CHAPTER 1
CHAPTER - I

INTRODUCTION

From time immemorial, mankind has strived to improve the basic amenities of food, clothing and shelter, for the civilised and cultured existence of the members of the society. The textile industry with the arts and skills of spinning, weaving, dyeing and printing had existed in India for at least five thousand years, in the service of clothing mankind, and Indian garments had always garnered a substantial portion of the world market, besides a stable status of honour and pride among the fabric artisans of the globe.

Today, textile industry is very ancient and large; it is second only to agriculture in India. In the long history of the country Indian cotton attracted foreign buyers and sustained textile mills in U.K. With the advent of freedom struggle, the policy of chakra made a silent revolution. Necessarily, independent India placed high priority on khadi to meet the domestic requirement of textiles, supplementing mill made clothes. The rapidly growing population of the country provided an ever expanding demand for cotton clothes.
The knitting (hosiery) industry is an unique and distinct part of the textile industry.

**History**

"Hosiery" generally refers to all knitted fabrics. Knitting is used to describe the technique of constructing textile structure by forming continuous yarn into intermeshing loops. It was originally derived from the ancient word “Nahayati”. Knitting by using needles with fingers may well have been practised since 1000 B.C. It is only after the tenth century that the knitting technique found prominence in Italy and then spread across Europe. Manufacturing of stockings appeared in England in 1550. The industry expanded in England rapidly in 19th century, when new innovations and inventions in the knitting technology received widespread encouragement and practical applications.

The machine knitting was developed for the first time by Rev. W. Lee in 1550. Circular knitting machines were developed in 1816. By the beginning of the Second World War, the knitting industry had a monopoly in the world of socks, stockings, underwear, woollen jersey and sweaters. The development of synthetic filament yarn and the high speed warp knitting machine are the two major events in the industry.
In India

The first cotton hosiery industry in India appeared at "KIDDERPORE" near Calcutta in 1893 with hand-knitting machines. However, the hosiery industry in India has remained for long technically backward, because the knitted fabrics are totally unsuitable for traditional Indian clothes like dhothies and sarees. With a recent shift in clothing habits in India knitted fabrics are becoming increasingly popular even for outer-wear. At present, hosiery industry has a permanent place of pride among the modern industries of the country.

The special characteristics of knitted fabrics, namely, elasticity and openness of structure, and its ability to yield and breathe, are reasons for significant and diversified growth of knitwear industry, moving 'socks and stockings', to 'underwear and sportswear' and finally to 'assorted garments of humanwear'. Today, the product matrix in the Indian hosiery manufacturing and trade has a wide repertoire of acceptable quality items achieved mainly through technological advances, shear entrepreneurship and booming world demand.

The hosiery products of India find not only a large and growing domestic market but also an expanding foreign trade, bringing substantial foreign exchange. It adds
significantly to the employment of labour in production and distribution. It is also an important source of tax revenue to both the Central and Tamil Nadu Government. Therefore, it has received policy support for expansion of capacity, technological upgradation, marketing and export.

It remains concentrated in a few locations, as could be seen in Table 1.

**TABLE - I**

Distribution of knitting machines in India

<table>
<thead>
<tr>
<th>Places</th>
<th>Knitting Units</th>
<th>Machineries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nos.</td>
<td>%</td>
</tr>
<tr>
<td>Tiruppur (T.N.)</td>
<td>1,950</td>
<td>32.63</td>
</tr>
<tr>
<td>Calcutta (W.B.)</td>
<td>2,829</td>
<td>47.15</td>
</tr>
<tr>
<td>Delhi</td>
<td>367</td>
<td>6.12</td>
</tr>
<tr>
<td>Others</td>
<td>846</td>
<td>14.10</td>
</tr>
<tr>
<td>Total</td>
<td>6,000</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: "Status of Indian Hosiery Industry" by A.I.S. Rao (1985) P. 553

Calcutta ranks first in both number of units and number of machines accounting for 47.15 percent and 41.2 percent respectively. It is closely followed by Tiruppur
of Coimbatore district in Tamil Nadu. Delhi ranks a distant third, while units in other areas account for 14.10 percent in number of units and 18.8 percent in machines.

During the year 1986, the knitting industry in India contained approximately 43,000 knitting machines of which 28,000 were circular knitting machines; 11,000 were flat knitting machines. 1,000 were warp knitting machines and 3,000 were socks knitting machines. It is estimated that there are 6,000 knitting units operating in India. The industry provides direct employment to 2.5 lakh persons with a turnover of about Rs.800 crores in Tamil Nadu.

In Tamil Nadu, among the 8,000 small scale enterprises, nearly 25 per cent are knitting units. The first knitting industry was established in Tiruppur in 1928. Very few manufacturers knitted a very low quality products with the machines operated by hands. There was a breakdown from 1963 to 1971 for want of financial assistance and also the difficulty to find market for their products.

When the major commercial banks were nationalised, they were directed to extend sufficient financial assistance by granting loans to the hosiery manufacturers.
in Tiruppur. It helped a rapid growth and now there exist 1,958 knitting factories in the town. Totally 30,000 persons are employed in the factories. Though hosiery products of Tiruppur found market throughout India it could not compete with producers of Calcutta in the northern states, because sales tax at one percent of value is levied by the northern states whereas Tamil Nadu Government has levied tax of five percent of value within the state and 2.5 percent outside states.

Knitwear products were manufactured in Tiruppur in Tamil Nadu, on a small scale from the start of this century. In fact, the South India Hosiery Manufacturer's Association was formed in Tiruppur in the year 1956, merely with 100 members, most of them having small scale units in and around Tiruppur. Today, there are around 1,200 members in this association, which not only accounts for a twelve-fold increase over the four decades, but also is a measure of the explosive exponential expansion of hosiery in Tiruppur.

The total value of the sale of hosiery products of Tiruppur is about Rs.175 crores per year. In view of the export of hosiery products to foreign countries, the manufacturers in Tiruppur are evincing great interest to
improve the quality and designs. Knitting companies in Tiruppur maintained the top quality in manufacturing their products. 110 of them have obtained I.S.I. mark for their products.

The export value of all types of fabrics and garments from India amounted to Rs.137.25 and 7.5 billion respectively in 1983 and knitted fabrics and garments constituted 18.3 percent of this. At present in terms of value, wollen knit goods constitute most of the exports followed by cotton knit goods.

The Problem Focus

On account of expanding demand for domestic use as well as exports, the hosiery units of Tiruppur are continuously updating their production technology, with care to ensure high quality and growth of output. The products are high value adding and the producers have to face a highly competitive market. The firms are relatively few and are located in close proximity to each other within Tiruppur town. Therefore, the market for hosiery products is oligopolistic and the products are much differentiated.

It requires the hosiery units to be always alert to the changing conditions of the market. Product promotion
by way of introducing new products or improving the quality of the products is their strategy with the competitive market. Therefore, production is widely diversified and the firms are concerned in protecting their profit. While the diversification of the products will reduce market risk to some extent, a more stable strategy will be to reduce market risk to some extent, a more stable strategy will be to reduce the cost of production so that profit margin is enlarged for any competitive price. Further, there is a foreign market, wherein, these small firms make their presence through the Hosiery Manufacturer’s Association and this demands high quality control, which is possible with advanced technologies in knitwear production. Therefore, the entrepreneurial success of small scale hosiery units depends largely upon their efforts to relate their production to the market demand, or creating sufficient demand to the products through appeal of quality and prices, even while ensuring that product is cost effective. Therefore, a techno-economic study of the knitwear industry in Tiruppur with a major accent on economical and technological aspects assumes special significance.

A special characteristic of hosiery industry in Tiruppur is that it includes units of widely varying size and performance. As it serves highly competitive
international markets, its stability and technological progress in production of various hosiery products are considered essential. Important questions arise in ensuring an efficient and sustainable production of the industry. First question is: whether the performances of the units are economically efficient? Are the managerial decisions helping cost effective production and competitive pricing in the sense that marginal cost equals price per unit of product or is there any monopoly profit? What is the relative performance of small and large units? What is the break-even level of production? What are the constraints faced by decision makers? How to achieve the maximum performance efficiency given the goals of the firms? If there are multiple goals and several constraints, what is the best way to decide optimal production plan? The study makes an attempt to answer these questions.

As the size of the firms varies so widely, no single solution will be appropriate. It is necessary to classify the firms by size of installed capacity and type of products produced and study their economics and technological progress. Once classified, it would be possible to select a representative firm for each class and prepare optimal plans for them. This is the aim of this study.
Most of the firms in hosiery industry of Tiruppur have the twin goals of (i) to minimize the market risk due to obsolescence of products and uncertainty of prices and margins. The progressiveness in technology adoption and careful choice of products to maximize aggregate net return to the investment are the ways to be cost effective in production and competitive in the market. Therefore, the firms in hosiery industry are ready to seek assistance for making decisions for optimal production. However, their decisions have to be made subject to not only several constraints but also multiple goals that are not complementary.

Conventional normative decision model of linear programming is therefore inadequate even if the constraints and the objective functions are all assumed to be linear. Recent developments in the field of operations research, or more specifically mathematical programming techniques offer several alternative models. Multiple Criteria Decision Making Model (MCDM); Multiple Objective Programming (MOP); Compromise Programming (CP); Lexicographic Goal Programming (LGP); Weighted Multiple Goals Programming (WMGP) are simple variations of the linear Programming model that could be solved by the conventional Simplex or Revised Simplex Methods.
Assumption of linear relationship for each of the goals and for each of the constraints need not be very restrictive because linearization or non-linear relationship with piecewise linear forms of separable programming technique is available. Therefore, the multi-goal and multiple constraint problems of the hosiery industry is amenable for mathematical programming models and firms desired to use them. To help the firms in identifying optimal production plan in a multiple goal setting is the aim of the present study. Preliminary trials with the alternative models (MCDM, MOP, CP, LGP, WMGP) demonstrated that the multiple objective (or goal) programming (MOP also called MGP) is both simple and comprehensive. The present study aims at evaluating the suitability of MGP for modelling production application for a selected firm. Thus, it is a vast study of decision making of a typical hosiery firm in Tiruppur town, for application of MGP as a decision tool.

Objectives

Overall objective of the study is to evaluate the performance efficiency of hosiery units of Tiruppur. Specific objectives are:

i) to study the trend, cycle and seasonal variations in the production of hosiery products.
ii) to evaluate economic efficiency of the units in terms of output / input ratio, factor intensity, employment of labour, returns to scale if any, and technological progress;

iii) to understand the differences if any in performance efficiency of firms of different sizes, in terms of profit rate, productivity of labour, returns to investment, capacity utilization and height of price over cost;

iv) to prepare optimal production plans, size class-wise, with the help of multicriteria programming model and to show the scope for progress of the firms; and

v) to suggest specific measures for improving performance of the hosiery industry in terms of scale of operation, managerial decisions concerning resource use and pricing of products and policy support necessary for production and export.

Hypotheses

Above objectives require the following hypotheses to be empirically tested.

i) The hosiery industry has registered a steady uptrend in production and value of export with small cyclical variations.
ii) There is increasing returns to scale in production and profit rate is high.

iii) Technological progress is biased towards capital use.

iv) Producing firms have multiple goals and therefore decision is complex.

v) The optimal decision model (LGP) is acceptable to the hosiery units.

Scope of the Study

The present study is an empirical case study to help a few hosiery firms selected to represent three size groups. It serves as a benchmark study because, the case firms are selected to be representative firms. The model represents a synthetic model which incorporates important features seen in other firms but not necessarily seen in the case firm. Thus, the set of decision variables may be larger than the set of activities seen in the case firms alone. Similarly, the values of parameters are simple averages of the sample of 60 hosiery firms. Some of the behavioural constraints such as lower or upper bounds for the values of the decision variables represent the sample characteristics rather than the case firm. Hence, the solutions of the model yield results that can be generalised. In this sense, the whole exercise becomes an
evaluation of the utility of the model and its application to hosiery firms in general.

Further, the optimal solution is subjected to sensitivity analysis for possible variations in the values of the parameters; some of these changes may be policy based. This exercise relaxes the restrictions imposed by the assumption of certainty of value of parameters (single value expectation) of the conventional linear programming. Finally, the model has also the advantage of using conventional simplex or revised simplex method of solving the problems, and there is no need for any special computer program.

Limitations

There are a few important limitations for the study. First, it is a normative analysis using linear programming as the tool. Therefore, all the limitations of normative models apply to this study also. Further, Linear Programming Model and simplex method have their own restrictive assumptions and they are also applicable. The synthetic firm approach removes the difficulties in using actual situation of the selected case firms, yet the final solution may not be applicable to extreme cases among the sample firms for several reasons. First, the
values of the parameters of the model, the set of decision variables and the right hand side constants were based on the primary data collected from the sample firms. Mostly, sample averages were used, but averages are poor representatives when variances are large. This problem is taken care of by the sensitivity analysis and the use of mathematical expectation rather than simple averages.

As the primary data were collected by survey method, it may contain response error and a few omissions. This problem was solved by inquisitive personal interview method and a few cross checks provided in the enquiry schedule. The preference ordering of the goals is not fixed, it usually changes with the changes in the market conditions for the products, and inputs labour and raw materials, and government policies on taxation of products and inputs. Further, the market structure itself may change drastically forcing the firms to change their conduct. These changes have a high probability in hosiery because the market includes export potential (foreign buyer demand) also. However, these changes do occur only in the long run and the entire exercise in this study is concerned with short run (of one year) production decisions only. Thus, the study has several restrictive assumptions. Therefore, the validity of the results is evaluated by the probability of their acceptance by the
firms and it was done by analysing the response (acceptability) of sample firms to the suggestions of the model.

Organisation of Thesis

The thesis is organised into seven chapters as follows.

CHAPTER I - INTRODUCTION

The background of the problem focus, objectives hypotheses and scope of the study are presented.

CHAPTER II - CONCEPTS AND REVIEW

Past studies related to the objectives of the present study are reviewed and concepts are defined.

CHAPTER III - MATERIAL AND METHODS

The profile of the hosiery industry in India and in Tiruppur is briefly presented; sources of data and method of collection, tools of analysis and the programming model are described.
CHAPTER IV - PERFORMANCE OF THE INDUSTRY
The result of the analysis of industry wide secondary data for trend, cycle, seasonal variation and instability in production, sales and export are presented and discussed.

CHAPTER V - ECONOMICS OF HOSIERY PRODUCTION
The primary data were analysed to estimate the unit cost of production, resource use efficiency, capacity utilization and profit, size group wise. The results are presented and discussed.

CHAPTER VI - GOAL PROGRAMMING
The multiple criteria goal programming model was specified and solved for a representative firm. The results are presented to show scope for realising various goals of the firms.

CHAPTER VII- SUMMARY AND CONCLUSION
A summary of the work done is presented, conclusions are drawn and their implications for decision making by hosiery firms and policy makers are stated.