CHAPTER VII
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SUMMARY AND CONCLUSIONS

The hosiery industry in India has shown significant growth, especially in the recent years - not only in production but also in sophistication of production technology and export of its products. In the industry Tiruppur has a place of pride, with a significantly large share in the market for hosiery products. It is characterised by wide variation in size of enterprises and types of technology from slow hand knitting small units to large automated units. While the large units are successful in placing hurdles for the entry of similar sophisticated units, small units with their low productive, labour intensive technology show significant growth in number and market share. Consequently, the market for hosiery products of Tiruppur has the characteristics of differentiated oligopoly. For majority of the small enterprises their success in business demands careful decision making on size and composition of production; use of capital and labour at optimal level and combination. To them mathematical programming appears to be an useful tool for decision making because it allows for several constraints and specified goal. However, the conventional linear programming (LP) model is inadequate when the goal of
the enterprise is not unique: a maximizing or minimizing objective function. Even small hosiery units are observed to operate with multiple goals. A modification of LP is possible and it is goal programming model, that allows multiple goals and multiple constraints yet remains simple to use an iterative procedure of the simplex method. This study is interested to evaluate and demonstrate the use of the goal programming decision making by non-automated hosiery enterprises and to evaluate the performance of the industry in Tiruppur*.

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

*Hosiery industry in Tiruppur refers to the aggregate of all the hosiery enterprises located in Tiruppur of Coimbatore district, Tamil Nadu.
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.

Data

In Tiruppur, there are more than 6000 units. After conducting a pilot study, data are collected from 120 firms, selected by simple random sampling method from the list of all firms arranged in the ascending order of their installed capacity. The required information is obtained from the records of the selected firms and further supplemented by personal enquiry with the administrative heads of the units. Secondary data are also collected from the publications of the Association of Tiruppur Knitwear Producers for time series analysis of growth and instability in production and export. Thus, both primary and secondary data are useful.

First attempt is to analyse the trend in production and export of hosiery products from Tiruppur. With the help of time series data for 25 years from 1971 to 1995. The year 1971 refers to the financial year 1970-71 i.e., the period from 1st
April 1970 to 31st March 1971; similarly for other years. Primary data are collected from the sample hosiery units for the year 1994-95. The sample firms are in the ascending order of their installed capacity and classified into three size groups A, B and C. The group A is comprised of top 40 firms in the list and represents the small units. The next 40 firms constituted the group B, of medium size and the remaining 40 firms formed group C - the large firms. The groups were tested for the statistical difference among them in the size of installed capacity. The differences were all statistically significant and therefore, the groups were studied separately.

Model

The major thrust of this study was to help the hosiery firms in identifying the product mix that would satisfy their organisation goals. All the firms produced more than three varieties of products and their goals were not unique. Therefore, the decisions were to be made in multiproduct and multigoal context, with constraints in resource supply and market conditions. Necessarily, it was a normative analysis.

There are two mathematical programming approaches to tackle the problem with multiple objectives or goals, viz., (i) GP - Goal Programming and (ii) MOP - Multiple Objective Programming. The focus of this study suggested the choice of goal programming. The aim of goal programming (GP) is to minimize the deviations
between the achievement (realisation) of the goals and their aspiration levels. The goals are included in the model by adding positive \( (N_j) \) and negative \( (P_j) \) deviation variables to the goal equations. They allow for under-achievement and over-achievement of the goal respectively. It was first assumed and then verified in the field that the hosiery firms can explicitly define all the goals that are relevant to a planning situation. Further, it assumes not only that they can attach priorities to those goals but also in a pre-emptive fashion. In other words, the fulfilment of the goals in a specific priority, \( Q_j \), is immeasurably preferable to the fulfilment of any other set of goals situated in a lower priority, \( Q_i \). In LGP, higher priority goals are satisfied first - it is only then that lower priorities are considered. It is the model use.

Application of LGP is done for representative firms, one for each of the three groups, A, B and C earlier described. The representative firm is one that has installed capacity closely equal to the mean installed capacity of the twenty firms in the groups. A comparative study of the solutions of the three representative firms would show the differences if any between firms of different size (installed capacity) and that information will be useful to know the size effect on business performance. The goals were
1. Maximising after tax profit
2. Minimising use of borrowed fund
3. Minimising use of labour

Findings

The hosiery industry of Tiruppur has grown in number from 3,069 in 1975 to 4,830 in 1980 – a significant addition of 57.38 percent. Though the absolute number is steadily increasing and has reached 6,510 in 1995, percentage addition during the successive five year periods is falling. The time series aggregate data show faster growth of installed capacity than that of the number of enterprises. Thus, the growth of the industry is from the increase in both number of units and their average installed capacity. The value of capital use refers to the operation and maintenance (O and M) costs and also the book value of machines used up (i.e.,) depreciation. This includes cost of raw material, energy and value of fixed assets used in production. This value has increased from Rs.57.53 crores in 1975 to Rs.690.10 crores in 1995. There has been a steady increase in percentage additions the largest being seen during the Eighth Plan. The production of hosiery industry requires the use of human labour of various skills. The total number of persons of all categories on roll at the beginning of each year is taken as a measure of employment of labour. By the end of the Fourth Plan, the hosiery industry of Tiruppur provided employment to 51,120 persons and the employment increased in
both absolute and percentage terms in all the five-year period, to reach 7.81 lakh persons in 1995. Thus, hosiery production is labour intensive and any investment in it would contribute to the employment objective also.

Technological progress is measured by the degree of modernization of machines. Therefore, the percentage of value of recent investment (less than five years) to the total value of the capital stock is taken as a measure of technological progress. There is a steady uptrend in technological progress and most significantly during the Eighth Plan Period. That explains larger increase in capital use than labour use during that period. There was growth not only in absolute value but also in the rate of growth, so that the value of production (Rs.1922.57 crores) in constant prices was more than 10 times of the value in 1975. As the price variation has been excluded by the use of (1980-'81) constant prices the significant growth is a measure of a real output.

The export valued at Rs.27.28 crores in 1975 rose to Rs.326.45 crores in 1995, both valued at constant (1980-'81) prices and in Indian rupee value. Thus, export has provided an incentive for production. However, the domestic market also is no less important, because it absorbs nearly 80 percent of the growing production.
Thus, the performance of the hosiery industry is rated high in terms of member of enterprises, capacity expansion, capital investment, employment of human labour, technological progress production, export and domestic sales. The substantial increase in production is more due to capacity expansion, than the increase in the number of enterprise. The hosiery industry has responded to the policy stimuli of NEP favourably and successfully with gains to itself and to the country. Its employment benefit is felt locally. Further, the temporal variation in production and also in export of hosiery products of Tiruppur is secular rather than cyclical. Absence of cyclical variation does not however ensures stability in variables because random or irregular variation may be large.

The instability in production and export of hosiery industry of Tiruppur was studied with the help of Cuddy and Valle Index, separately for the period 1975-'90 and 1991-'95. It is seen that instability in both production and export is larger in the second period than in the first period and it is larger in export than in production in both the periods. Thus, the new economic policy has achieved growth with larger instability.

The modernisation of production through technological progress and the policy support of NEP have significantly
contributed to the rise in Capital productivity in hosiery industry of Tiruppur and compound growth rate in it works out to 2.64 per cent per annum. Similar results were seen in labour productivity also from Rs.6,510 per person in 1975 to Rs.19,250 per person in 1994; both at constant (1980-'81) prices.

Aggregate industry wide production function was studied. It shows hosiery industry of Tiruppur has good scope for a more intensive production. The pace of technological progress observed in the industry may help the cause. Therefore future scope for hosiery in Tiruppur is vast.

The results of production function analysis of primary data reveal much scope for improving economic efficiency in resource use. A comparative study of the performance of hosiery units of different sizes among themselves and with the performance of the industry as a whole shows that in every group and for the industry as a whole, the capital is used less than optimally. In labour use, a large scope is seen for the industry as a whole but little scope in small and medium size hosiery enterprises. There is increasing returns to scale in medium and large groups and industry as a whole, but there is constant returns to scale in small units.
The results of the LGP show that the small units gain by specializing in production of banians ($X_1$) with limited diversification to childrenwear ($X_6$), ladies nightee ($X_{11}$), and T-shirts for male ($X_6$). The medium sized hosiery units should pay attention to sales promotion to achieve sales of at least 40,000 pieces. In large units, there is scope for further expansion of production. But it would require sales promotion as at present sales limit production and capacity utilisation is not full.

The performance efficiency of the hosiery units in three size groups was compared with four specific measures viz.,

(a) capital productivity  (b) labour productivity
(c) capacity utilization and (d) the sales realization. It is seen that for the small hosiery units optimal plan has largest values of capital and labour productivity and better capacity utilisation and sales realisation but the capital labour ratio is marginally smaller. It means that optimal plan satisfies the goals set by the hosiery unit and priority ordering in them and improve performance efficiency of the unit, even while reducing capital intensity.

For the medium sized units, capital productivity ($\pi/k$), labour productivity ($\pi/L$) and factor intensity ($K/L$) increased
from existing plan to plan 3. The inference is that, by increasing the sales potential the medium sized hosiery units could steadily improve their performance efficiency. However, capacity utilisation and sales realisation were less. For large units, capital productivity and labour productivity declined, but the factor intensity, capacity utilization and sales realization improved significantly.

A comparative study of the three size groups shows that optimal plans presented opportunities to improve performance efficiency in all the groups but the gain was larger, larger the size of the units. This was in agreement with increasing returns to scale for medium and large units and constant returns to scale to small units.

An opinion survey of the sample respondents showed that 49.17 percent of the respondents readily accepted the plans as useful to them without any reservation while 39.17 percent of them accepted with condition. The conditions related to administrative problems only. Hence it may be concluded that the LGP model is really usable by the hosiery units. Studied size group wise acceptance rate was highest in the large units, followed by small units and medium units in that order. Therefore, the LGP model can be successfully used for decision making with multiple goals and defined priority ordering of them.
CONCLUSIONS

Above summary of findings were used to verify the empirical hypotheses of the study. The first hypothesis is that the temporal variation in production and export of hosiery products is secular rather than cyclical. The results of the trend analysis of production and export proved this hypothesis to be true. Production function analysis showed that there was constant returns to scale in small units, but increasing returns to scale for other groups; the profit rate \( \frac{\pi}{K} \) was significantly larger than unity and it increased with the rise in sales limit. Thus, the second hypothesis is also true. Technological progress comes through modernization of machines, computer application and even automation. However, the process is largely labour intensive, hence, labour use also increased. Thus, the third hypothesis that technological progress is biased towards capital use is found to be true as \( K/L \) ratio is larger than unity and it increased with the size of production.

The results show that hosiery units - big or small operate with multiple goals and multiple constraints including the limit to sales in general and of specific products. Thus, the decision making is really complex. This is the fourth hypothesis of the study and justifies the use of LGP.
The optimal decision models based on LGP were acceptable for majority of the hosiery units and for still larger number with some conditions related to administrative problems; they would require some help to accept the plans. Therefore, the fifth hypothesis is also verified to be true.

Thus, all the hypotheses stand verified and it leads to the conclusion that the complex problem of decision making in hosiery units can be successfully solved by the LGP model and the results are acceptable to the end users. The goal programming exercise yield plans that would improve performance efficiency of the hosiery units and will generate employment of labour, if the additional investment of capital can be mobilized. Uptrends in export and nearly 80 percent absorption in domestic sales even at highest level of production, less than full capacity utilisation are indicators of the scope for the growth of hosiery industry; that will provide an expanding market for the products. So, making investment in hosiery units will benefit the units and also the economy through its contribution to labour employment and export earnings.
Implications

Above results have few policy implications. They are stated below:

1. As there is an uptrend in production and export of hosiery units, it must be sustained to the benefit of the units and the economy. Most crucial requirements for this are capital and technology. The government policy must be to ensure adequate flow of capital and technology if need be, by foreign assistance.

2. There is an increasing returns to scale and large units are more efficient. Therefore the policy should be to encourage large units rather than small units. The cooperatives and corporate bodies (joint stock companies) must be encouraged for group action by desiring small investors.

3. Technology upgradation may be attempted by investment in research and development with government subsidy and tax holidays for it.

4. The hosiery units must be educated and supported with information and infrastructure (especially software packages) to encourage their use of LGP which is shown to yield results acceptable to them.