shows how profitable this can be. The centre operated a small project between November 1982 and March 1983. The project made profits but nevertheless failed due to administrative conflicts. Below are its production costs based on the assumption of a weekly production of one tonne:[14]

Conversion costs:

	Kshs	
4 workers wages at 125/-per week	500	
4 social workers* at 25/-" "	100	
Transport 2 trips at 150 per trip	300	
Washing powder	50	
Electricity	200	
	1,550	
10% contigency	150	
Total conversion costs		1700
Plus cost of materials:		
Buying 1000 kgs of waste at 60 cts/kg	600	
Add 10% allowance for rejects	60	
Total costs		660
		2360

* Note the "social workers" were employed part-time and were usually assigned petty jobs such as sweeping. Hence, their wage of Kshs. 25/- is not an underpayment.

Capital Investment:	Kshs.
Sorting machine	7,000
Saw blade	1,000
Working capital to buy 1000 kgs of waste	600
	8,600

Sales: at 5/= per kg = Kshs. 5,000

Profitability

Profits = sales less total costs.

2640 = 5000 - 2300

i.e. 2.64 Kshs per kg

Margin = sales - costs

4340 = 5000 - 660

Break even point = 1700/4340 = 39%

capacity utilization.

Foreign Exchange savings

These figures were computed using a selling price of 5/= per kg. The project director had approached several plastic firms for the sale of their reclaimed materials. Most of these firms had indicated a willingness to buy the reclaimed materials for up to 7/= per kg. The director also acknowledged that it could have been possible with time to reclaim at least 5 tonnes per day. The reclaimed material was mainly polyethylene whose local price when new is about Kshs. 21.50 per kg of which Kshs. 15.50 is the foreign exchange cost. The rest is for domestic cost plus duties.

About 10,000 metric tonnes of PE were consumed annually between 1979-82 (Table 31). This is equivalent to 27 tonnes per day. Thus by assuming a daily reclamation of 5 tonnes of polyethylene waste, or 18% of the daily production of PE articles then about Kshs. 14.6 million worth of foreign exchange would be saved annually.

Although only a small project, it does demonstrate the potential for foreign exchange savings and the profitability of re-cycling. However, it would be more beneficial if other used materials (e.g. paper, glass and metal) were collected together simultaneously. This would make collecting easier and transportation cheaper. Furthermore, by using unskilled and unemployed labour a waste re-cycling industry would help to generate some income for the very poor while also saving foreign exchange.

5.5 Pelletization of PVC

At present both PVC powder and Pellets/granules (see Appendix 5) are imported. About 2000 tonnes of PVC pellets are imported annually. The powder is cheaper than the granules. The process of pelletizing is a simple one and the investment needed is small. If pelletizing were done locally there would be considerable reduction of foreign exchange needs. But most firms using resins would not advocate pelletizing for the fear that they would supply their competitors with cheap pellets.

Pelletization is a simple process which entails the extrusion through a die of PVC resin in form of very small rods which are then cut into small granules. This granulation is needed to ease their melting during the manufacture of final products e.g. conduits, bottles and caps. The exact shapes of the granule is not important.

The capital investment for a pelletizing unit includes a small production space, a compounding machine, an extruder and a chopping machine. At present underutilized space and compounding and extruding machinery exists in various places in the country. Only a die and a small chopping machine may be needed. Hence the investment cost would be very low. Below are the pelletizing costs for 2000 tonnes of PVC per annum.[15]

Electricity:	150 kw at 65 ct by 1200 hrs/yr	Kshs. 117,000
Water:		24,000
Labour*:	3 men at Kshs. 2400/yr	72,000
Repair:		100,000
Depreciation:	(over 5 years)	250,000
Spillage:	2000 T at 0.025/T by Ksh 12000/T	600,000
Total		Ksh. 1,163,000

Note* Some of these men are assumed to work on part time.

The conversion costs of PVC pellets is Kshs.1,163,000/2000 = Kshs. 582 per tonne. Even after allowing another 50% just to be on the conservative side, the conversion costs per tonne becomes Kshs 850 or about US$60. The cost (June 1984) of PVC powder at Mombasa is US$800 per tonne. Hence, US$ 60 plus US$ 800 is equal to US$860 which is still US$ 238 (foreign exchange savings per tonne) less than the selling price of PVC granules at Mombasa. Thus the production of 2,000 tonnes of domestically pelletized granules per annum would save US$476,000 or Kshs 6.8 million in foreign exchange.

5.6 The Potential for Domestic Manufacture of Plastic Raw Materials

5.6.1 The Potential for Domestic Manufacture of P.V.C.

In 1979, the government invited proposals from various companies for the consideration of domestic production of PVC. Among those companies that responded in time were: (a) Eslon Plastics (Nairobi) submitted one proposal; (b) Birla Technical Services BTS (Calcutta) submitted one proposal; and (c) Mortgage and Finance Co. (Nairobi) submitted two proposals. Bohra evaluated these proposals and ranked the BTS proposal as the best.[16] First the manufacturing process of PVC is considered and the costing and feasibility of the BTS outlined.

PVC is produced by the polymerization of vinyl chloride monomer in the presence of a catalyst. In turn vinyl chloride monomer is produced by the cracking of Ethylene Di chloride releasing some hydrochloric acid in the process. Ethylene Di chloride is obtained by reacting alcohol (ethanol) with chlorine. In Kenya, the best source of these raw materials would be sugar cane or cassava for alcohol and salt for chlorine. The minimum economically sized plant for manufacturing PVC known to exist is 15,000 TPY but the capacity may be as high as 200,000 TPY. Some statistics for the BTS proposed project follow.[17]

1.	Plant capacity	20,000 TPY
2.	Feed Stock	Ethylene Di chloride
3.	Collaboration (Technology)	Open
4.	Capital Investment	407.5 million Kshs.
5.	Location	Central Province
6.	Cost of sales	8,940 Kshs./Ton
7.	Selling Price	11,437 " "
8.	Financial Plan	
	own capital	30% equity
	Government	70%
9.	Profitability	
	Internal rate of return (IRR) on total capital	55.5%
	Payback period	6 years
	IRR on equity	16%

Net cash generation after repayment of term loans is $1.3 million increasing to $ 3 million per annum.

10. Foreign exchange savings

. Net foreign exchange savings per year at $1200 PTY would the $186 million in first year, $ 21.1 million in second year, and $22.5 million in third year as production increased to near full capacity.

Though this project relies on governmental financial support, it appears from the cost of sales, selling price, profitability and foreign exchange savings that the project has considerable benefits. This certainly merits further evaluation.

5.6.2 The Potential Manufacture of Low Density Polyethylene [18]

There are three types of PE which differ in their fabrication method, density, molecular structure and usage. They include: (a) LDPE, (b) Linear low density polyethylene and (c) High density polyethylene. This section is only concerned with LDPE. The Fabrication costs and feasibility of LDPE production are considered.

Fabrication of LDPE entails the polymerization of the monomers which are compressed at a well fixed pressure depending on the grades of PE to be obtained. By means of proper catalysts, the reaction is initiated and continuously operated in a reactor, its accurate control is obtained by controlling the injection of the catalyst. The heat from the reaction is carried away by the affluents. Melted resins receive several additives if necessary and are pelletized and, cooled in a stream of water.

Batscha noted that the domestic production of LDPE is not feasible without governmental assistance by way of: (a) full exemption from the duty on imported equipment and materials, and (b) loans at 8% average rates of interest. Only with this allowance does the production of LDPE become feasible:

Cost and Feasibility of LDPE production.

Investment:	Thousands of US Dollars
Polymerization Unit	25,500
Utilities and storage	4,000
Shipping cost ot site	1,200
Adjustment of construction to local conditions	2,990
Training	500
Land	80
	34,670
Contigency	330
	35,000
Conversion costs:	
Manpower	800
Maintenance	1100
Taxes and Insurances	700
Sales and Administration	400

Knowhow and R & D	400
Depreciation (12 years)	2,915
Interest on working capital	200
Total conversion costs	6,515

With the tariff waivers and interest subsidies then the internal rate of return of the project is 14.6% and the foreign exchange savings per tonne is $355. From this evidence, it appears as if the project could generate considerable savings. However, there is need for further evaluation as the project's economic feasibility is liable to change.

5.7 Import of Plastic Components and Goods

Although many processes have been installed, most of the Kenyan made plastic products are for packaging and consumer uses. The common products fabricated include PVC pipes, shoes, coated fabrics and film products. Thus to be self-sufficient in the production of plastic goods, Kenya should substitute for the plastic components and goods presently imported. This section shows that scope does exist to import. Substitute for imported items both competing and not competing with current Kenyan plastics processors.

5.7.1 Competing Imports

'Competing imports' refers to imports of plastic goods that are similar or identical to domestic ones. It may also refer to those imports that would require minimal investment for their domestic production to commence.

Capacity to manufacture competing imports exists in the country and is under-utilized. However, many of the competing items are still coming into the country for various reasons. For instance, A.S. Kalsi points out that

> "Some people have even imported laminated Sheets in Kenya under the guise of "PHENOLIC" Sheets or "MELAMINE" Sheets thus avoiding the payment of correct Customs Duty of 110% which our Government has enforced to protect the local industry from harsh competition from importers."[19]

> "(also) household articles are being imported even though licenses are not being issued ... cotton bud sticks - import licences are given but we can make them. Compass boxes, tender is given to middlemen by the Ministry of Education. (These middlemen end up importing)"[20]

Examples of competing imports are: plastic bags, coated fabrics, cassettes, hair combs, telephone wires and some cables, sanitary ware, formica, hose pipes, flower pots, toys, school compass sets, tea strainers, and baby feeding bottles. This list could be longer as many of the presently produced items are also being imported.

5.7.2 Non-Competing Imports

'Non competing imports' refers to plastic products which are not close substitutes to the domestically made items. Examples of such products are: (a) industrial plastics e.g. appliance parts, automotive parts and tools and hardware; and (b) building and construction plastics e.g. low pressure laminated sheets, pipes and fixtures, electrical appliances, signs & advertisements, building pannels, and roof eaves.

Section 5.7.1 and 5.7.2. have demonstrated that the plastics industry has much poential for further import substitution. Most of the potential import substitutes are inputs into other industries. Thus, Kenya should import substitute to stimulate forward linkages as well as to create employment.

5.8 The Export Market for Kenyan Plastics

The present Development Plan aims at promoting export earnings.[21] However, the plastics industry in Kenya exports little. This can be explained by the entrepreneurs' attitudes towards exports and the size of the plastic firms.

5.8.1 Volume of Exports

Plastic products are exported to the neighbouring countries plus Malawi, Zambia, Rwanda, Burundi, and the Middle East. The export statistics (Table 32) show that, on average, between 1979/82 1,337 tonnes worth about Kshs. 25 million were exported. The exports have been declining between 1980/2. This volume of exports is tiny when compared with the amount of plastic raw materials imported (Chapter III, Section 3.5.2). But there are also indirect exports such as packaging for soda and petroleum which is not included in these statistics.

Table 32

Export of Plastic Goods*

Year	Quantity		Value	
	Tonnes	Annual % Growth	'000 Kshs	Annual % Growth
1979	957	116	13,541	152%
1980	2,067	-42%	34.095	27%
1981	1,204	-7%	24,927	4%
1982	1,120		26,156	
Average	1,337	22%	24,680	43%

Source: Republic of Kenya. The Annual Trade Reports 1979-82

Note (Table 32):

(i) *These exports include only the plastic goods classified under the Standard International Trade Classification Code 893. i.e. articles n.e.s.: bags for packing and protective purposes; clothing and clothing accessories and footware.

Only 25% of the surveyed firms have involved themselves in the export market at any time. Likewise, only a small range of plastic products has been/is exported. (Table 33). Thus, obviously processors focus on the domestic market for their outputs.

Table 33

Products and Percentage Exported

Product	% of firms'output
1. Petroleum packaging containers	60% (Direct & Indirect)
2. Plastic woven sacks	80% (Direct & Indirect)
3. Plastic shoes	10%
4. Pens*	5%
5. PVC Pipes*	5%
6. Conduits*	20%
7. Plates cups etc.	20%
8. Coated Fabrics	20%
9. Medical Syringes	30%

Source: Own Survey.

Note to Table 33.

(1) *Products are exported once in a while

5.8.2 Entrepreneurs attitude towards Export Market

As observed, plastics processors focus on the domestic market. This is explained by their attitude towards exports. During the survey the processors were asked whether they receive enquires about their products from other countries. This question tells whether our exports are becoming popular. However, 40% of the firms responded positively. This implies that a majority of the plastic firms are not known beyond national boundaries. Also the firms were asked whether they had a programme (or intended to have) for promoting exports of their products. About 7% responded positively.

Most of the processors justified their focus on the domestic market on: (a) the uncertainity in procurement of plastic raw materials; (b) lack of foreign exchange in the neighbouring countries; and (c) the high duty on raw materials which makes their products less competitive on the international market.

However, inspite of these complains, scope for increased production for exports seems to exist. The main reason explaining minimal participation in the export markets is that plastic firms are small and underutilized.

Hirsch and Adar, show that export performance is positively correlated with the size of the firm measured in terms of total sales.[22] Since my study demonstrates that most Kenyan plastics firms are small and underutilized (see hypothesis 4), one would anticipate a low volume of exports.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

This study exemplified some of the industrialization problems faced by LDCs. The developmental issues explored in this study pertain to the inputs, processes, and outputs of the plastics industry.

6.1 Inputs into the Plastics Industry

The inputs studied were: (a) moulds, machinery and spare parts; (b) mould makers, and (c) plastic raw materials.

6.1.1 Moulds, Machinery and Spare parts

Moulds are crucial in the development of products for this industry. The results from testing hypothesis 9 show that over 94% of the firms import more than 90% of their moulds. This can be explained by the inability of commercial machineshops to confidently make a big range of of moulds. They have no testing facilities for newly assembled moulds, and sometimes have difficulty obtaining high quality steels and hence delay deliveries.

Repair of moulds in the Kenyan plastics industry is done by four groups: (a) the processing firms themselves, (b) local commercial machine shops (c) overseas mould repairers, and (d) other plastics fabricators possessing machine shops. These groups do not interact freely as there is little co-operation between them. This lack of co-operation hampers the growth of the mould making and repair industry.

Policy Recommendation

The government should discourage the importation of moulds as far as possible. Certainly the range of moulds that local commercial machineshops can make should not be imported. Mould making capacity should also be widened. This could be done by an easier availability of raw materials for making moulds (e.g. supply of high quality steels).

Machinery

Machinery differentiation retards the growth of a spare parts industry, hinders repair and maintenance and consequently slows the development of machinery manufacturing. Machines in the Kenyan plastics industry are relatively new. For each of the examined processes, there is a wide range of makes dominated by a few common makes e.g. blow moulding has 13 makes dominated by 2 makes. However, despite technical differentiation of machinery, machinery repair and maintenance is not short term problem in this industry. But to eliminate future problems, there is need to reduce the number of makes and models.

Policy Recommendation

To industrialize, Kenya must limit the number of machinery makes and models. Thus, for each of the established processes, the government should issue import licenses to those importing only the common makes.

6.1.2 Mould Makers

At present, though mould makers are expatriates there is no institution in the country that offers basic training in mould making or plastics technology. Hence there is need to Kenyanize this sector and to develop training facilities.

Policy Recommendation

Some basic courses in plastics and mould making should be started at the various Institutes of technology existing in the country.

6.1.3 Plastic Raw Materials

Most inputs for a plastics industry are imported but there are several ways of reducing import dependence. This not only would save foreign exchange but it would also be a step towards utilization of local sources of inputs. The areas explored in this paper were: avoiding inappropriate products, instituting a national buying co-operative, and recycle of plastic waste, pelletizing PVC, manufacturing of PVC and LDPE locally. Below, we outline the findings briefly and then offer recommendation

6.1.3.1 Inappropriate products

In the study we have shown that many inappropriate products exist due to the lack of a central body controlling what products are made.

Policy Recommendation

In order to cut the unnecessary demand for plastics raw materials, Kenya should authorize the Kenya Bureau of Standards to ban inappropriate products.

6.1.3.2 National buying Co-operation

The study has demonstrated that though the establishment of a national buying co-operative might encounter some resistance, it would benefit the nation.

Policy Recommendation

Kenya should set up a national buying co-operative. It should be controlled by the firms in the industry and should be organized by a team of experts with adequate knowledge of the raw materials, processes and machines used in the industry.

6.1.3.3 Recycling of Plastic Waste

Recycling of plastic waste helps to ease the problem of disposing the waste, re-using valuable waste and coping with increased prices of virgin materials.

Re-use of Factory Waste

At present, Kenya recycles mostly the factory waste and trim but throws away PVC pipe waste which could be used with woodflour to make composites for the building industry.

Need for further Research

A technical, economic and financial feasibility study should be conducted with a view to promoting the re-cycling PVC pipe waste and the use of PVC/woodflour composites. If the project is feasible, it should be implemented.

Recycling Outside Factory Waste

Though profitable, Kenyan industrialists seldom recycle outside factory waste. Recycling of waste creates jobs for unskilled and unemployed labour and saves at least Kshs. 14.6 million worth of foreign exchange annually.

Policy Recommendation

Kenya should initiate a recycling industry in order to generate employment and save foreign exchange. This industry should collect together all materials for recycling e.g. paper, glass and metal. This would make the operation more efficient and profitable.

6.1.3.4 Pelletization of PVC

Kenya can benefit by pelletizing PVC. The process is simple and requires minimal investment as under-utilized equipment exists. We have demonstrated that pelletization can save for Kenya at least Kshs. 6.8 million in foreign exchange per annum as well as supplying the PVC pellet users with raw materials at a lower price.

Policy Recommendation

PVC resin should be pelletized in Kenya. This can be done by banning imports of PVC compound, and contracting the pelletization to an industrialist.

To avoid profit gouging, the price of pelletized granules should be controlled.

6.1.3.5 The Potential for Domestic Manufacture of Plastic Raw Materials

In Kenya only PVC and PE are consumed in amounts close to the minimum required to establish a small but still economic plant. There has been an attempt to conduct feasibility studies on PVC and LDPE in Kenya. Together, the projects would appear to benefit the nation by saving about US$24 million per annum.

Policy Recommendation

Kenya should seriously evaluate these projects and consider the potential for domestic production of plastic raw materials in order to be self-reliant on domestic sources of inputs.

Need for further research

A study should be conducted to survey the market for the main plastics e.g. alkyds and polyurethane.

In all, the above recommendations would reduce dependency on imported inputs, would create jobs and would save for Kenya at least Kshs. 393.4 million per year.

6.2 Processing of Plastic Goods

The Kenyan plastics industry has grown anarchistically In this economic sector, resources are grossly under-utilized due to demand and supply causes.

6.2.1 Growth of Kenyan Plastics Industry

Many processes are established but most entrepreneurs produce film, pipes and injected products. Since the process determines the output, planners should identify processes with the highest forward linkages. This could be done by focusing on the kind of plastic products needed for economic development of other industries, e.g. plastics in agriculture, electric conduits in buildings and industry and coated fabrics for the car and furniture industry e.g. low pressure laminated sheets in electric motor industry (a large market exists).

Policy Recommendation

The Government should control capital investment in processes already having too many competing firms but it should also encourage firms to invest in priority processes.

6.2.2. Capacity Utilization in the Plastics Industry

The outcome of testing Hypotheses one and two indicate that most plastics firms are small (employing less than 40 production workers) and are utilized at only 53% of the potential operating time.

The results of testing Hypotheses three and four show that the rates of capacity utilization vary between firms and processes. It is highest in the extrusion of conduits (7[illegible]%) and lowest in foaming (10%). Firms in processes with low rates of utilization either suffered from deficient demand or competing imports.

Testing Hypothesis 5 shows that the rates of the utilization of labourforce, supervisors and production space are high. Production is machine paced and hence labour requires little supervision.

The outcome of testing Hypothesis six shows that about 50% of the firms felt that they under-used their plants due to deficient and seasonal demand and the lack of spares. However, 91% of the firms thought that difficulties in procurement of raw materials was very crucial.

All processes should be identified and those that have under-utilized firms due to deficient demand should not be encouraged to purchase more equipment. But processes with under-utilized firms due to competition from imported products should be encouraged to grow by banning the imports. Plastic raw materials should also be made available to the firms by giving import licenses. Due to inter-sectoral linkages, a comprehensive policy should be designed to raise the level of capacity utilization in this industry. Thus, the results from this paper should be considered together with those of the University of Nairobi Industrial Research Project.

6.3 Plastic Outputs

Kenya imports many final goods and the domestic production of plastics is characterised by unnecessary product differentiation. There are some, though not large, prospects for further exports.

6.3.1 Imported final Goods

At present Kenya imports both competing and non-competing items.

Policy Recommendation

Imports of products that can be made in the country should be banned. Kenya should also start producing plastic components and parts for the other industries.

6.3.2 Unnecessary Product Differentiation

Results of testing Hypothesis eight shows that half litre containers are unnecessarily differentiated. This is typical of the production of containers of less than two litres.

Policy Recommendation

The production of containers and household items should be standardized and the production of unapproved designs should be banned. This authority should be given to the Kenya Bureau of Standards.

6.3.3 Prospects of Exports

The production of plastics is carried out in small - under-utilised firms and the entrepreneurs mainly focus on the domestic market. Thus Kenya exports little.

Policy Recommendation

An export market survey for plastic products should be conducted.

6.4 Summary of the results

The plastics industry in Kenya is heterogeneous and has many economic linkages with other sectors. This industry began after Kenya attained independence and is characterised by anarchistic growth. It mainly produces packaging and consumer goods rather than industrial components and parts though it contributes significantly to the growth of manufacturing in terms of value added and employment.

Resources in this industry are grossly underutilized: plant and equipment operates at 53% of the potential operating time though the utilization rates vary between firms and processes. The industry is affected by deficient demand and competing imports. Deficient and seasonal demand and a lack of spareparts were suggested by 50% of the entrepreneurs to be the principal causes for underutilization though 90% of them viewed difficulties in procuring raw materials as the most critical cause.

This industry depends on imported inputs. Machinery is relatively new and is technically unnecessarily differentiated. But there are few repair and maintenance problems yet. However, Kenya should reduce the number of makes and models, in order to prevent problems of spares in the future. The industry also lacks good mould making facilities. At present all the mould makers are expatriates of Asian origin. Furthermore, there is no institution in Kenya to train or provide basic courses in mould making. Plastic raw materials are consumed in very low volumes except for PVC and PE. There are also several alternatives to reduce dependence on imported plastic raw material e.g. pelletizing of P.V.C. and re-cycling plastic waste. These alternatives would also create more employment.

The products made locally, especially containers of less than two litres, are technically unnecessarily differentiated. This ties up equipment and increases demand for foreign exchange as moulds are mostly imported.

Kenya also imports both competing and non-competing plastic products and exports little since most entrepreneurs focus mainly on the domestic market.

CHAPTER I

Footnote

1. Republic of Kenya, Development Plan 1984-88, (Nairobi, Government Printer, 1984) p. 197.

CHAPTER II

Footnotes

1. Plastics are difficult to define as the term refers to a wide range of materials with similar characteristics. Any acceptable definition may fall short by either excluding some of these materials or by including unnecessary ones. However, many definitions are similar and are based on the molecular structure of these materials and their processing methods.

   Examples of definitions used can be found in: Miner, D.F. and J. B. Seastone, Handbook of Engineering Materials (London, Chapmain and Hall Limited, 1955) p.3- 168; Simonds, H. R. and J. M. Church, A Concise Guide to Plastics (New York, Reinhold Book Corporation, 1968)p.1; Arnold, L. K. Introduction to Plastics (10wa, the lowa State University Press, 1968) p.3; Clauser, H.R. Peckner, D. R. Fabian and M. W. Riley, (eds) The Encyclopaedia of Engineering Materials and Processes . (New York, Reinhold Publishing Corporation, 1963) p.481, and J. Dubois, and F. W. John, Plastics (New York, Van Nostraud Company, 1974) p.1.

2. See the main commercial polymers by group and chemical type.

Thermosets	Thermoplastics
Amino	Polyolefin
Urea-formaldehyde	Polythene LD
Melamine formaldehyde	Polythene HD
	Polypropylene
Phenolic	
Phenol-formaldehyde	Vinyl
Modified Phenol	Polyvinyl Chloride
Formaldehyde	Polyvinyl Acetate
Cresol Formaldehyde	Co-polymers

Polyester	Polystyrene & Co-polymers
Alkyd	Polyamide e.g. Nylon
Other types	Acrylic
	Cellulosic
	Polycarbonate
Polyurethane	Polyacetal
Polyether	Polyfluorocarbon
Polyester	
Silicone	

Source: Chubb, L. W. Plastics, Rubbers and Fibres (London, Pan Books Limited, 1967) pp.23-24.

3. For the technical distinction between Thermosets and Thermoplastics see Sors, L Plastic Mould Engineering (Oxford, Pergamon Press, 1967) p.1.

4. For instance, P.V.C. is used for manufacturing: PVC Pipes and fittings conduits and fittings, Hoses, Shoes, Coated Cables, Leather Cloth, Floor Tiles, miscellaneous products such as bottles, caps etc.

5. Miner and Seastone, op.cit., ..pp.3-168.to 3-239.

6. Simonds and church, op.cit., ...*p.20

7. Literature on application of plastics is well documented, for instance: Arnold, op:cit 17. Briston J. H. and C.C. Gosselin, Introduction to Plastics London, Newnes-Butterworths, 1970) part III chapters 6-10. Mienes, K. Plastics in Europe (London, Morrison & Gibb Limited, 1964) chapter 15 and the rest of the book, and hence, this section aims at drawing attention of the numerous end uses of plastics.

8. For a detailed account of application of plastics in agriculture, see Clark, A. D."Plastics Processing and Applications in Agriculture in less developed Countries". UNIDO, ID/WG 184/2 June, 1974. Carrasco M.A. "Application of Plastics in Bolivian agriculture" UNIDO, ID/WG 184/24. 1974 and Brun, R "The uses of Plastics to help farmers in the southern sahel" UNIDO, ID/WG 184/11 1974.

9. Desmond, A.D., "Packaging and Plastics," UNIDO, ID/WG 392/1, March, 1973, outlines the role of plastics in packaging.

10. For instance, see Klein, E., "Determinants of manpower underutilization and availability," International Labour Review, Vol.122, March - April, 1983, pp.183 - 195.

11. Klein, L. R., "Some Theorical Issues in the measurement of capacity," Econometric vol.28, April, 1960, pp.272 - 286.

12. See some attempts to measure actual and potential output in: Phillips, A., "An Appraisal of Measures of capacity," American Economic Review, Vol.53, May, 1963. In appraising capacity measurement in U.S., Phillips reviews five seperate but not completely independent research projects. These are; The McGrawHill Department of Economics, the National Industrial Conference Board, Fortune Magazine the Wharton School Econometric Unit, and the Division of Research and Statistics Federal Reserve System; and in Ball, R. J., and E. Smolenky. "The structure of multipler: Accelerator Models of the U.S. 1909 - 1951," International Labour Review, September, 1961, who are among the first to develop the production function approach to measure capacity. Note that it is beyond the scope of this paper to discuss the various methods used to estimate both actual and potential output.

13. See: (a)

Lim, D., "Capacity utilization of local and Foreign Establishments in Malaysian Manufacturing," The Review of Economics and Statistics, February, 1976, p.212.; (b) Konzolo, J. M., The Capital Goods and Spare Parts Industries: A Case Study of Electric Motor Reconditioning and Manufacture in Kenya. M.A. Research Paper, Economics Department, University of Nairobi, August, 1982 pp.21 - 30.; (c) Lecraw, D. J., "Determinants of capacity utilization by firms in less developed countries," Journal of Development Economics, May, 1978, p.144.; (d) Coughlin, P. E., "Converting crisis to Boom for Kenyan Foundries and Metal Engineering Industries; Technical Possibilities versus Political and Bureaucratic obstacles," working paper, No. 398, IDS, University of Nairobi, August, 1983.

14. Winston, C.G., "Capital utilization in Economic Development," Economic Journal Vol.81, May, 1971, pp.36 - 7. Winston vividly shows the relationship between the rate of capacity utilization and the growth of an economy. Note that in a developing country that is already exploiting both its capacity to tax and its available technology to the fullest, under-utilization can only result in a lower rate of growth. Assuming this is the case with most LDC's, then pervasive capital under-utilization would only deter economic development.

15. These examples are cited in Jacob, E., "Causes of under-utilization of production capacities in industry and their effects on the production process of selected LDC's," Economic Quarterly. January, 1976.

16. Lecraw; op. cit., p.144.

17. Coughlin, op. cit., pp.1 - 3.

18. Konzolo, op. cit., p.30.

19. Lim, op. cit., p.212.

20. Lecraw, op. cit., p.139.

21. Winston, op. cit., p.42.

22. Wangwe, S. M., "Factors influencing capacity utilization in Tanzania manufacturing, "International Labour Review . Vol. 115, January - February, 1977, pp.65 - 77.

23. Baily, M. A., "Capital utilization in Kenya manufacturing industry." Discussion paper, No.206, IDS, University of Nairobi, August, 1974.

24. Chamberlin, E. H., "Product Heterogeneity and Public Policy." American Economic Review: Papers and proceedings, Vol.40, May. 1950, p.87.

25. Hunter, A., "Product Differentiation and Welfare Economics," The Quarterly Journal of Economics, Vol. 69, November, 1955, p.533.

26. Marsden, K., "Progressive Technology for Developing Countries" in Jolly, R. etal (eds), Third World Employment: problems and strategy. (Harmondswoth, Penguin, 1973). p.29.

27. Coughlin, op. cit., p.16.

28. UNCTAD, "Import substitution in Developing Countries, "UNCTAD/RM36, August, 1969, p.2.

29. Hirschman, A. O., "The Political Economy of Import Substituting Industrialization im Latin America, "The quarterly Journal of Economics Vol. 82, February, 1968 p.5.

30. Nixson.F., "Import Substituting Industrialization" in Fransman, M., (ed) Industry and Accumulation in Africa. (London, Heinemann, 1982). p.41.

31. Ibid., p.44.

32. Ibid., pp.44 - 45.

33. Power J. H., "Import Substitution as an Industrialization Strategy,". The Philippine Economic Journal, Vol.5, No.2, 1966, pp.169 - 74. and reprinted in Meier, G. M., Leading issues in Economic Development (New York, Oxford University press, 1976).

34. Baer, W., "Import Substitution and Industrialization in Latin America Experiences and Interpretation," Latin American Research Review, Spring 1972, pp.100 - 8. and reprinted in Meier G. M., Leading Issues in Economic Development. (New York, Oxford University Press, 1976).

35. ILO, Employment, Incomes and Equality. (Geneva, ILO, 1972), pp.180 - 182.

36. Kuuya M., "Import substitution as an industrial strategy: The Tanzanian case," in Rweyemamu, J. F., (ed) Industrialization and Income Distribution in Africa. (Dakar, Codesrra, 1980). p. 71.

37. Nixson, op. cit., p.49.

38. Kuuya, M., op. cit., p.72.

39. Power, J. H., op. cit., p.741.

[illegible]. Bruton, H. J., "The Import-substitution strategy of Economic Development: A survey," The Pakistan Development Review, Vol. 10, Summer, 1970. p. 1[illegible].

CHAPTER III

Footnotes

1. Moulding compound refers to a mixture of pure plymer with additives, i.e. the compounded plastic raw materials. Additives aid in: imparting desirable properties, retarding dterioration of the article, fabrication, imparting special visual effects or giving colour, or producing a cheaper item with adequate properties for the end use. In other words, additives act as: Binders, Plasticizers, Colorants, Catalysts, Lubricants or Stabilizers.

2. UN., Indexes to the International Standard Industrial Classification of all Economic Activities. (New York, UN, 1971). p.32.

3. Byabafumu, D. "Its a plastic World," The Executive. October, 1982, p.7.

4. The National Christian Council of Kenya. Who controls Industry in Kenya?: Report of a Working Party. (Nairobi, East African Publishing House, 1968). pp.114 - 115.

5. This information was obtained during the survey.

6. Republic of Kenya. Annual Trade Report 1982 (Nairobi, Government Printer, 1983). Introductory Chapter.

7. Kenya, Statistical Abstract 1982 (Nairobi, Government Printer, 1983). p.128. see note 3.

CHAPTER IV

Footnotes

1. Although independent, this study is an integral part of a broader spectrum of co-ordinated studies: Begumisa, G., on The Kenya Machine Goods and Spare Parts Industries: a case study of the Pumps Industry. M.A. Research Paper, Economics Department, University of Nairobi, 1982; Konzolo, J.M.,op.cit: Coughlin, P.E.,op.cit; and Murage, Z. N. on The Vehicle Assembly Industry in Kenya: An Economic Evaluation. M.A. Research paper, Economic Department, University of Nairobi, November, 1983.

2. Coughlin, P. E.,Op.cit p.3. He uses a weighted average utilization index. This frame work is adopted in this study.

3. For example, 90% of the plastic pipes are directly and indirectly sold to the Kenyan Government, thus, when less plastic pipes are demanded, pipe producers are compelled to stop running some of their machines.

4. For instance, Kenana project in Sudan demands about 10 million polypropylene plastic woven sacks per annum. A certain plastic bag product in Kenya is only able to supply the project with 0.06 million bags per annum.(i.e. the market share is only 0.6%).Increased supply is hampered by the high prices of Kenyan plastic bags. This plastic firm observed that the price they quoted was always 30% higher than what Non Eastern African Countries also supplying this project with bags quoted.

5. Machinery differentiation is technically unnecessary when machines are of different makes and models but are functionally the same.

6. Product differentiation is technically unnecessary when containers of about the same size are of different designs but are functionally the same.

7. Half litre bottles were selected to demonstrate the existence of product differentiation because they are typical examples in blow moulding of containers of less than 2 litres.

8. Mould making facilities are defined to encompass: a) machineshop assumed to be properly equipped, b) Technicians basically mould designers and makers. A designer is a skilled worker with 'technical knowledge' of designing moulds. A maker is a person who can translate a design into a mould. A designer/maker; is a person possessing these two qualities; and c) Repair facilities which can do both minor and major repairs.

CHAPTER V

Footnotes

1. Mr. Nielsen, Managing Director, Tetrapak E.A. Ltd., interviewed by P. Coughlin. 10/4/84.

2. Subramanian, v., "Low Density Polyethylene in Kenya," Terminal report prepared for the Industrial Services and Promotion Centre of the ministry of Industry, April, 197].

3. In Chapter IV, we indicated that most of Kenya's plastics machinery is relatively new. Thus, this industry does not face severe repair and maintenance problems. However, the need for co-ordinating the importation of spares and parts will become increasingly important in the future.

4. P. Lakhani, Managing Direct, Premium Drums Ltd., interviewed by the author, 14/7/83.

5. During the survey, the author observed that most processors consume all their stocks of plastic raw materials and then close their factories. However, with improved import licensing, firms might tend to overstock. By distributing materials on time, a cooperative would help eliminate any need for overstocking.

6. Interview by P. Coughlin, June, 1983. Anonymity requested.

7. Interview by the author, August, 1983. Anonymity requested.

8. Interview by P. Coughlin, June 1983. Anonymity requested.

9. Ibid.

10. Interview by the author, October, 1983. Anonymity requested.

11. Interview by the author, September, 1983. Anonymity requested.

12. Interview by the author, August, 1983. Anonymity requested.

13. One recent development in the field of applications of PVC for the building industry has been the introduction of PVC woodflour composites. This technology has been pioneered by Sonesson Plast AB, Malmo, Sweden. The data on the cost of machinery, capacity of production and the personnel required for a production unit can be provided by Sonesson Plast AB. Information on woodflour composite was obtained from various industrialists converting PVC pipes.

14. This data was obtained from the file on the plastic recycling project, Salvation Army, Makadara Community Centre, Nairobi, and from interviews with Captain Ndwiga, Assistant Social Secretary (Project Director), Salvation Army headquarters, on 19.3.84 and 26.3.84.

15. These estimates were obtained from A. Kumar, Production Manager, Eslon Plastics Limited on 19.6.83.

16. Bohra, A.D., "Polyvinyl chloride: Evaluation of Proposals," Industrial Promotion Centre, Ministry of Industry, June, 1980. p. 7. The information on the PVC project is extracted from this article.

17. Ibid., pp. 1-72.

18. Batscha, E.H., "Manufacture of low Density Polyethylene in Kenya," Technical Assistance Expert, UNIDO, June, 1982. The information for this section was obtained from this document which is available from the Industrial Services and Promotion Centre of the Ministry of Industry.

19. Mr. Buller, Production Manager, Euromica Limited, Interviewed by the author, on 17.8.83.

20. Mr. Mahendra Shah, Managing Director, Pan Plastics Limited, Interviewed by the author on 8.6.83.

21. Republic of Kenya, Development Plan 1984 - 88 (Nairobi, Government Printer, 1983) p. 209.

22. Hirsch, S. and Z. V. "Firm Size and Export Performance," World Development, Vol 12, no. 7, July, 1974.

BIBLIOGRAPHY

Arnold, L. K.; *Introduction to Plastis*, (IOwa, the IOwa Univerisity Press, 1968).

Baily, M. A.; "Capital Utilization in Kenya Manufacturing Industry." Discussion paper No.206, IDS, University of Nairobi, August, 1974.

Ball, R. J. and Smolensky, E.; "The structure of the multiplier: Accelerator Models of the US 1909 - 1951." *International Labour Review*. September, 1961.

Batscha, E. H.; "Manufacture of Low Density Polyethylene in Kenya," Industrial survey and promotion centre, Ministry of Industry, June, 1982.

Beadle, J. D., (ed); *Processing Plastics*. (London, Macmillan, 1972).

Bohra, A. D.; "Poly Vinyl Chloride: Evaluation of Proposals." Industrial Survey and Promotion Centre, Ministry of Industry, June, 1980.

Bosodersten.; International Economics, (London, the Macmillan Press Limited, 1970).

Briston, J. H. and Gosselin, C. C.; *Introduction to Plastics*, (London, Newnes - Butterworths, 1970).

Brun, R.; "The uses of Plastics to helf farmers in the Southern Sahel." UNIDO, ID/WG 184/11, 1974.

Bruton, H. J.; "The Import-substitution strategy of Economic Development: A survey.." *The Pakistan Development Review*, vol.10, summer 1970.

Brydson, J. A.; *Plastic Materials*, (London, Butterworths, 1975).

Byabafumu, D.; "Its a Plastic World." *The Executive*, October, 1982.

Carrasco, M. A.; "Application of Plastics in Bolivian Agriculture." UNIDO, ID/WG 184/24, 1974.

Chamberlin, E. H.; Product Heterogeneity and Public Policy." American Economic Review: Papers and Proceeding, Vol.40, May, 1950.

Chubb, L. W.; Plastics, Rubbers and Fibres, (London, Pan Books Limited, 1967).

Clerk, A. D.; "Plastics Processing and Applications in Agriculture in Less Developed Countries." UNIDO, ID/WE 184/24, 1974.

Clauser, H. R. et. al. (eds).; The Encyclopaedia of Engineering Materials and Processes, (New York, Reinhold Publishing Corporation, 1963).

Coughlin, P. E.; "Converting Crisis to Boom for Kenyan Foundries and Metal Engineering Industries: Technical possibilities versus Political and Bureaucratic obstacles." Working Paper, No.398, IDS, University of Nairobi, August, 1983.

Desmond, A. D.; "Packaging and Plastics." UNIDO, ID/WG 392/1, March, 1973.

DuBois, J. and John, F. W.; Plastics, (New York, Van Nastraud Company, 1974).

Hirsch, S. and Adar, Z. V.; "Firm Size and Export Performance." World Development Vol.12, No.7, July, 1974.

Hirschman, A. O.; "The Political Economy of Import Substituting Industrialization in Latin America." The Quarterly Journal of Economics. Vol. 182, February, 1968.

Hunter, A.; "Product Differentiation and Welfare Economics." The Quarterly Journal of of Economics, Vol.69, November, 1955.

ILO.; Employment, Incomes and Equality: A strategy for increasing employment in Kenya, (Geneva, ILO, 1972).

Jacob, E.; "Causes of under-utilization of production capacities in industry and their effects on the Production Processes of selected Developing Countries." Economic Quarterly January, 1976.

Klein, E.; "Determinants of Manpower under-utilization and availability." International Labour Review, Vol.22, March - April, 1983.

Klein, L. R.; "Some Theoritical Issues in the Measurement of Capacity. Econometrica, Vol.28, April, 1960.

Kuuya, M.: "Import substitution as an industrial strategy: The Tanzanian case." In Rwenyemamu, J.F., (ed) Industrialization and Income Distribution in Africa. (Dakar, Codesrra, 1980).

Lecraw, D. J.; "Determinants of Capacity Utilization by Firms in Less Developed Countries." The Journal of Development Economics, May, 1976.

Lim ,D. "Capacity Utilization of Local and Foreign Establishments in Malaysian Manufacturing." The Review of Economics and statistics, February, 1976.

Marsden, K.; "Progressive Technology for Developing Countries." In Jolly, R. et. al. (eds). Third World Employment: Problems and Strategy. (Harmondsworth, Penguin, 1973).

Mascia, L.; The Role of Additives in Plastics, (London, Arnold, 1974).

Meier, G.M.; Leading Issues in Economic Development, (New York, Oxford University Press, 1976).

Mienes, K.; Plastics in Europe, (London, Morrison and Gibb Limited, 1964).

Miner, D. F. and Seastone, J. B.; Handbook of Engineering Materials, (London, Champman and Hall Limited, 1955).

National Christian Council of Kenya.; Who Controls Industry in Kenya? Report of a Working Party, (Nairobi, East African Publishing House, 1968).

Nixson, F.; "Import Substituting Industrialization." In Fransman, M. (ed)., Industry and Accumulation in Africa, (London, Heinemann, 1982).

Patton, W. J.; Plastics Technology: Theory Design and Manufacture, (Reston Publishing Company., 1976).

Phelps, M. G. and Wasow, B.; "Measuring protection and its effects in Kenya," working paper No.34, IDS, University of Nairobi, no date.

Phillips, A.; "An Appraisal of Measures of Capacity." American Economic Review, Vol.53, May, 1963.

Republic of Kenya; Customs and Excise Department Ministry of Finance. Annual Trade Report, (Nairobi, Statistical Branch Customs and Excise Department, 1963 through 1982).

Republic of Kenya; Ministry of Economic Planning and Development, Development Plan 1984 - 88, (Nairobi, Government Printer, 1983).

Republic of Kenya; Ministry of Economic Planning and Development, Statistical Abstracts, (Nairobi, Government Printer, 1975 - 83).

Robertson, D.; International Trade Policy, (London, Macmillan, 1972).

Simonds, H. R. and Church. J. M.; A Concise Guide to Plastics (New York, Reinhold Book Corporation, 1968).

Sors, L.; Plastic Moulding Engineering, (Oxford, Pergamon Press, 1967).

Subramanian, V.; "Low Density Polyethylene Market Survey in Kenya," Industrial Survey Promotion Centre, Ministry of Industry, April, 1979.

Sutcliffe, R. B.; Industry and Development, (London, Addison-Wsley Publishing Company, 1971).

UN.; Indexes to the International Standard Industrial Classification of all Economic Activities, (New York, UN, 1971).

UNCTAD.; "Import Substitution in Developing Countries." UNCTAD/RM36, August, 1969.

Yarsley, V. E.; Plastics in the Service of Man, (Hammondsworth, Penguin Books 1956).

Appendix 1A

Table 34A: Nairobi Firms

Distribution of Shifts and Workers

Firm Code (1)	SHIFT INFORMATION Work Days/Week (2)	Av^o Work Hrs/Week (3)	Shift 1 Hrs (4)	Shift II Hrs (5)	Shift III Hrs (6)	WORKERS Total Number of Workers (7)	Production Workers (8)	Office Staff (9)
1	5	120.0	9.0	15.0	0	70	62	8
2	7	168.0	11.0	13.0	0	80	77	3
3	7	168.0	8.0	8.0	8	153	138	15
4	7	168.0	8,0	8,0	8	20	20	AFM
5	7	168.0	8.0	8.0	8	139	127	12
6	6	144.0	9.0	15.0	0	230	210	20
7	6	144.0	9.0	15.0	0	35	33	2
8	5	47.5	9.5	-	-	7	7	-
9	6	144.0	12.0	12.0	0	12	10	2
10	7	168.0	10.5	13.5	0	120	118	2
11	5	45.0	9.0	-	-	12	10	2

Table 34 A Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
12	5.0	45.0	9.0	-	-	24	23	1
13	5.0	45.0	9.0	-	-	17	15	2
14	5.0	85.0	9.0	8	-	14	14	AFM
15	7.0	168.0	10.0	14	0	90	84	6
16	5.5	132.0	6.0	6	12	20	18	2
17	7.0	168.0	8.0	8	8	120	116	4
18	5.5	46.8	8.5	-	-	110	92	18
19	5.5	46.8	8.5	-	-	11	10	1
20	5.0	45.0	9.0	-	-	26	18	8
21	5.5	49.5	9.0	-	-	52	40	12
22	7.0	168.0	9.0	15	0	45	30	15
23	5.5	49.5	9.0	-	-	33	31	2
24	5.5	46.8	8.5	-	-	15	12	3
25	5.0	47.5	9.5	-	-	92	90	2
26	5.5	132.0	8.0	6	10	76	68	8
27	6.0	144.0	12.0	12	0	165	153	12
28	7.0	168.0	12.0	12	0	180	170	10
29	6.0	96.0	8.0	8	-	12	12	-
30	7.0	168.0	9.0	7	8	20	20	AFM
31	5.5	132.0	8.0	8	8	57	57	AFM
32	6.0	144.0	8.0	8	8	245	239	6
33	7.0	168.0	12.0	12	0	61	61	AFM

Source: Own Survey

Table 34B: Mombasa Firms.

Distribution of Shifts and Workers

Firm Code	SHIFT INFORMATION					WORKERS		
	Work Days/Week	Average Work Hrs/Week	Shifts Pattern Hours			Total Number of Workers	Production Workers	Office Staff
			Shift 1	Shift II	Shift III			
34	5.0	45	9	-	-	20	18	2
35	5.5	132	8	8	8	12	11	1
36	7.0	168	8	8	8	140	125	15
37	7.0	168	8	8	8	425	414	11
38	7.0	112	8	8	-	18	17	1
39	6.0	144	8	8	8	45	43	2
40	5.5	44	8	-	-	7	6	1
41	5.0	40	8	-	-	4	4	-
42	5.0	120	12	12	0	22	20	2
43	6.0	84	5	9	10	11	10	1
44	7.0	168	8	8	8	60	60	AFM

Notes to Tables 34A and 34B

AFM: In these Firms, plastic goods and non-plastic are produced together while administrative functions are executed by a central body.

Appendix 2

Table 35

Plant(s) Utilization Rates by Firm and Group

Firm size By Number of Production Workers (1)	Firm Code (2)	Production Worker (3)	Lismax (4)	CU_{i1} (5)	CU_{i2} (6)	CU_{i3} (7)
0-10	8	7	7	30.8	20.6	19.3
	9	10	5	93.5	93.5	51.9
	11	10	10	29.2	29.2	29.2
	19	10	10	30.4	21.7	21.7
	40	6	6	28.6	15.0	15.0
	41	4	4	26.0	17.3	17.3
	Total	47	42	-	-	-
	Group Weighted Average			37.0	30.5	25.3
11-20	4	20	8	90.9	90.9	90.9
	13	15	15	29.2	29.2	29.2
	14	14	7	55.2	36.8	36.8
	16	18	6	85.7	61.2	59.1
	20	18	18	29.2	16.2	16.2
	24	12	12	30.4	15.2	12.7
	29	12	6	62.3	62.3	41.6
	30	20	8	90.9	60.6	60.6
	34	18	18	29.2	20.9	13.3
	35	11	5	62.9	62.9	62.9
	38	17	11	56.2	56.2	32.1
	42	20	10	77.9	51.9	51.9
	43	11	5	37.9	18.6	18.6
	Total	206	129	-	-	-
	Group Weighted Average			50.2	39.1	33.4
21-40	7	33	15	68.6	50.8	45.7
	12	23	23	29.2	29.2	29.2
	21	40	40	32.1	23.0	20.1
	22	30	18	86.4	86.4	86.4
	23	30	30	32.1	23.8	22.2
	Total	156	126			
	Group Weighted Average			43.7	36.7	34.8
41-60	31	7	19	85.7	74.5	59.1
	39	43	15	89.4	89.4	89.4
	44	60	20	100.0	100.0	100.0
	Total	170	54			
	Group Weighted Average			92.0	88.1	82.7

Table 35Continued

(1)	(2)	(3)	(4)	(5)	(6)	(7)
61-80	1	62	40	56.0	34.7	25.3
	2	77	42	99.2	90.2	82.7
	26	68	26	74.8	57.5	53.4
	33	61	31	100.0	71.6	63.1
	Total	268	139			
	Group Weighted Average			82.4	64.0	56.3
81-100	15	84	30	100.0	92.6	88.5
	18	92	92	30.4	8.9	8.2
	25	90	90	30.8	25.7	23.7
	Total	266	212			
	Group Weighted Average			40.4	27.9	26.1
101-150	3	138	54	92.9	92.9	92.9
	5	127	48	96.2	77.0	71.3
	10	118	82	74.7	74.7	74.7
	17	116	42	100.0	62.8	59.1
	36	125	55	82.6	71.9	71.9
	Total	624	281			
	Group Weighted Average			87.2	76.3	74.7
150+	6	210	73	89.7	74.7	40.8
	27	153	72	65.8	50.6	50.6
	28	170	70	88.3	58.9	58.9
	32	239	103	72.3	55.6	55.6
	37	414	264	57.0	43.9	43.9
	Total	1186	582			
	Group Weighted Average			68.7	52.5	48.2
All Groups		2923	1565	65.8	52.7	49.0

Source: Own Survey

Appendix 3

Table 36

Plant Utilisation Rates by Firm and Process

Firm Code (1)	Process (2)	Lismax "Weight" (3)	CU_{i1} % (4)	CU_{i2} % (5)	CU_{i3} % (6)
2	Blow Moulding and injection Moulding: Plants Engaged In both processes	42	99.2	90.2	82.7
3		54	92.9	92.9	92.9
6		73	89.7	74.7	40.8
7		15	68.6	50.8	45.7
10		82	74.7	74.7	74.7
24		12	30.4	15.2	12.7
34		18	29.2	20.9	13.3
36		55	82.6	71.9	71.9
37		264	57.0	43.9	43.9
42		10	77.9	51.9	51.9
	Total	625			
	Process Weighted Average		70.6	60.4	55.6
12	Calendering	23	29.2	29.2	29.2
27		72	60.8	50.6	50.6
	Total	95			
	Process Weighted Average		56.9	45.4	45.4
14	Coating "Wire"	7	55.2	36.8	36.8
43		5	37.3	18.6	18.6
	Total	12			
	Process Weighted Average		47.7	29.2	29.2
4	Compression Moulding	8	90.9	90.9	90.9
26		26	74.8	57.5	53.4
	Total	34			
	Process Weighted Average		78.6	65.4	62.2
	EXTRUSION:				
9	Conduit	5	93.5	93.5	51.9
16	Extrusion	6	85.7	61.2	59.2
	Total	11			
	Process Weighted Average		89.2	75.9	55.8
1	Film Extrusion	40	56.0	34.7	25.3
15		30	100.0	92.6	88.5
17		42	100.0	62.8	59.1
22		18	86.4	86.4	86.4
30		8	90.9	60.6	60.6

Table continued

(1)	(2)	(3)	(4)	(5)	(6)
41		4	26.0	17.3	17.3
	Total	142			
	Process Weighted Average		83.3	62.8	58.2
5	Pipe	48	96.2	77.0	71.3
28	Extrusion	70	88.3	58.9	58.9
29		6	32.3	62.5	41.6
	Total	124			
	Process Weighted Average		90.1	65.0	63.8
11	Floor Tile Extrusion	10	29.2	29.2	29.2
	Total Extrusion	287			
	Process Weighted Average		83.7	62.3	58.6
18	Foaming	92	30.4	8.9	8.2
19		10	30.4	21.7	21.7
	Total	102			
	Process Weighted Average		30.4	10.2	9.5
21	Injection	40	32.1	23.0	20.1
23	Moulding:	30	32.1	23.8	22.2
21	(Plants doing	19	85.7	74.5	59.1
35	Injection Moulding	5	62.9	62.9	62.9
38	only)	11	56.2	56.2	32.1
39		15	89.4	89.4	89.4
44		20	100.0	100.0	100.0
	Total	140			
	Process Weighted Average		58.2	52.3	47.2
13	Lamination	15	29.2	29.2	29.2
8	Rotational Moulding	7	30.8	20.6	19.3
20	Vacuum Forming	18	29.2	16.2	16.2
32	Weaving	103	72.3	55.6	55.6
33		31	100.0	71.6	63.1
	Total	134			
	Process Weighted Average		78.7	59.3	57.3
25	"Others"	90	30.8	25.7	23.7
40	e.g.Pen Assembly	6	28.6	15.0	15.0
	Total	96			
	Process Weighted Average		30.7	25.0	23.2
ALL PROCESSES COMBINED		1565	65.8	52.7	49.0

Appendix 4A

Table 37A Blow Moulding

Machinery Plasticity Capacity Utilisation at Plant Level

Firm Code (1)	H_{id} Hrs. (2)	W_{id} Kg/Hr (3)	MU_N % (4)	MU_W % (5)
1	30	200	19.5	-
	96	100	63.3	-
	Total	300		
	MU_N &	MU_W	40.9	33.7
2	120	150	77.9	
	120	15	77.9	
	120	15	77.9	
	120	36	77.9	
	120	36	77.9	
	84	15	54.5	
	0	51	0.0	
	84	100	54.5	
	120	36	77.9	
	Total	454		
	MU_N &	MU_W	64.1	63.2
3	142	65	92.2	
	142	50	92.2	
	142	50	92.2	
	Total	165		
	MU_N &	MU_W	92.2	92.0
6	40	75	26.0	
	40	175	26.0	
	Total	250		
	MU_N &	MU_W	26.0	26.0

Table 37 A Continued

(1)	(2)	(3)	(4)	(5)
7	72	100	46.8	
	72	100	46.8	
	Total	200		
	MU_N &	MU_W	46.8	46.8
34	0	100	0	0
	Total	100		
	MU_N &	MU_W	0	0
36	84	63	54.5	
	40	75	26	
	84	50	54.5	
	84	100	54.5	
	154	50	100.0	
	120	50	77.9	
	154	50	100.0	
	120	31	77.9	
	Total	469		
	MU_N &	MU_W	68.2	63.7
37	154	46	100	
	154	58	100	
	154	83	100	
	154	83	100	
	154	63	100	
	Total	333		
	MU_N &	MU_W	100	100
42	120	125	77.9	
	MU_N &	MU_W	77.9	77.9

Source: Own Survey

Appendix 4B

Table 37B: Injection Moulding

Machinery Plasticity Capacity Utilisation at Plant Level

Firm Code (1)	Hid Hrs (2)	Wid Grams/Impression (3)	MU_N (4)	MU_W (5)
1	120	500	77.9	
	120	100	77.9	
	Total	600		
		MU_N & MU_W	77.9	77.9
2	42	30	27.3	
	84	70	54.5	
	84	70	54.5	
	84	70	54.5	
	154	30	100.0	
	154	100	100.0	
	Total	370		
	MU_N&MU_W		65.2	68.3
7	120.0	250	77.9	
	120.0	100	77.9	
	120.0	30	77.9	
	Total	380		
	MU_N & MU_W		77.9	77.9
21	49.5	480	32.1	
	49.5	375	32.1	
	49.5	375	32.1	
	49.5	250	32.1	
	49.5	250	32.1	
	Total	1730		
	MU_N&MU_W		32.1	32.1
23	44	140	28.6	
	44	90	28.6	
	44	140	28.6	
	Total	370		
	MU_N& MU_W		28.6	28.6
31	88	1000	57.1	
	88	900	57.1	
	88	750	57.1	
	88	750	57.1	
	88	750	57.1	

Table 37 B Continued

(1)	(2)	(3)	(4)	(5)
31	88	750	57.1	
	Total	4900		
	MU_N & MU_W		57.1	57.1
34	0	750	0.0	
	0	750	0.0	
	0	450	0.0	
	0	450	0.0	
	40	100	26.0	
	40	100	26.0	
	40	100	26.0	
	40	100	26.0	
	Total	2800		
	MU_N & MU_W		13.0	3.7
35	120	750	77.9	
	120	450	77.9	
	Total	1200		
	MU_N & MU_W		77.9	77.9
36	0	180	0.0	
	84	500	54.5	
	84	1000	54.5	
	84	1250	54.5	
	40	30	26.0	
	40	30	26.0	
	84	2500	54.5	
	84	150	54.5	
	84	1500	54.5	
	84	1500	54.5	
	42	100	27.3	
	Total	8740	41.9	52.9
37	105	175	68.2	
	105	175	68.2	
	105	280	68.2	
	105	200	68.2	
	Total	830	68.2	
	MU_N & MU_W		68.2	68.2

Table 37B Continued

(1)	(2)	(3)	(4)	(5)
38	100	300	. 0	
	154	38	100	
	154	450	100	
	154	70	100	
	154	140	100	
	154	330	100	
	154	450	100	
	154	175	100	
	154	55	100	
	154	60	100	
		2068	90	85.5
39	154	1100	100.0	
	154	750	100.0	
	Total	1850		
	MU_N & MU_W		100.0	100.0
42	120	60	77.9	
	120	120	77.9	
	120	140	77.9	
	120	85	77.9	
	120	100	77.9	
	Total	505	77.9	
	MU_N&MU_W		77.9	77.9
44	120	150	77.9	
	84	2500	54.5	
	84	4000	54.5	
	84	1500	54.5	
	120	300	77.9	
	120	300	77.9	
	120	200	77.9	
	84	100	54.5	
	Total	9050		
	MU_N&MU_W		66.2	57.0

Source: Own survey

Appendix 4C

Table 37C: Film Extrusion

Machinery Plasticity Capacity Utilisation at Plant Level

Firm Code (1)	H_{id} (2)	W_{id} Kg/Hr (3)	MU_N % (4)	MU_W % (5)
1	120	25	77.9	
	120	100	77.9	
	120	130	77.9	
	120	60	77.9	
	120	75	77.9	
	120	100	77.9	
	120	250	77.9	
	120	90	77.9	
	120	82	77.9	
	120	150	77.9	
	0	400	0	
	120	80	77.9	
	120	75	77.9	
	Total	1617		
	MU_N & MU_W		71.9	58.6
15	120	160	77.9	
	120	110	77.9	
	154	120	100.0	
	84	60	54.5	
	84	110	54.5	
	84	150	54.5	
	154	90	100.0	
	66	70	42.9	
	42	75	27.3	
	Total	945		
	MU_N & MU_W		65.5	68.3
22	H_{id}	W_{id}	MU_N	MU_W
	144	115	93.5	
	144	38	93.5	
	144	20	93.5	
	Total	173		
	MU_N & MU_W		93.5	93.5
32	144	130	93.5	
	144	130	93.5	
	84	60	54.5	
	Total	320	80.5	86.2

Table 37C Continued

(1)	(2)	(3)	(4)	(5)
33	144 42	75 75	93.5 27.3	
	Total	150		
		MU_N & MU_W	60.4	60.4

Source: Own Survey

Appendix 4D

Table:37D Pipe Extrusion

Machinery Plasticity Capacity Utilisation at Plant

Firm Code	H_{id} Hrs	W_{id} Kg/hr	MU_N %	MU_W %
15	84	210	54.5	
	84	110	54.5	
	84	167	54.5	
	68	60	44.5	
	0	150	00.0	
	Total	697		
		MU_N & MU_W	41.5	41.9
28	93	83	60.4	
	93	125	60.4	
	93	417	60.4	
	93	167	60.4	
	93	83	60.4	
	Total	875	60.4	
		MU_N & MU_W	60.4	60.4
29	0	125	0	
	70	150	45.5	
	70	330	45.5	
	Total	605		
	W_{id}	MU_N & MU_W	30.3	36.1

Source: Own Survey

Table 38

Market Survey of P.V.C. in Kenya 1983

Processing Firm		End Product	Grade of Raw Material	Capacity	
Name	Location			Installed	Consumption
Eslon Plastics Ltd.	Nairobi	Pipes	PVC Resin	6,000	2,500
Metal Box (K) Limited	Thika	Pipes	PVC Resin	6,000	480
Nile Investment	Limuru	Pipes	PVC Resin	10,000	4,000
Bata Shoe Co.(K) Ltd.	Limuru	Shoes	PVC Resin	2,800	1,300
Bata Shoe Co.(K) Ltd.	Mombasa	Shoes	PVC Resin	1,000	800
E. A. Cables	Nairobi	Cables		1,000	600
Sera Coating	Nairobi	Leather Cloth	PVC Resin	1,000	480
Dunlop (K) Limited	Nairobi	PVC Floor Tiles	PVC Resin	-	120
Ezzi Vinyl Products	Nairobi	Vinyl Asbestos Tils	PVC Resin	300	200
Cable & Plastics	Mombasa	Hoses/Conduits	PVC Compound	650	100
Classons	Nairobi	Hoses /Conduits	PVC Compound	-	360
Crown Paint	Nairobi	Hoses /Conduits	PVC Compound	-	250
Ega tube	Nairobi	Hoses /Conduits	PVC Compound	720	430
Kaluworks	Nairobi	Hoses /Conduits	PVC Compound	600	120
R. H. Devani	Nairobi	Hoses /Conduits	PVC Compound	-	250
Afro Plastics	Nairobi	Bottles/Containers	PVC Compound	200	150
Pan Plastics	Nairobi	BBottles/Containers	PVC Compound	.	

Source : Own Survey

Note: Appendix 5

1) Figures on the consumption of P.V.C. are inaccurate estimates but they present a fair picture of the situation as at 1983.

2) P.V.C. is primarily used for pipe and shoe manufacturing in Kenya and is consumed mostly in form of resin (Powder).

Appendix 5

Questionnaire

1. **Contact**

Person interviewed Date..............

Name .... Tel.No...........

2. **General Information**

Name ....

Address ....

Telephone ....

3. **Physical Location**

Street ....

Town ....

Year of establishment ....

4. **Activities**

State the type of activities undertaken e.g. printing, extruding, moulding etc. ....

....

....

....

5. **Raw Materials**

Name the raw materials used in the production process

....

....

....

6. Products

Name the products that you make ....

....

....

....

....

7. Growth of the Industry

What was your production in tonnes for 1982?

Blow moulding ....

Injection moulding ....

Extrusion ....

8a Production Per Year in Tonnes: 1973-1981

Year	Blow Moulding	Injection Moulding	Extrusion	Total
1973				
1974				
1975				
1976				
1977				
1978				
1979				
1980				
1981				
1982				

8b Give a monthly breakdown of production in tonnes for 1982

Monthly Production in tonnes for 1982

Month	Blow Moulding	Injection Moulding	Extrusion	Total
January				
February				
March				
April				
May				
June				
July				
August				
September				
October				
November				
December				

Machinery Inventory

9a Machinery: Capacity By Type

PURCHASE		INJECTORS			CAPACITY		
Year	From: 1. Kenyan User 2. Imported	C.I.F Value	Make	Model	Maximum grammes per impression	Impressions per hour	Average Hrs of operation per week

MACHINERY: CAPACITY BY TYPE

9b.

PURCHASE		BLOW MOULERS			CAPACITY	
Year	From: 1.Kenyan User 2.Imported	C.I.F. Value	Make	Model	Kgs per hr.	AvHrs operation per week

9c. MACHINERY CAPACITY BY TYPE

PURCHASE		EXTRUDERS			CAPACITY	
Year	KU - M -	C.I.F. Value	Make	Model	Kgs. per hour	Av° Hrs of operation per week

9d. MACHINERY BY TYPE

PURCHASE		EXTRUDERS			CAPACITY	
Year	KU - M -	C.I.F. Value	Make	Model	Inches per minute	Average Hrs of operation per week

MACHINERY: CAPACITY BY TYPE

9e

PURCHASE		OTHERS			CAPACITY	
Year	Ku - M -	C.I.F.	Make	Model	Capacity to be Indicated at the Plant	Average Hrs of Operation per Week

OTHERS - Excludes Injectors, Blow Moulders and Extruders.

10. On Average, how may hours did you work per week during the past 4-weeks.

Production Space

11. By reorganizing your use of the production space, by what % could you increase plastics equipment and still be efficient? ....%

Labour:Shift Information for 1983

12. How many days do you work in a week? .... days.
13. How many shift(s) do you operate in a day?(i.e. in 24 hours) ....
14. State the starting time and end time of the shift(s).

Day	Shift	Starting time	Breaks	Ending Time
Weekdays	1st 2nd 3rd			
Saturday	1st 2nd 3rd			
Sunday	1st 2nd 3rd			

15. Do machines shutdown during breaks? Yes/No.

16. What is the total number of workers?

17. Distibution of workers over shifts.

Category of Employees	SHIFTS					
	1st		2nd		3rd	
Managers						
Supervisors/Foremen						
Technicians:						
Skilled						
Semi Skilled						
Unskilled						
Operatives						
Others (specify)						
Total						

M = Male, F = Female

Labour Stack

18. What % additional production could you get givan the same number of men, machines and hours if you received more orders for jobs? ....%

Machinery Slack

19. If you had more orders, what % additional production could you get with the same machines, hours but with more men ....%

20. Supervisory Load

What % more men could your present supervisors oversee effectively? ....%

Productivity

21. Would you anticipate productivity of 2nd and 3rd shift to; remain the same .... to increase ....% or to fall ....% relative to 1st shift.

Some Causes of Capacity Under-Utilisation

22. Reasons for not utilising full capacity over the last 24 months (1982/3) . Please rank the following plus any other that you may have according to the order of importance.

A = Very important

B = Important

C = Some what important

D = Not important

Rank and Reason

(i) Seasonal Demand ....

(ii) Insufficient Demand ....

(iii) Difficulties over raw material supplies ....
....

(iv) Fuel shortages ....

(v) Shortage of skilled manpower ....

State the category ....

(vi) Plant Breakdowns ....

(vii) Difficulties obtaining spare parts ....
....

Investment in Capital

23. If need exists to expand machinery, do you have to obtain permission from the government? Yes/No.

24. If yes, what requirements do you have to meet in order to get the permission?.................................
....
....

Moulds and Dies

Designing and Making

25. Do you make moulds/dies? Yes/No.

26. If yes, complete the table below.

	Designers	Designers/Makes	Makers
Expatriates Local Skilled Semi skilled			
Total			

27. Are the Designers sufficient to meet the firms requirements? Yes/No.

28. If yes, what % additional production of moulds/dies could you get from these men if you had more work for them with the same hours ....% with max longrun overtime ....%.

29. If no, how do you intend to meet the surplus demand?

....

....

....

30. Would you consider selling and/or repairing the mould/ dies commercially? Yes/No.

31. Explain ....

....

....

32. Do you experience difficulties in getting special steels for moulds? Yes/No.

33. If yes, explain the difficulties ....

....

....

34. Apart from making moulds/dies, do you have other sources for them? Yes/No.

35. If yes, state the sources (table below)

Source and Supplies of Moulds/Dies

Source	Name of Supplier	Value of Moulds/Dies obtained 1982
Local Manufacturer		
Direct Import		
Large Scale Importer		
Customers		

36. For imported moulds/dies, do they have any special characteristic that make it impossible to obtain them locally? Yes/No.

If yes, explain ....

....

....

....

<u>Repair and Maintainance of Moulds/Dies</u>

37. Do you have a machine shop? Yes/No.

38. If yes, what are the main activities carried our in the machine shops? ....

....

....

39. Who repairs the moulds/dies?

☐ Own repairs: ☐ Minor repair

☐ Major repair

☐ Local Manufacturers/repairers of moulds/dies

☐ Other processing firms which repair moulds/dies

40. What are the most prevalent problems in repairing of moulds/dies ....

....

....

....

41. Is there any difficulties to obtain technicians with skills to repair the moulds.

42. If yes, how do you intend to remedy the situation?
....
....

43. Do you train technicians to repair the moulds/dies? Yes/No.

44. If yes, how long does it take a good fitter/welder to learn this ?......................................

45. Do those who complete the training leave to other firms? Yes/No.

46. If yes, what % leaves? ....%

47. PRODUCT DIFFERENTIATION: CONTAINERS UP TO 2 LITRES

Number of Main Designs of Moulds		Type of Mould	Cost of Mould	Changing Time	Product Made	Quantity	Price	Size e.g. ½Lt.
Processor	Customer							

- 210 -

48. How often do you exchange moulds in the machines?
e.g. (2 x 1 month) ....
....
....

49. What determines how often you exchange the moulds in the machines?...
....
....

50. How long does it take to exchange a mould?
(i.e. time in hours) ....hours.

51. How much does the change over time cost you?
(Cost or revenue lost) ....
....

52. Given the same kind of machine e.g. a printer, do spare parts of different makes and models fit into one another? Yes/No.

53. If no, what effect has this on the provision of spare parts? ....
....
....

54. Has the range of machinery model(s) being increasing or decreasing? ....

55. If the range has been increasing, does this affect the cost of production? Yes/No.

56. If yes, How? ....
....
....

57. When buying machinery, why don't you confine yourself to a small range of models? ....
....
....

58. Do you have idle machines? Yes/No.

59. If yes, how long have they been idle ....
Reasons for idleness (e.g. obsoleteness)..............
....
....

Availability of Spare Parts

60. Where do you get the spare parts from?
Manufacture some of the spares ....%
Have them made by commercial machine shops .....%
Import directly
Obtain from local importers ....%

61. Are there any problems in getting spare parts? Yes/No.

62. If yes, state the nature of the problems. e.g.

Cannot get the spares for machinery ....

....

....

....

63. How do you overcome these problems? ....

....

....

....

OTHER AREAS

Imports: Plastics Raw Materials

64. Where do you obtain plastics raw material from?

Large scale importer ....%

Local manufacturer ....%

Import ....%

If you import, do you buy from your central stores?

Yes/No.

65. If the buying of the plastics raw material was controlled by the firms in the industry, by what % would you reduce C.I.F on the raw material due to freight and quantity order discounts..........%

66. Do you experience shortage of plastic raw materials?

Yes/No.

67. If yes, what causes the problem ....

....

How do you cope with the problem ....

....

Imports: Possibilities for Import Substituting Plastic Raw·Materials

68. Is there any possibility of producing plastics raw material domestically? Yes/No.

69. If no what factors hinder the production ....

....

....

70. If the possibility of recycling plastics material? Yes/No.

71. What are the difficulties, e.g. lack of machinery etc...

....

Imports of Finished Plastics Products

72. Does Kenya import finished plastics goods? Yes/No.

73. If yes, what are they ....

....

Is there any possibilities of producing these goods or some of them domestically? Yes/No.

Explain ....

....

Availability of Imported Inputs

74. Do you face any hardships in getting

(i) Import licenses? Yes/No.

If yes, what difficulties ....

....

....

How long do you usually wait? ....

Are your requests sometimes rejected? Yes/No.

(ii) Foreign exchange? Yes/No.

If yes explain ....

....

....

75. What is the effect of these problems on:

Stocking .... Operations ....

.... etc.

76. If there were no foreign exchange and import license problems and licensing took only two weeks could you lower your stocks?

1) Raise/fall of machinery spare parts ....%
2) Raise/fall of plastics raw materials ....%
3) Overall (by value ....%

77. What is the approximate value of current stocks
1) Spares
2) Raw Materials

Exports

78. Do you export? Yes/No.

If yes (a) What products do you export ....

....

....

(b) To which Country? ....

....

....

(c) What % of your output do you export?.....

....

....

79. Do you receive enquires from other countries? Yes/No.

80. If yes, how do you respond? ....

....

....

81. Do you have a programme aimed at promoting exports?

Yes/No.

If no, why? ....

....

....

Ownership

82. Who owns the firm?

(i) 100% local:

a) Government

b) African

c) Asian

(ii) 100% foreign

(iii) Joint venture:

Local private ....%

Local government ....%

Foreign ....

(iv) Subsidiary of TNC's

(v) No idea

83. Who are your competitors? ....

....

....

Appendix 7A

FIRMS VISITED: LOCATION, ADDRESS AND YEAR ESTABLISHED

Firm	Year
A. C. M. E. Containers, Mombasa/Nairobi Road, Miritini, P. O. Box 86420, MOMBASA.	1978
Afro-Plastics (K) Limited, Lusaka Road, P. O. Box 18184, NAIROBI.	1969
Bata Shoe Company (K) Limited, Limuru, P. O. Box 23, LIMURU.	1965
Bata Shoe Company (K) Limited, Zanzibar Road, P. O. Box 90100, MOMBASA.	1978
Bobmil Industries Limited, Enterprise Road, P. O. Box 48875, NAIROBI.	1982
Cable and Plastics, Jommo Kenyatta Avenue, P. O. Box 86636, MOMBASA.	1975
Coast Cables, Mombasa/Nairobi Road, Miritini, P. O. Box 86420, MOMBASA .	1979
Cosmo Plastics, Homabay Road, P. O. Box 46338, NAIROBI.	1977
Clasons Plastics Limited, Lunga Lunga Road, P. O. Box 46030, NAIROBI.	1979

Firm	Year
G.D. & Brothers Limited, Redhill, P. O. Box 155, LIMURU.	1976
Haco Industries (K) Limited, (Kalamvita Industries), Machakos Street, P. O. Box 90481, NAIROBI.	1975
Haco Industries (K) Limited, (Kalamvita Industries), Changamwe Road, P. O. Box 46707, NAIROBI.	1975
J. K. Industries, Rangwe Road, Off Lunga Lunga Road, P. O. Box 49201, NAIROBI.	1970
Joy Bathroom, Homabay Road, P. O. Box 18827, NAIROBI.	1978
Kaluworks Limited, Mwageka Road, P. O. Box 90421, MOMBASA.	1982
Kenapen Industries Limited, Mogadishu Road, P. O. Box 46707, NAIROBI.	1979
Kensack, C/o E.A. Bag & Cordage Co. Limited, Private Bag Ruiru, Off Industries Road, THIKA.	1978
Kenya Industrial Plastics Limited, Pate Road, P. O. Box 44794, NAIROBI.	1968

Firm	Year
Dunlop (K) Limited, Nanyuki Road, P. O. Box 30102, NAIROBI.	1975
East African Cables, Chui Road, P. O. Box 18243, NAIROBI.	1965
Ega Tube, Dakar Road, P. O. Box 43387, NAIROBI.	1966
Emco Plastica International Limited, Chai Street, Off Shimanzi Road, P. O. Box 82968, MOMBASA.	1965
Eslon Plastics, Jirore Road, P. O. Box 41761, NAIROBI.	1964
Euromica, Nanyuki Road, P. O. Box 40919, NAIROBI.	1975
Ezzi Vinyl Products, Funzi Road, P. O. Box 18529, NAIROBI.	1969
Fortune Plast, (A.M.C.E. Plastics), Saramala Street, P. O. Box 82602, MOMBASA.	1982
General Plastics, Wajir Road, P. O. Box 10032, NAIROBI.	1974

Firm	Year
Mela Plas Limited, Baba Dogo Road, Ruaraka, P. O. Box 40962, NAIROBI.	1980
Mepal Plastics (K) Limited, Lunga Lunga Road, P. O. Box 47875, NAIROBI.	1980
Meta Plastics, Funzi Road, P. O. Box 48811, NAIROBI.	1963
Metal Box, (African Plastic Limited), Industries Road, P. O. Box 109, THIKA.	1972
Multi Product Limited, Tangana Road, P. O. Box 82755, MOMBASA.	1963
Nile Investment (E.A.), Limuru, P. O. Box 218, LIMURU.	1977
Packaging Africa (1976) Limited, Lumumba/Miji Kenda Street, P. O. Box 98541, MOMBASA.	1976
Pan Plastics, Baba Dogo Road, Ruaraka, P. O. Box 40962, NAIROBI.	1964
Plastics Products, Lusingeti Road, P. O. Box 78039, NAIROBI.	1979
Polycans, Gideon Rimba Road, P. O. Box 90661, MOMBASA.	1977

Firm	Year
Premium Drums, (Akilo & Associate), Lokitaung Road, P. O. Box 78101, NAIROBI.	1974
Sera Coating Limited, Lusingeti Road, P. O. Box 78056, NAIROBI.	1974
Sumaria Industries Limited, Near Tiger Shoe Co., P. O. Box 42565, NAIROBI.	1979
Tritex Industries Limited, (Flora Industries), Gideon Rimba Road, P. O. Box 87447, MOMBASA	1981
Uni Plastics, Baba Dogo Road, Ruaraka, P. O. Box 48538, NAIROBI.	1964
Uni Sack, Thika/Kilimambogo Road, P. O. Box 1272, THIKA.	1978
Van-Leer E.A. Limited, Gilgil Road, P. O. Box 18272, NAIROBI.	1975
Vita Foam, Chai Street, Off Shimanzi Road, P. O. Box 90223, MOMBASA.	1968
Vita Foam, Bamburi Road, P. O. Box 18094, NAIROBI.	1968

Notes: (1) Year of establishment may refer to:-

a. When a firm started production or

b. When a firm was sold to or bought by a new concern

(2) The firm was known by the name in brackets at a certain point of time.

Appendix 7B

LIST OF PLASTIC FIRMS NOT VISITED

Chesebrough Ponds Limited,
P. O. Box 40476,
NAIROBI.

Dodhia Packaging Limited,
P. O. Box 46206,
NAIROBI

East African Records,
P. O. Box 30256,
NAIROBI

Foam Plastic Limited,
P. O. Box 48570,
NAIROBI

Furaha Toys,
P. O. Box 73340,
NAIROBI

Kenby Cables,
P. O. Box 64,
KISUMU

Kenpoly Manufacturers,
P. O. Box 30032,
NAIROBI

Machakos Foam Industries Limited,
P. O. Box 1246,
KANGUNDO

Polyfabs Limited,
P. O. Rox 11013,
NAIROBI

Rai Plywood (K) Limited,
P. O. Box 241,
ELDORET

R. H. Devani,
P. O. Box 18342,
NAIROBI

United Bags Limited,
P. O. Box 45315 (Tel 2226 Kikuyu),
NAIROBI.

Note that Appendices 7A - B omits:

1) Establishments whose plastic fabrication is a secondary economic activity e.g.

   a) Booth Manufacturing
   b) Ken Alluminium
   c) Johnson Wax
   d) and Shanti Perfumery Works

2) Firms using coated fabrics as inputs. e.g.

   a) Afrolite Industries
   b) Kenya Poly Goods Manufacturers

3) All firms dealing with plastics in advertisement e.g.

   a) Pelican Limited
   b) K.H. Karimbhai
   c) Adkraft International
   d) Neon and General Signs

4) Very small plastic firms (employing less than five workers) e.g.

   a) Ball Pens and Allied Industries
   b) Plastic Electricons
   c) Praks Manufacturers
   d) Simba Plastics

5) Plastic Raw Materials Suppliers e.g.

   a) Hoechst East Africa Limited
   b) Imperial Chemicals
   c) Shell Chemicals
   d) Bayer

6) Plastic Machinery Suppliers and Consultants e.g.

   a) Kaeler Africa Limited