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APPROPRIATE TECHNOLOGY FOR THE PRODUCTION OF TEXTILES

EVALUATION OF APPROPRIATE TECHNOLOGY FOR TEXTILE PRODUCTION

Background Paper

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EVALUATION OF APPROPRIATE TECHNOLOGY FOR TEXTILE PRODUCTION IN A DEVELOPING COUNTRY

by

The National Industrial Development Corporation Ltd.
India

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PREFACE

Textile industry is one of the earliest industries to be set up in many developing countries. In the last three decades or so, there have been rapid and many-sided advances in the techniques of textile manufacture, so that choice of technology is difficult even at the purely technical or sectoral level. In actuality however, technology choice in developing countries will have to transcend sectoral considerations and be harmonised with the national macro-economic plans for development.

The present note attempts to analyse the relevance to developing countries of alternative technologies available for different stages of textile manufacture. Its scope is restricted to the main apparel fibres, cotton and manmade fibres. The discussion is primarily based on the profile of textile manufacture in India, where a wide range of technologies and scale of operations exist side by side. Nevertheless, the observations and recommendations should have a degree of generality.

CHAPTER 1 : APPROPRIATE TECHNOLOGY - HISTORICAL PERSPECTIVE AND CRITERIA FOR CHOICE

1.1 Introduction

The terms "appropriate technology", "intermediate technology", "low cost technology" and "informal technology" are often synonymously employed and have been topics of intense, if not entirely fruitful, debate in recent years. Since the discussion has semantic, philosophical, ideological and political overtones, a brief consideration of the factors that have thrown up this issue might help to form a better perspective.

1.2 Historical Background

Shortly after the Second World War, the developing countries, many of which had just become independent, embarked on a programme of industrial development. Industrialisation was meant to bring about a shift from total dependence on agriculture, to create large-scale employment and to generate all round economic progress.

The developing countries had hoped to accelerate the process of industrialisation by adopting the latest technologies which had been perfected and commercially implemented in the industrially advanced nations. Such an approach, it was felt, would help to avoid the slow trial and error route which the developed countries had followed and thus shorten the path towards economic prosperity, a feeling shared by the developed countries as well.

The experience with the transfer of technology from developed to developing countries has largely belied the original expectations. While it is true that the developing countries have progressed at the aggregate level in terms of the most commonly used measure of economic well-being, namely the Gross National Product, the "quality" or pattern of the progress has not been satisfactory. It has been observed in many of the developing countries that the introduction of the latest available technologies has served the interests of only a small, and mostly urban-based, segment of the population. The large rural masses have had little or no share in the fruits of development. Continued unemployment on a large scale in the rural areas and the attendant migration to urban centres have been the other side of the picture of industrialisation in the developing countries. The proven inadequacy of technology transfer in fulfilling the national objectives of developing countries has prompted a searching reexamination of the basic assumptions. This is the genesis of the concept of appropriate technology.

It is generally conceded that while the massive import of technology has not helped the developing countries in attaining economic prosperity, the fault as such does not lie in any technical deficiency of imported technology. This conclusion is fairly obvious since these technologies have withstood the test of technical, economic and commercial viability in the countries of their origin. But they do not, or cannot, serve equally well when transplanted in a new environment.

This brings us to the question of "appropriateness". Obvious as it may sound, it is useful to keep in mind that appropriateness is not an immutable feature. The appropriateness of a technology for instance cannot be delinked from considerations such as appropriate when, to whom or for what purpose. In other words, appropriateness shifts in time and space, governed by the conditions locally operating and it will be unreasonable to expect a universally appropriate technology.

The experience of the developing countries with the latest imported technology can be analysed against this background. Scarcity of capital resources, particularly of foreign exchange, is a common feature in most of the developing countries. Moreover, one of the main objectives of industrial development in these countries is employment generation on a vast scale. On the other hand, the latest technologies are labour displacing since they have been designed to counter the labour scarcity and the consequent high labour cost in developed countries. The high degree of automation in the newer technologies has resulted in an increase in the capital requirements. In retrospect, it is not really surprising that such capital-intensive, automated and labour displacing technologies should have turned out to be broadly unsuitable to the developing countries, where the requirements are in general diametrically opposite.

Apart from the unfavourable capital/labour components of the advanced technologies, there have also been other factors inhibiting a successful working of these imported technologies in the developing countries.

While the core of a technology might be the machinery, an efficient utilisation of technology requires also several other peripheral factors of which technical skill, organisational and managerial support, infrastructural facilities for transport, communication and storage, and the availability of appropriate raw materials are the most important. The machinery can be imported relatively easily but the supporting facilities are more difficult to establish and maintain. The lack of such facilities has been an equally important factor in deciding the suitability of imported technologies in developing countries.

1.3 Criteria for Choice

If the most advanced technologies are not necessarily the most suitable for the developing countries, the question arises: what are the constituents of an appropriate technology? The foregoing considerations indicate that there can be no general set of criteria, but that the constituents will vary from industry to industry and from country to country.

The term "Appropriate Technology" connotes a choice and hence the existence of alternative technologies, not more scientific possibilities but commercially established. This may not be a given condition in all industries. For instance, there is practically no choice in technology in oil drilling or nuclear energy although such situations are rare. On the other hand, an industry such as textile offers a host of established technologies amongst which a choice can be made.

Relative availability of capital and labour is a major factor in the choice of technology. Allied to this is the available capability to absorb and assimilate the chosen technology.

National objectives will also have a bearing on the choice of technology. Broad-based enhancement of the standards of living, employment generation; development of regional or special markets; prevention or minimisation of migration from rural urban areas - some or all of these might be the desired goals. It may also be necessary to rank the objectives in the order of importance if they cannot all be simultaneously fulfilled.

Hence, from a national point of view, a spectrum of technologies rather than a single technology is likely to be the appropriate choice without any a priori elimination of advanced technologies. Moreover, the choice of a technology mix is not a rigid, once-for-all process. As conditions and requirements change, so will the technology base and the adoption of a given technology should be considered as a transitional stage. The long term objective should be to replace imported technologies gradually through development based on internal innovative skills. Thus there does not appear to be any valid reason for the reservation expressed in some quarters that rejection of the latest technologies by the developing countries on the ground of inappropriateness would tend to perpetuate, if not enlarge, the technological gap between the developed and the developing countries and to saddle the developing countries with inefficient and obsolete technologies.

In the above discussion, the term "developing countries" has been used to distinguish a group of countries which have certain common features. It is, however, important to bear in mind that there is a considerable amount of diversity among the countries of this group, diversity in the current stage of development, and in the relative availability of labour, capital, skills etc. The developing countries span a wide range from capital-surplus and labour-scarce nations such as the oil producing states to capital-scarce and labour-abundant countries such as India. Obviously, a general treatment of developing countries is not possible. The following chapters are in respect of low income/labour surplus countries with India as an example.

CHAPTER 2 : THE TEXTILE INDUSTRY

Production of yarns and fabrics is one of the earliest occupations known to man. As civilisation advanced, more refined techniques of fabric manufacture came into vogue and the scale of operations increased. In fact, the industrial revolution was ushered by two developments connected with textiles : Hargreave's spinning Jenny and Arkveright's Water Frame.

2.1 Textile Manufacture as an Industry

The textile industry has all along shown distinct product specialisation with separate segments for different fibres such as cotton, wool, flax, silk, jute etc. Of these, the cotton sector has a world-wide significance and has hence been singled out for a detailed discussion in what follows.

In the last two centuries, textile industry has undergone several changes in technology and in organisation. Nevertheless, almost every country has preserved till today the traditional techniques of fabric manufacture and embellishment. However, with very few exceptions the older methods are nurtured mainly as a national heritage and do not have any significance in terms of volume of production.

The pace of technological developments has been particularly rapid after the Second World War. The arrival of manmade fibres on the textile scene necessitated technological changes in the industry which had till then been processing the natural fibres such as cotton, wool, flax and silk.

General development in other areas has also had an impact on the textile industry. The emergence of other industries which offered higher wages and better working conditions tended to wean the labour force away from the textile industry. As a result, the more recent developments in the textile industry have been in the direction of higher production rates, increasing automation and reduction in the labour complement. Textile industry has thus largely lost its character of labour intensiveness and has become a capital intensive sector. The ratio of labour cost to the total cost of production has steadily decreased, while capital investment per work place has correspondingly risen. An idea of these changes can be had from Table 1.

TABLE 1 : CAPITAL INTENSITY IN COTTON SPINNING AND WEAVING

(a) Spinning : Production 570 kg/h of carded yarn 34s Nm.

		1950	1960	1968	1971	1974
1.	Number of spindles	29,600	25,200	19,600	19,600	19,600
2.	Investment in Machinery, Buildings and Services (Million Swiss Francs)	8.6	12.6	12.7	19.9	21.7
3.	Number of operatives per shift	98	64	44	32	26
4.	Capital Investment per Physical working place (Thousand Swiss Francs)	88	197	288	622 1200*	835 1400*

* For open end spinning

(b) Weaving (including Preparation and Cloth Inspection)

Production : 3250 m^2/h

Grey Fabric Width 90 cm

26 Reed and 26 Picks; Warp and Weft 34s Nm

Productions in the spinning and weaving models are balanced

		1950	1960	1970	1974
1.	Number of Looms	900*	248**	226**	226**
2.	Investment in Machinery and Services (Million Swiss Francs)	14.5	16.9	24.9	36.5
3.	Number of Operatives per Shift	219	72	68	62
4.	Capital Investment per Physical Working Place (Thousand Swiss Francs)	66	235	366	588

* Shuttle Looms

** Shuttleless Looms

SOURCE : U. Hartmann,

"The Growing Capital Intensity of the Textile Industry and its challenge to Management"

Cotton and Allied Textile Industries, 1975, Vol. 16, p.33.

2.2 Textile Industry in Developing Countries

A few of the developing countries have well established textile industries of long standing. Others have given a high priority to setting up a textile industry in their national plans for industrial development. Because of its traditional labour intensiveness and relatively low capital investment requirements, the textile industry was considered as a favourable avenue for employment generation. Since, a number of these developing countries also produce significant quantities of cotton raw material supply was assured. Consequently, a sizeable spinning and weaving capacity has been created in the developing countries in the last couple of decades. As can be seen from Table 2, the proportion of cotton type spindles in the developing countries increased from 14.7% in 1950 to 37.4% in 1975. Similarly, the number of looms increased from 16.2% to 34.5% in the period from 1952 - 1975.

TABLE 2 : COTTON SYSTEM SPINDLES IN PLACE

Million Spindles

	1950	1965	1975
Developed Countries	86.7 (70.3)	63.4 (48.7)	49.9 (33.6)
Developing Countries	18.1 (14.7)	34.7 (26.6)	55.6 (37.4)
Socialist Countries	18.6 (15.0)	32.2 (24.7)	43.0 (29.0)
World Total	123.3 (100.0)	130.4 (100.0)	148.6 (100.0)

COTTON SYSTEM LOOMS IN PLACE

Thousand Looms

	1952	1965	1975
Developed Countries	1 757 (64.4)	1,321 (48.7)	959 (32.8)
Developing Countries	441 (16.2)	655 (24.1)	1,008 (34.5)
Socialist Countries	532 (19.4)	737 (27.2)	956 (32.7)
World Total	2,730 (100.0)	2,713 (100.0)	2,923 (100.0)

Figures in parentheses indicate percentages

SOURCE : International Cotton Industry Statistics (various volumes) IFCATI

Many of the developing countries depend on the developed countries for supply of machinery. The level of technology varies from country to country but is generally lower than that in advanced countries.

2.3 Textile Industry in India

India has a long and rich tradition in textile manufacture and is considered as the birth place of cotton textiles. The use of starch for sizing and of vegetable and mineral substances for colouration was widely known well before the Christian era. Special ornamentation techniques such as tie and dye and resist printing had been perfected. In more recent times, the Dacca muslins, calicoes and chintzes were world-renowned and highly prized. The manufacture was in the hands of master artisans with the knowledge and skill being passed down from generation to generation.

First the industrial revolution and then the political subjugation of India by the British caused severe setbacks to the traditional textile manufacture. Progressively severe restrictions were placed on the production and export of muslins and calicoes to England. The mechanisation of textile manufacture within India itself added to the travails of the cottage textile industry.

Textile manufacture on an industrial scale started in India in the middle of the nineteenth century. The statistical details of the Indian textile industry upto the end of the Second World War are given in Table 3.

TABLE 3 : INDIAN COTTON TEXTILE INDUSTRY 1860 - 1946

Year	Number of Mills	Number of Spindles (Million)	Number of Looms (Thousand)	Yarn Production (Million kg)	Fabric Production (Million Metres)		
					Mills	Hand-Looms	Total
1866	13	0.3	3.4	n.a.	n.a.	n.a.	n.a.
1901	178	4.8	4[illegible].5	25[illegible].9	n.a.	n.a.	n.a.
1911	233	6.1	85.8	283.5	n.a.	n.a.	n.a.
1921	249	7.3	133.5	314.6	1,307	1,052*	2,359*
1931	314	9.1	175.2	438.2	2,249	1,244*	3,493*
1941	396	10.0	200.2	715.3	3,548	1,509*	5,057*
1946	423	10.4	202.[illegible]	62[illegible].6	3.868	1,253*	5,221*

n.a. = Not available; * Estimated

SOURCE : Indian Cotton Textile Industry Centenary Volume 1950
Indian Cotton Textile Industry (Various Volumes)

In the first few decades, the industry had concentrated on spinning coarse yarns and there was a lucrative yarn trade with China and Japan. Fabric finishing was virtually unknown; grey fabrics were exported to Lancashire and re-imported in the finished form. The industry was also not in a position to meet the home demand, although fabric imports declined from 62% of the total consumption in 1901 to 15% in 1936 with a corresponding increase in production within the country.

The history of the Indian textile industry is closely interlinked with the national movement for independence. The rivalry between the Lancashire and the Indian textile industry resulted in the imposition of protective tariffs against Indian textiles and of measures to counteract the competitive advantages India had by way of cheap labour. These steps had an impact going beyond the economic sphere; they were viewed in India as expressions of political dominance and were met with calls for the boycott of foreign, specifically British textiles in India.

The resulting Swadeshi movement triggered off an increased fabric production in India. In one sense it also marked the beginnings of the Khadi (hand spun - hand woven textiles) movement, although Mahatma Gandhi, the main advocate of Khadi, viewed it in a much broader perspective. According to him the resurgence of the spinning wheel in Indian villages "has nothing to do with machinery or the propaganda for boycott of foreign cloth. It is purely and simply a question of the economic condition of the Indian masses"[1].

The outbreak of the Second World War witnessed a further growth in the Indian textile industry. With India serving as an operational base in Asia for the allied powers, the textile industry was called upon to meet the sizable military requirements and domestic consumption had to be curtailed.

Textile Industry in Independent India

The partioning of the sub-continent in 1947 seriously dislocated the textile industry. A substantial portion of the cotton-growing areas

1 Young India, 1922

went to Pakistan while most of the cotton textile manufacturing capacity remained within the Indian territory.

Each of the young independent nations had to take steps necessary to stabilise its textile industry - India had to increase cotton cultivation and Pakistan had to augment her textile manufacturing capacity.

The Government of India had also decided as a policy measure to encourage the small scale sector. The measures taken in pursuance of this policy included (a) reservation of selected products solely for the decentralised sector (saris, dhotis, bedsheets, etc., of certain counts and/or using coloured yarns); (b) fiscal incentives for setting up decentralised units; (c) preferential treatment in excise duty in case of yarn supplied to, and fabrics produced by the decentralised sector; (d) restrictions on the use of filament yarn by the organised sector and on yarn exports to assure regular raw material supply to the decentralised sector; and (e) establishment of agencies for the general promotion of these sectors (e.g., Khadi and Village Industries Commission, and Handloom Development Corporation).

As a consequence of this policy, there has been a pronounced growth in the production of woven cloth by the decentralised sector and the number of spinning mills which supply yarn to this sector (see Table 4). The early 1950s also saw the beginnings of production of manmade fibres (regenerated cellulosics) in India and this led to the establishment of a section of decentralised sector concerns with weaving, the so called art silk

TABLE 4 : INDIAN COTTON TEXTILE INDUSTRY: 1950 - 1976

Year	Number of Mills			Number of Spindles (Million)	Number of Looms ('000)	Yarn Production (Million kg)	Fabric Production (Million Metres)		
	Spinning	Composite	Total				Mills	Powerloom & Handloom	Total
1950	94	268	362	10.5	191.5	533	3,351	911	4,262
1955	116	292	408	12.0	202.7	740	4,658	1,620	6,278
1960	186	293	479	13.5	200.3	788	4,616	2,013	6,629
1965	253	290	543	15.4	206.5	939	4,587	3,056	7,643
1970	366	290	656	17.7	208.3	965	4,157	3,692	7,849
1975	403	288	691	18.9	206.9	989	4,032	4,002	8,034
1976	409	289	698	19.5	207.7	1006	3,881	4,064	7,945

SOURCES : (i) Handbook of Statistics on Cotton Textile Industry

(ii) Indian Textile Industry Annual (Various Volumes) sector. The advent of other Manmade fibres - polymides and polyesters - in later years resulted in an increased production of blended yarns and fabrics and also in the introduction of modern knitting machines, albeit on a small scale.

In the last 15 years or so, the Indian cotton textile industry has been subjected to severe strains and a large number of mills were on the verge of closedown. The reasons for the shift in fortunes are complex and a detailed discussion of the factors is beyond the scope of the present discussion. The Government felt compelled to intervene to avoid large scale unemployment that the closure of mills would have caused. The National and State Textile Corporations constituted during this period have taken over the sick mills. The number of mills under Government control today is well over 100. Several measures have been initiated to rejuvenate the sick mills.

A glance at the structure of the textile manufacturing industry in India today brings out several characteristic features. Firstly there is the segmentation of the industry into different organisational groups : the organised sector comprising of mills which can be further sub-divided into private sector, public sector and co-operative sector; then the decentralised sector consisting of hand spinning, hand looms, power looms (including, art silk looms), knitting, chemical processing, etc. Within each of the sectors, the individual units span a wide spectrum in respect of size, output, turnover, technical competence, and to some extent the level of technology.

The textile industry in India is, by and large, yet to adopt the most recent technological developments. Although India has a sizable textile machinery manufacturing industry, the production is generally restricted to "conventional" technology and machinery incorporating the most modern advances has to be imported. In view of the high cost of imported machines and the high levels of import duty, imported technology becomes prohibitive for most mills, although individual mills with specialised production pattern may find one or the other imported technology attractive. This situation is likely to continue until the more sophisticated machinery is manufactured in India.

It can hence be said that advanced technology is not suitable for a large section of the Indian textile industry even if considerations are restricted to the narrow economic aspects. The upkeep and operation of the modern machinery is also likely to pose problems in many mills, although there are a sufficient number of units with the necessary competence and skills.

At the same time, the productivity levels in the organised sector are low, even when allowances are made for the overall level of technology, and low machine utilisation as a result of raw material shortages, power cuts and labour unrest. The more important factor is the old and obsolete machinery in many mills. Modernisation is an urgent need of the textile industry. However, modernisation in the Indian context does not imply a switching over to more advanced technologies. Replacement of machines that are in poor mechanical shape or renovation, i.e., conversion of existing machines for higher productivity is a more realistic and feasible approach.

The decentralised sector is even more heterogeneous. It is important to bear in mind that the definition of the decentralised sector is largely based on the scale of production and does not always take into consideration the technological factors. Thus, in the knitting sector, there are warp and circular knitting machines which represent a fairly high level of technology. Similarly, between the organised and power loom sectors, there is no basic difference in the level of technology.

At the other extreme, the decentralised sector continues to employ techniques which have remained unaltered over decades if not centuries. Hand spinning, hand weaving, block printing are some of the typical examples. Hence it would be erroneous to broadly equate the decentralised sector in India with "outmoded" technology.

[illegible], the various segments of textile manufacture play an important role in the economy of India. With annual yarn and fabric production of around 1000 million kg and 9000 million metres respectively, India has one of the [illegible] textile manufacturing capacities in the world. Textile manufacture provides direct employment to several million persons and plays an important role in the Indian economy.

The following chapters contain an account of the technologies currently employed by the different segments.

CHAPTER 3 : TECHNOLOGY OF SPINNING

3.1 General Level of Spinning Technology

For the greater part of this century, the spinning operation was characterised by a number of separate processes with material handling between the successive stages. Developments in spinning technology in the last two decades eliminated some of the material handling and introduced an element of automation; direct chute feeding to cards and automatic doffing at ring frames are two examples of this type of development. The general trend towards higher productivity rates has asserted itself in spinning technology as well. Speed increases of 400% and more have been achieved on machines such as cards and draw frames. The ring frame productivity has also registered an increase, though to a relatively modest extent of about 30%. The adoption of mechanical and electronic devices has helped to maintain product quality despite the higher machine speeds and has in fact actually resulted in reducing the number of preparatory stages.

However, the most striking development in spinning technology has been the evolution of radically new methods of yarn formation such as open end spinning, self-twist spinning, and twistless spinning. These technologies use unconventional methods for imparting twist to the yarn or rely on methods other than twisting to provide inter-fibre cohesion.

As a result, the inherent limitations to higher speeds encountered in ring spinning have been bypassed and appreciable increases in spinning productivity have been possible. Of these, open end spinning has been accepted quite widely on a commercial scale. A total of about 0.9 million open end spinning units (equivalent to approximately 2.4 million ring spinning spindles) are working at present in different parts of the world.

3.2 Spinning Technology in India

As discussed in Chapter 2, there has been a considerable increase in the number of spinning mills in India since 1950. At present, the spinning mills have a share of 37% of the total spinning capacity in India. Of the total of 413 spinning mills, 50 are cooperative enterprises formed by cooperative societies of either weavers or cotton growers.

A large number of the spinning mills are located in South India, in and around the city of Coimbatore. The spinning mills are relatively small in size; nearly 35% have a capacity of 12000 spindles or less. The composite mills on the other hand are larger and have an average capacity of 43,000 spindles.

Production of blended yarns of cotton, viscose and polyester has steadily increased over the years. The volume of production of blended yarns in 1975 was 40.5 million kg. or 14.5% of the total.

The rising popularity of blends and the availability of indigenous long staple varieties of cotton have also led to a gradual but perceptible shift towards finer counts. Counts finer than 40s Ne (English cotton count) represented 12.5% of the total production in 1976 as against 6.9% in 1961.

The above changes in the raw materials or pattern of production have been absorbed without any major shifts in technology. The general level of technology in India can perhaps be best denoted as intermediate. Developments such as semi-high or high production carding, high speed draw frames, speed frames and ring frames have been adopted to varying extents. However, the more recent innovations such as chute feeding, automatic doffing and open end spinning have yet to find their way into the Indian industry.

India is self-reliant in conventional spinning machinery. On the other hand, machinery incorporating the latest technological advances such as open end spinning machinery has to be imported. The cost of imported machinery outweighs the advantages of these developments in terms of higher productivity, lower wage costs or improved product quality. As an example, a techno-economic comparison of ring spinning and open end spinning is given in Table 5.

It is seen that the relative economic viability of open end spinning diminishes steadily as the count becomes finer. There is also the further uncertainty, whether this technology will be suitable for the Indian cottons which have a high content of impurities and foreign matter.

TABLE 5 : COMPARISON OF RING AND OPEN END SPINNING

Daily Production 5400 kg. of Carded yarn

	10s Ne		16s Ne		20s Ne		28s Ne	
	Ring spinning	Open end spinning	Ring spinning	Open end spinning	Ring spinning	Open end spinning	Ring spinning	Open end spinning
Total Investment[1] (Million Rupees)	10.78	23.57	13.61	37.37	18.20	58.03	22.43	70.40
Conversion Costs[2] (Rupees per kg)	0.63	0.35	0.88	0.59	1.06	0.92	1.33	1.08
Annual Profits after Tax (Million Rupees)	1.95	2.16	2.17	2.39	2.39	2.50	2.57	2.75
Simple Payback Period[3] (years)	5.5	10.9	6.3	15.6	7.6	23.2	8.7	25.6

1 Inclusive of investment in spinning preparatory machines

2 Labour and power

3 Gross investment divided by annual profit after tax

3.21 Technology of Hand Spinning

The spinning wheel or Charkha, which became a symbol of self-reliance and the fight for independence, has continued to flourish in independent India. Approximately 0.5 million spinning wheels are in operation today with a total cotton yarn production of about 5 million kg. per year. Much of this yarn is in the coarse count range and produced in regions scattered all over the country.

In the mid 1950s a new technology of hand spinning, the Ambar Charkha, was introduced. This machine incorporates the essential features of a conventional ring frame and has 2-6 spindles per unit. The Khadi and Village Industries Commission has taken the initiative in the refinement and propagation of the Ambar Charkha. A total of about 0.1 million Ambar Charkhas with 0.5 million spindles are in operation today and produce about 6 million kg. of cotton yarn. The counts spun on the Ambar Charkha are limited to approximately 20s Ne. A set of preparatory machines which are essentially scaled-down adaptations of the mill technology have also been designed for the Ambar Charkha sector. One set of preparatory machines can feed about 25 Charkhas. The hand spinning sector provides employment to around 0.7 million persons. As of today, yarns spun on the Ambar Charkha are poorer in quality compared to those produced in spinning or composite mills. Lack of trained workers, and deficiencies in the design of the machines are two of the major causes for the low quality of hand spun yarns. It should be possible to overcome these drawbacks. The Ambar Charkha has the potential for employment generation with low capital investment. A comparison of the productivity, labour employment and capital requirements of the different spinning technologies is given in Table 6.

Such a comparison presupposes that the product of each of the technologies is comparable at least in a limited range. As indicated above this assumption is not warranted at the present time. Design improvements for the Ambar Charkha for improving yarn quality for instance are bound to increase the cost of the Charkha to a certain extent but the over-all capital requirements per work place are still likely to be lower than in the other technologies. A provision for operation of the Ambar Charkha by power will no doubt increase its productivity considerably, though this measure may not be feasible on a large scale immediately.

The model of centralising the pre-spinning operations adopted by the Khadi and Village Industries Commission deserves a closer look since it offers the possibility of combining the advantages of large scale and small scale operations. In the operation of spinning, the stages upto the roving frame can be conveniently and economically operated on a large scale. Here, the mill technology with higher productivity rates and adequate control of product quality appears to be more efficient. The final stage of spinning can be decentralised, with each of the spinning units consisting of one or more manually operated Ambar Charkhas. Such an arrangement does impose restrictions on the physical location of the individual spinning units vis-a-vis the central preparatory unit. The implications of

TABLE 6 : COMPARISON OF ALTERNATIVE TECHNOLOGIES FOR SPINNING

Count : 20s Ne, Carded 1000 kg/day

	Number of Spinning Units	Investment Rs. Million*	Employment Persons	Average Wages Rs. per month	Labour Cost Rs./kg.	Capital Cost per Worker Rs.	Capital Cost per kg.**
Box Charkha	11,100	2.85	11,600	125	58.00	245	1.97
Amber Charkha	12,500	2.08	2,600	125	13.00	800	1.43
Ring Spinning Frame	2,400	3.37	28	500	0.58	1,20,000	2.32
Open End Spinning Machine	800	10.75	10	550	0.24	10,75,000	7.41

Single shift working in Box Charkha and Amber Charkha.

Three shift working in ring and open end spinning.

* Inclusive of investment in spinning preparatory machines.

** Computed by dividing the investment, discounted at the rate of 16% over 10 years, by the annual production.

material transport between the nucleus plant and the satellite spinning units need to be studied in detail. This arrangement will require other facilities for efficient functioning. Provision should be made for machinery maintenance and supply of spare parts. Proper training to the operatives of the Ambar Charkha should also help in enhancing the productivity and quality.

There has been a recent proposal to introduce manmade fibres into the hand spinning sector. This scheme is meant to broaden the product range of Khadi textiles and takes into account the increasing popularity of manmade fibres, particularly of polyester, in India. A more serious examination of the various aspects of the scheme is called for. The likely demand for Khadi blended textiles will have to be assessed against the background of the high price of polyester fibres in India and the relatively high cost of production in hand spinning. Secondly the yarn quality would assume far more importance with the more expensive manmade fibres; waste levels and the proportion of sub-standard yarn will have to be kept to a minimum. Moreover since the hand-spun blended yarn will be processed subsequently in the decentralised sector, the availability of required facilities in weaving and finishing require to be carefully examined. The rough and natural texture of Khadi textiles has a novelty appeal that cannot easily be matched by mill-made textiles. A planned and imaginative promotion of such features of Khadi textiles both in domestic and export markets might bring fruitful results.

CHAPTER 4 : TECHNOLOGY OF FABRIC PRODUCTION

As in case of spinning, developments in fabric manufacture have had raising productivity levels as one of the main objectives. A noteworthy development is the loss in dominance of weaving as a fabric manufacturing technology. Knitting has asserted itself as a viable alternative technology for manufacture of outerwear. Fabric manufacture without the intermediate stage of yarn formation has become a reality. Stitch bonding techniques, which can be viewed as a combination of knitting and weaving, have further extended the range of fabric manufacturing technologies. Knitting and stitch bonding offer production rates which are well above the levels which the conventional shuttle loom is capable of.

4.1 Weaving Technology

Larger package sizes, electronic process and product monitoring, and engineering refinements of machine parts for higher speeds are some of the prominent features of modern machines in the preparatory stages (winding, warping and sizing) of weaving. Operating speeds in these stages have increased manyfold.

After several decades of relative stagnancy, the loom has undergone radical changes in the last two decades or so. The conventional automatic loom developed in the early years of the present century held sway with only marginal changes in design. Alternative methods of weft insertion developed during the early 1950s brought shuttleless looms into the picture. Once the need to propel a heavy shuttle across the warp sheet was obviated, limitations on loom width and speed were eliminated. The most modern shuttleless looms operate at weft insertion rates of about 700 metres/min. with fabric widths of 330 cm. Still higher production rates are being aimed at in some of the new technologies such as multiphase weaving; however these are yet to be commercially accepted.

4.2 Weaving Technology in India

4.21 Mill Sector

The recent developments in weaving preparatory have been introduced in Indian mills to a relatively larger extent than the developments in weaving itself. Automatic warp and pirn winding machines, high speed warping machines and multi-cylinder sizing machines have been installed in a fairly large number of mills. Many of these machines are manufactured indigenously in collaboration with machine manufacturers in industrialised countries.

On the other hand, weaving in the organised sector continues to be preponderantly on non-automatic shuttle looms which have remained unmodified in design for several decades. Of a total of approximately 2,08,000 looms in the mill sector in India, roughly 80% are non-automatic looms, and the rest are mostly conventional automatic shuttle looms. Very recently, a small number of shuttleless looms have been installed by some mills. The proportion of non-automatic looms is very high in India even if the comparison is restricted to the developing countries. For instance, Hong Kong (100%), Pakistan (81%), Egypt (78%) and Brazil (4%) all have a substantially higher proportion of automatic shuttle looms.

The conventional automatic loom does not facilitate higher production rates. Its major advantage over the non-automatic loom is in the reduction of labour complement. For example, one weaver can be put in charge of 48 automatic looms as against 4 or 6 looms of the non-automatic type. In consequence, the labour cost per unit volume of production is reduced. The second advantage of automatic looms lies in the higher quality of output resulting from various control and monitoring devices which these looms are fitted with.

Despite these demonstrated benefits, the Indian mill industry has not introduced automatic looms on as large a scale as some of the other developing countries. The primary reason is that a changeover to the conventional shuttle automatic looms is not viable for many mills. Automatic looms of Indian manufacture are priced three to five times higher than equivalent non-automatic looms. The general level of yarn quality in Indian mills does not permit the allocation of more than 16 automatic looms per weaver. As a result, the advantages of reduced labour costs/unit output are not commensurate with increased investment. While this analysis reflects the overall situation, automatic looms have been found to be appropriate and economically viable wherever fabric quality (absence of weaving defects) is a major criterion as in fabrics meant for exports or in high-priced fabrics.

The second-generation automatic shuttle looms and the shuttleless looms become even less attractive economically because of the still higher investment costs and the liklihood of added costs in spinning and weaving preparation to provide yarn of the required quality.

The results of a techno-economic analysis of alternative weaving technologies in the Indian scene are reproduced in Table 7.

TABLE 7 : TECHNO-ECONOMICS OF ALTERNATIVE SYSTEMS OF WEAVING IN THE ORGANISED SECTOR

	Type of Looms			
	Non-Automatic	Conventional Automatic	High Speed Automatic	Shuttle-less
Total Investment[1] (Million Rupees)	3.5	33.4	41.6	67.1
Conversion Costs[2] (Rupees per Metre)	0.65	0.64	0.61	0.60
Annual Profits after Tax (Million Rupees)	2.4	3.1	3.3	3.6
Simple Payback Period[3] (Years)	1.4	10.8	12.8	18.6

The values are based on an annual production of approximately 11 million metres of cotton fabric 48 x 25 reed/picks/cm; 36s (Ne) in warp and weft.

1 Inclusive of investment on weaving preparatory machines

2 Labour, power, and accessories

3 Total investment divided by annual profit after tax

In spite of its relative superiority under the present circumstances, the non-automatic loom can be improved in several ways for added efficiency. Some of the more important features of automatic looms such as the warp stop motion, individual drive and floating swells can be advantageously incorporated into the non-automatic loom. There is also scope for an increase in speed of the non-automatic loom. Developmental activity along these lines has largely been completed at the Ahmedabad Textile Industry's Research Association, Ahmedabad, and it is expected that non-automatic looms of an improved design will be shortly available to the industry. These changes should help in improving the technology of the non-automatic loom without upsetting its economic advantages.

4.22 Decentralised Sector

Accurate information on different aspects of the decentralised sector such as production capacity, volume of production, and employment are difficult to come by since there is no regular data collection. The figures mentioned in the following sections are therefore estimates available from different governmental and other agencies.

Power Loom Sector

There are approximately 0.2 million power looms in India working on cotton yarns, with an annual output of roughly 1800 million metres. The state of Maharashtra and the towns of Malegaon and Bhiwandi in particular, have the largest number of power looms.

In terms of technology, this sector is hardly distinguishable from the mill sector; the looms in the power loom sector are almost identical in design to non-automatic looms installed in mills. Therefore, power looms can produce the same range of fabrics as the mill sector. The major differences are in the scale of operation and in the organisational set-up.

The units are small, with an average 4 to 20 looms per unit. Very few of them have facilities for pre-weaving activities. They procure yarn from mills, warp yarn in the form of sized beams and weft yarn in packages. Pirn-winding is carried out within the units themselves or through contractual arrangements. Similarly, the units have to depend on outside establishments for fabric finishing. The common mode is that traders acting as intermediaries purchase cloth from the power loom units and arrange for further processing as well as marketing. This system has given rise to a sizable small scale sector in fabric finishing, an aspect which will be discussed in the next chapter.

Art Silk Sector

As the name implies, this sector is concerned with the weaving of art silk or manmade fibre fabrics and is a comparatively recent entrant in the decentralised sector. Established in the early 1930s with imported viscose rayon as raw material, this sector received a boost in 1950s and 1960s when plants were set up in India, first for the production of regenerated cellulosics and then of other manmade fibres.

The art silk sector today has a capacity of 1,11,000 power looms which are basically similar to the looms in the mills or in the cotton power loom sector and adapted in details for weaving manmade fibres. The industry uses both cellulosic and synthetic fibres and produces a variety of textiles of which shirtings, sarees and dress materials are important items.

There is a noticeable geographical concentration of this sector. The state of Gujarat has 48,000 looms (or 43% of the total) most of which are situated in the town of Surat. Three other states, (Maharashtra, Karnataka and Punjab) account for another 46% of the capacity in this sector.

Most of the art silk weaving units are small with 1 to 6 looms. There are only 3 units in the country with more than 300 looms each. The size distribution of the units in Gujarat as obtained in a sample survey is shown in Table 8.

TABLE 8 : SIZE DISTRIBUTION OF ART SILK WEAVING UNITS IN GUJARAT

Number of Looms	Number of Units	% of Total
1 - 6	3970	83.2
7 - 24	618	13.0
25 - 50	110	2.3
51 - 100	46	1.0
101 and above	25	0.5
	4769	100.0

The smaller units produce only grey fabrics; a few of the larger units have their own facilities for dyeing and printing. A group of separate chemical processing units have come up which cater to finishing requirements of manmade fibre fabrics and also frequently take over the marketing function.

Handloom Sector

Handloom weaving has a long tradition in India and is the oldest of all the sectors. The design of handlooms and the process of hand weaving have remained essentially unaltered over decades or even centuries. It is estimated that there are 3.5 million handlooms in India, spread all over the country. This sector provides employment to several million persons. Both throw-shuttle and fly-shuttle looms are in operation. The states of Andhra Pradesh, Uttar Pradesh and Tamil Nadu together account for about 45% of the total number of handlooms. In the north-eastern regions of India, handlooms are employed largely to meet the domestic consumption of one or a small number of families and there is hardly any production for commercial purposes.

The output of handlooms is around 2300 million metres per year, which is roughly 25% of India's total fabric production. The main items of production are sarees, dhoties, shirtings, furnishings, and other items of household linen, with a fair amount of product specialisation amongst the different regions. Handloom fabrics and garments have a significant place in India's textile exports as well; their share in the total value of exports in 1976 was around 30%.

Handlooms draw their supply of yarn from spinning mills in the form of hanks. A considerable amount of yarn bleaching and dyeing is carried out in the hank form, again on a small scale. The need for fabric finishing is relatively less in handloom fabrics compared to powerloom fabrics.

The small scale of operations constitutes one of the major strengths of handloom weaving. Short runs can be handled without any loss in efficiency or increase in cost or waste. Therefore hand weaving lends itself well to the production of fabrics with woven colour patterns. At the same time, the manual operation does impose several limitations on the product range. Fabrics wider than about 150 cm are difficult to weave on handlooms, as are fabrics with a high thread density in warp or weft. There is no inherent limitation to the range of yarn counts that can be used; nevertheless because of the difficulties in producing a dense fabric, only yarns of coarse and medium counts are employed.

There has been a vigorous cooperative movement in the handloom sector and nearly half the total number of handlooms are at present in the cooperative fold. The cooperative societies provide centralised services in raw material procurement, financing, and marketing, and have gradually replaced the "master weaver" who had traditionally discharged these functions.

Comparison of Technologies

The various technologies of weaving have been compared with respect to production rates, investment and employment potential (see Table 9).

TABLE 9 : COMPARISON OF ALTERNATIVE TECHNOLOGIES FOR WEAVING

Production 20000 Metres per day

	Number of Looms	Investment Rs. (Million)*	Employment Persons	Average Wages Rs. per Month	Labour Cost Rs. per Metre	Capital Cost per Worker Rs.	Capital Cost Rs. per Metre#
Handloom	3300	3.96	4900	175	1.72	800	0.14
Power Loom (Cotton)	255	1.28	1600	300	0.32	850	0.04
Non-automatic Loom (Mill)	222	2.63	370	500	0.12	7100	0.09
Conventional Automatic Loom	239	11.73	261	550	0.10	45000	0.40
High Speed Automatic Loom	169	16.36	223	550	0.08	73500	0.56
Shuttleless Loom	53	24.18	102	600	0.04	237000	0.83
Power Loom (Art Silk)**	416	10.4	586	600	0.70	17750	0.36

Single shift working in handlooms

Three shift working in others

* Inclusive of investment in weaving preparatory machines

** Not comparable with the other technologies because of product differences

\# Computed by dividing the investment, discounted at the rate of 16% over 10 years, by the annual production

There are inherent limitations to an analysis of this type, since the product ranges of the various sectors differ markedly from one another. As mentioned earlier, handloom fabrics have a relatively low thread density and are produced from coarser yarns. At the other extreme, the art silk sector produces light-weight fabrics, employing fine yarns and a high thread density. The power loom and organised sectors cover the entire range. Hence a comparison on the basis of a common product is rendered difficult. Moreover, if fabrics with elaborate coloured patterns are considered, the manufacturing costs in the mill sector will rise considerably. The results should hence be viewed mainly as broad indicators.

4.3 Knitting Technology

4.31 General Level of Technology

One of the most striking developments in fabric production in the last decade has been the growth of knitting technology as an alternative to weaving. From a technology traditionally restricted to the production of underwear, foundation garments, and sportswear, knitting has emerged as a serious competitor to weaving (see Table 10) in the manufacture of ladies' and men's outerwear.

TABLE 10 : PERCENT OF KNITTED FABRICS TO OVERALL FABRIC PRODUCTION

	1960	1970
Industrialised Countries	6.1	17.9
Developing Countries	4.6	8.0
East European Countries	0.9	1.8
	5.0	12.0

SOURCE : Study on Textiles L/3797 GATT, Part I - 21

Several factors have been responsible for the growth of knitting technology. Firstly, there has been the increasing use of manmade fibres in the form of normal and texturised filaments and knitting can handle these without difficulties. Secondly, preparation of yarn for knitting is less elaborate than for weaving, and hence comparatively shorter runs are economical in knitting and the technology can respond better to the rapidly changing demands of the fashion trade. Lastly, knitted fabrics are more elastic because of their structure and have better easy-care properties than woven fabrics.

The recent advances in knitting technology show the same basic features as in spinning and weaving. Improved design features of knitting machines permit much higher production rates, particularly in warp knitting. Highly sophisticated electronic devices are a common feature especially for patterning on circular knitting machines. There have also been attempts to increase the versatility of knitting machines so that products such as pile fabrics, men's suitings, and furnishings which were once reserved for weaving, can be knitted today.

In spite of these trends towards higher production, automation and complexity of design, knitting technology is relatively more labour intensive than weaving technology.

4.32 Knitting Technology in India

Knitting in India has all along been a small scale or even cottage industry. For this reason, accurate and reliable statistical information is hard to come by. It has been estimated that there are about 5000 knitting factories in India manufacturing cotton, woollen and synthetic fibres. A total of about 100,000 people are employed by the industry either directly in knitting or in the associated operations of bleaching, cutting, making-up, etc[1]. The Indian knitting industry uses a wide variety of machines, as can be seen from Table 11.

Most of the factories are small, with 1 to 10 machines per unit. There is also a somewhat pronounced regional product specialisation. Cotton hosiery units are concentrated mostly in the states of W. Bengal and Tamil Nadu and the woollen knitting units are in Punjab. The knitting units processing manmade fibres are located in Maharashtra, particularly in Bombay.

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1 K. Sreenivasan and Indira Doraiswamy
"Survey of the Knitting Industry".
The South India Textile Research Association,
Coimbatore, 1973.

TABLE 11 : ESTIMATED NUMBER OF KNITTING MACHINES OF VARIOUS TYPES

Particulars of Machines	Number of Machines
1. a. Sock knitting machines (Hand operated)	9,000
b. Sock knitting machines (Single cylinder)	1,500
c. Sock knitting machines (Double cylinder)	350
2. Flat knitting machines (Mostly hand driven)	8,550
3. Circular knitting machines	26,450
4. Warp knitting machines	844

SOURCE : J. G. Parikh,
"Knitting in India",
Manmade Textiles In India, 1977. Dec.

The knitting sector consumes 30 million kg. of cotton yarn per annum and about the same amount of manmade fibre yarn.

The knitting sector needs to replace its machinery, a large part of which is old. Lack of finance, reluctance on the part of owners to diversify and modernise, and difficulties in procuring new machinery appear to be the major factors impeding modernisation.

The simpler type of knitting machines are produced in India. However, the knitting machinery manufacturing industry is also fragmented and machine quality is below par. Greater attention needs to be paid to make appropriate choice of raw materials and fabrication techniques, closer adherence to specifications, and interchangeability of parts. Modern knitting machines (warp and circular) have to be imported at present and the high cost puts these machines beyond the reach of many knitting units.

Very few of the knitting units have qualified technical staff. Being small, the units find it uneconomical to recruit qualified supervisors. Added to this, is the dearth of qualified knitting technologists in India.

Similarly, more extensive facilities are required for operative training. The level of mechanisation in knitting is relatively high and even a simple knitting machine is more complicated in design and construction than for instance a non-automatic loom. Hence availability of trained operatives and technologists assumes importance.

Comparison of Knitting Technologies

Information on investment requirements, production rates, and employment for different knitting technologies is given in Table 12.

A comparison of alternative technologies is even more difficult in knitting than in weaving since product differentiation is more pronounced. Sock knitting and hosiery manufacture are quite distinct from flat, circular or warp knitting of outerwear. Within the latter group, flat knitting differs from the other two in that it employs much coarser yarns. The figures given in Table 12 should hence be interpretted within those limitations.

TABLE 12 : COMPARISON OF DIFFERENT KNITTING TECHNOLOGIES

	Machine Cost Rs.	Production Rate kg./ Machine-shift	Employment Persons/ Machine-shift	Average Wages/ Month Rs.	Wage Cost per kg. Rs.	Capital Cost per Worker Rs.	Capital Cost per kg. Rs. **
Sock knitting (Power operated)	1,00,000	1.4	0.75	400	8.33	44,400	17.52
Flat knitting (Manual)	2,000	8	2	250	2.50	1,000	0.17
Flat knitting (Power driven)	3,000	10	2	300	2.40	500	0.07
Circular knitting	20,000	20	0.6	400	0.50	11,100	0.25
Circular knitting (Jacquard)	68,000	20	0.6	400	0.50	37,800	0.83
Warp knitting	5,00,000*	70	1.5	500	0.43	1,11,100	1.75

Single shift working in manual flat knitting.

Three shift working in others.

* Inclusive of warping machine.

** Computed by dividing the investment, discounted at the rate of 16% over 10 years, by the annual production.

CHAPTER 5 : TECHNOLOGY OF FINISHING

5.1 General Level of Finishing Technology

Since finishing is primarily concerned with enhancing the visual and ornamental appeal of textiles, it has to respond, more than any other branch of textiles, to the constantly changing demands of fashion and taste. The introduction of manmade fibres has been accompanied by new dyes, auxiliaries and machinery, specially suited to them. Similarly, the growing popularity of knitted fabrics initiated special finishing techniques such as jet dyeing. Cotton finishing has also undergone significant changes to meet the stiffening competition from manmade fibres. Wash and wear and durable press finishing of cotton fabrics have been developed in an attempt to match the easy-care performance of manmade fibres. The increasing concern about fire hazards of textiles and pollution has resulted in legislative measures for safety. These steps have in turn catalysed new developments in finishing of which fire retardant finishing, solvent processing, and transfer printing are some major examples.

As in case of the technologies of yarn and fabric manufacture, finishing technology has also undergone changes towards higher speeds and elimination of intermittent processing. Continuous bleaching and dyeing have been widely accepted. Machine speeds in many of the finishing operations have also substantially increased with the result that the total time required for fabric finishing is far less than it was a couple of decades ago.

5.2 Finishing Technology in India

5.21 Organised Sector

Finishing in the organised sector was introduced much later compared to spinning and weaving. As mentioned in Chapter 2, there was a considerable volume of export of yarn and grey fabric in the early decades of the existence of the Indian textile industry. The integration of operations came about mainly as a result of the call for boycott of foreign textiles.

A large number of the composite mills have their own processing facilities; in addition some of the spinning mills carry out yarn bleaching and dyeing on a limited scale. In recent years, there has been an appreciable increase in the volume of finishing, particularly in dyeing and printing, as can be seen from Table 13.

TABLE 13 : FABRIC FINISHING IN THE ORGANISED SECTOR (Million Metres)

Year	Bleached	Dyed	Printed	Mercerised	Sanforised	Other Chemically processed
1960	1,784	750	590	n.a.	n.a.	n.a.
1965	1,736	890	777	713	323	49
1970	1,799	1,228	1,088	811	430	100
1975	1,807	1,264	1,134	744	314	76
1976	1,702	1,193	995	883	390	89

n.a. Not available

SOURCE : Handbook of Statistics on Cotton Textile Industry 1977, ICMF

Most of the mills process only their own fabrics; processing of fabrics produced in other mills is not common, even though surplus machine capacity is generally available. Large and independent process houses with modern machinery, which buy cloth for finishing or undertake contract finishing are a relatively new phenomenon in the Indian textile industry. The number of such units is, however, steadily increasing.

The organised sector has been quicker to introduce the more recent developments in finishing compared to spinning and weaving. Some of the recent developments such as high pressure continuous bleaching, jet dyeing and rotary screen printing are in regular use in a number of mills. The value added in finishing being substantially greater than in spinning or weaving, a versatile range in finishing enhances the profitability of mills. This consideration perhaps explains the relatively quick adoptions of the more recent developments. The textile machinery manufacturing industry in India has also been prompt in arranging for the indigenous manufacture of several modern machines.

The introduction of manmade fibres - particularly of the non-cellulosics has had a major impact on finishing. The cotton-type machinery in spinning, weaving and knitting can be used for manmade fibres or blends with little or no modifications. On the other hand, finishing of fabrics from manmade fibres or blends calls for vastly different technologies and chemicals, because of the basic differences in the physical and chemical properties of these fibres. This transition has been accomplished with relative ease by the organised sector.

Product runs are comparatively short in dyeing and printing. An average composite mill in India produces around 50,000 metres of fabric per day. This total production is fragmented into several different sorts in finishing, with the result that lot runs of 5000 metres or less are not uncommon in dyeing and printing. This production pattern should, strictly speaking, rule out the use of high speed machines which are most advantageous in processing long runs. All the same, such machines are in operation in the mills either because they enhance the product quality or because they extend the range of finishing styles. Such considerations are no doubt important in catering to the export or fashion markets.

5.22 Decentralised Sector

The traditional styles of dyeing and printing have been preserved over several centuries and there are several centres in different parts of the country specialising in one technique or the other. The decentralised sector has also extended its range of operations: fibres other than cotton are handled; almost the entire class of dyes available are used; and roller and screen printing have been added to block printing.

Very little finishing is done on handloom fabrics; bleaching and dyeing are carried out on the yarn itself prior to weaving. Each of the other sectors in decentralised fabric production - power loom sector, art silk sector, and knitting sector - has more or less its own finishing sector, specialising in the particular type of fabric. Finishing units for knitted or manmade fibre fabrics are situated in or near the centres of fabric manufacture; in contrast the units handling power loom cotton fabrics show a wider geographical dispersion.

Ahmedabad, Rajkot, Jetpur (in the state of Gujarat), Jaipur, Jodhpur and Pali (in the state of Rajasthan) are the major centres for cottage scale dyeing and printing of power loom fabrics. The city of Ahmedabad provides an interesting contrast. There are around 65 mills in the city, many of which have their own process houses. Side by side, there is a flourishing and reasonably large cottage-finishing sector for block and screen printing.

In terms of volume of production, the sector for power loom fabrics is the most important. With the exception of dhoties, the entire production on power looms is dyed and/or printed. This sector can best be discussed with the example of Jetpur.

Example of Jetpur

Jetpur is a small town with a population of about 55,000 and situated about 250 kilometers south-west of Ahmedabad. Nearly 80% of the working population in the town is directly or indirectly connected with cottage scale finishing.

There are around 500 units in Jetpur for dyeing and printing, most of which concentrate on screen printing of saris. A number of dyes - reactives, naphthols, indigosols, and rapidogens - are used for printing; the volume of printing with each of these dye classes naturally changes from time to time depending on market demands.

Much of the printing is on a contract basis; traders place orders on the basis of printed samples prepared by the units, supply the bleached fabric and undertake marketing. A few of the bigger units buy the fabric and sell it on their own after printing.

Each unit prints on an average 150 saris or approximately 750 metres per day. Thus the annual volume of production (assuming 300 working days in a year) for all the units taken together works out to around 100 million metres, which is roughly 10% of the volume of printing in the organised sector (see Table 13). This is a remarkably high figure for a small town.

An average-size factory has three printing tables and employs eight to nine people working in groups. Wages are on a piece rate basis and the average daily earnings of a printer are roughly Rs.20/- which compare favourably with those of a printer in a mill.

Runs are generally short: The print length for each design is normally around 500 metres and 4 to 5 different colour combinations are used in each design. As such the run for each design and colour combination is around 100 metres. Such a small scale of operation will be manifestly uneconomical in the organised sector. The designs are fairly intricate; on an average there are 6 to 8 colours in each design. The printing coverage is quite high. The quality of printing is generally satisfactory in terms of clarity and wash fastness.

The units have been set up with very little capital expenditure. In addition to printing tables, which are the major equipments, the units have very simple gadgets for steaming. Printed fabrics are dried in air and washed in the nearby river. Washing, pressing and folding are carried out by separate groups working for a number of units.

The printing units have formed an association of their own which acts as their spokesman, takes part in arbitrations between printers and trades and arrangesfor the supply of dyes and chemicals which are scarce.

The vigour and growth of the decentralised printing sector in Jetpur are indeed praiseworthy. However, the development appears to have been carried beyond the optimum level already. For instance, the town is facing a severe water pollution problem; even the ground water seems to be affected by the continuous discharge of effluents in open spaces over a prolonged period. Availability of skilled workers is becoming increasingly difficult and wage levels are rising. It would be desirable to take these factors into account in planning for development of similar centres elsewhere.

Comparison of Technologies for Printing

The alternative technologies for printing have been compared in respect of various socio-economic aspects and the results are reproduced in Table 14.

TABLE 14 : COMPARISON OF ALTERNATIVE TECHNOLOGIES FOR PRINTING

Production 50,000 Metres/day

	Number of Machines	Investment Rs. Million*	Employment Persons	Average Wage per Month Rs.	Labour Cost Rs. per Metre	Capital Cost per Worker Rs.	Capital Cost Rs. per Metre**
Hand Screen Printing	-	2.00***	600	350	0.17	3,300	0.03
Roller Printing (6 colours)	3	1.80	63	400	0.02	28,600	0.02
Flat Bed Screen Printing							
(a) Semi-automatic (indigenous)	18	8.28	486	450	0.16	17,000	0.11
(b) Fully automatic (imported)	12	14.40	216	450	0.08	66,700	0.20
Rotary Screen Printing							
(a) Indigenous	2	4.40	60	475	0.02	73,300	0.06
(b) Imported	3	12.00	90	475	0.04	1,33,300	0.15

Single shift working in hand screen printing

Three shift working in others

* Cost of rollers/screens not included

** Computed by dividing the investment, discounted at the rate of 16% over 10 years, by the annual production

*** Cost of tables

The problems in comparing different technologies are less severe in case of printing than in case of spinning, weaving or knitting. Although the various methods differ with respect to styling possibilities, intricacy of pattern, clarity etc., there is an adequate common ground for comparison. It is seen that hand screen printing compares favourably with the other technologies in terms of labour cost. The advantages of hand screen printing will be even greater in short runs, as mentioned earlier. This technology is also labour intensive. It should, however, be noted that space requirements for hand screen printing are considerably higher than for other techniques. The cost of land and building will add to the capital requirements; these have not been included in the present analysis because they vary significantly from region to region.

CHAPTER 6 : GARMENT INDUSTRY

6.1 World Garment Industry

In contrast to other branches of the textile industry, the garment industry has undergone relatively less technological changes, and continues to rely on a large and skilled labour force. Much of the advances in the clothing industry have been in the nature of improved material handling techniques and streamlined sequencing of operations for enhancing labour productivity.

The garment industry in the developed countries went through a phase of rapid expansion in the 1950s and early 1960s. Since then, the pace of growth has slackened appreciably. On the other hand, the 1960s and 1970s have been a period of remarkable growth in the clothing industry of the developing countries as a whole, as can be seen in Table 15.

Concurrently, there has been a pronounced increase in the export of made-up garments from the developing to the developed countries, with Hong Kong, South Korea, India and other Asia accounting for a major share.

6.2 Garment Industry in India

Garment-making as an organised activity is yet to strike deep roots in India. The industry came into existence during the Second World War in response to the demand for military uniforms and subsequently switched over to catering to the civilian needs. However, in the 1950s and early 1960s, garment-making was more or less at the cottage industry level. Between 1963 and 1970, a number of large and medium scale factories were set up, primarily as a result of the expanding international trade in garments. The schemes introduced by the Government of India for the promotion of garment exports served as a stimulus to the growth of the garment industry.

TABLE 15 : TOTAL CLOTHING PRODUCTION BY MAIN AREAS 1961-70

Thousand Units

		Woven	Index Numbers 1961=100	Knitting (Excluding Hosiery)	Index Numbers 1961=100	Total	Index Numbers 1961=100
Industrialised Countries	1961	2,353,300	100	3,194,300	100	5,547,600	100
	1965	2,852,800	121	3,994,100	125	6,846,900	123
	1970	3,038,600	129	4,018,100	126	7,056,700	127
Selected Developing Countries[1]	1961	180,900	100	212,700	100	393,600	100
	1965	276,700	153	355,900	167	632,600	161
	1970	608,400	336	805,400	379	1,413,800	359
Selected East European Countries[2]	1961	79,800	100	160,500	100	240,300	100
	1965	122,500	154	228,400	142	350,900	146
	1970	183,300	230	379,600	237	562,900	234
Total above	1961	2,613,900	100	3,567,500	100	6,181,400	100
	1965	3,245,800	124	4,578,400	128	7,824,200	127
	1970	3,834,300	147	5,203,100	146	9,037,400	146

1 Woven clothing - Republic of Korea, Hong Kong, Colombia, El Salvador, Egypt and other Asia

Knitted Clothing - Republic of Korea, Hong Kong, Egypt, Portugal and other Asia

2 Romania and Poland

SOURCE : Study on Textiles, GATT L/3797, 1972, p. I-38.

Comprehensive information is lacking on the capacity, production, employment and other aspects of the Indian garment industry. It has been estimated that approximately 0.5 million persons are engaged by the industry. Available data have been analysed to obtain an indication of the size of the garment-making units (see Table 16).

TABLE 16 : DISTRIBUTION OF GARMENT-MAKING UNITS IN INDIA ACCORDING TO SIZE

Number of Machines	Number of Units	Percentage of Subtotal
Less than 10	26	8.5
11 - 50	137	45.1
51 - 100	73	24.0
101 - 500	60	19.8
Above 500	8	2.6
Sub-Total	304	100.0
Data not available	286	
Total	590	

SOURCE : Indian Clothing Directory 1977
The Clothing Manufacturers Association of India, Bombay

Capacity utilisation in the Indian garment-making industry is relatively low, amounting to an overall average of 65% (single shift) according to a survey carried out in 1970-71[1]. Generally speaking, the smaller and medium units have higher capacity utilisation as also the units con-

1 M. Narayanaswamy and V. Sri Ram
The Garment Industry in India, 1972
Economic And Scientific Research Foundation, New Delhi

concentrating on exports.

The garment industry represents a combination of a fair degree of mechanisation and labour intensiveness. For instance, the investment on machinery required for a unit with a capacity of 500 garments per shift at a level of technology fairly common in India today will be approximately 0.35 million rupees. Such a unit will provide 120 work places so that the investment per work place will be around Rs.3,000. On a cottage industry level, the investment per work place will be even less; each pedal operated sewing machine costing approximately Rs.800/- will employ one person. In such a set up, centralised facilities for button-holing, overlocking etc., will have to be provided so that the total investment per work place may work out to around Rs.1,500/-.

The labour productivity in the Indian garment-making units is lower than that in other, particularly the Western, countries. Units employing manually operated sewing machines have an inherent limitation in respect of labour productivity. Streamlining of the operations and a systematic adoption of industrial engineering techniques should be of help in increasing the labour productivity. Despite the lower output per worker, India enjoys distinct cost advantages over the Western countries because of the lower wage level.

6.21 Garments in India's Textile Exports

A major factor in the accelerated growth of the Indian garment industry has been the favourable conditions in the world market. The share of readymades in India's textile exports has steadily risen in the last few years (see Table 17). Nearly 30% of the output of the garment industry is exported. Shirts, ladies' dresses and blouses, are the major items of export. The garments are made mostly out of woven cotton fabrics with handloom fabrics accounting for about 50%. Here then is an example of two decentralised sectors of an industry jointly playing a major part in international trade.

TABLE 17 : GARMENTS IN INDIA'S COTTON TEXTILE EXPORTS

Year	Value of cotton textile exports (Million Rupees)	
	Apparel and Manufactures	Total
1970	293.5 (22.5)	1301.8
1971	365.2 (28.9)	1263.4
1972	528.9 (30.5)	1736.7
1973	827.3 (31.2)	2653.3
1974	1572.4 (42.3)	3720.6
1975	1618.3 (52.3)	3095.8
1976	3185.5 (53.4)	5968.0

Figures in parantheses indicate percentages

SOURCE : Handbook of Statistics on Cotton Textile Industry, 1977, ICMF, Bombay

The garment industry can improve its export performance further if certain basic constraints are removed. As mentioned above, export is almost solely restricted to cotton garments. The industry is unable to compete in the international market in the field of garments from manmade fibres or blends because of the high price of such fabrics in India. Selective import of fabric or fibre exclusively for re-export in the garment form is a possible step for expanding garment export, which offers sufficient protection to the indigenous fibre manufacturing industry. Non-availability of fault-free fabrics in adequate lengths is another factor which has prevented the industry from entering the more remunerative dress-shirt market.

While rising demand in the international market has stimulated the growth of the Indian garment industry, reliance on exports has also been somewhat of a handicap to the industry. The uncertainties of the international quota system as part of the Multi-Fibre Agreement come in the way of an expansion and long term planning. Moreover, since exports are largely restricted to cotton garments, there are marked seasonal fluctuations with the demand slackening in winter. These two factors account in a large measure for the relatively low capacity utilisation in the industry. A sizable and assured domestic market which would provide the necessary cushioning is yet to be built up by the garment industry.

6.22 Garment Industry and the Domestic Market

It is surprising at first glance that, in a country of India's size, the garment industry does not have a broad-based and large domestic market. The industry at present has only a very small share of the internal market and, according to one estimate, meets no more than 2% of the domestic clothing requirements. Admittedly, the dress patterns, with the saris and dhotis predominating, are one of the causes. But the most important factor operating against a widespread acceptance of readymade garments is that they are more expensive than garments made to measure by tailors. The price differential is of such a magnitude that it offsets the advantages that readymade garments offer: convenience; improved design features and finish and incorporation of better quality accessories such as thread, interlinings, etc.

Although the garment industry enjoys the advantages of larger scale production owing to bulk buying of fabrics, less waste and lower costs of production, the cost benefits instead of reaching the consumer, tend to be eroded in the distribution channel. Overheads, cost of packing, freight and retailer's margin add up to 40 to 50% of the final garment cost and tilt the balance in favour of tailor-made garments.

Most units prefer to meet the demand in large cities. Since the factories are located in or near the metroplotian cities, this policy appears rational in that freight costs are reduced. Moreover, tailoring charges in the cities are higher than in rural areas and this helps to make ready-made garments more competitive vis-a-vis tailor-made articles. Lastly, the urban population is also more fashion-conscious and places a higher premium on the style and design features of readymade garments.

Children's wear is another outlet which is being increasingly taken over by the garment industry. The fabric requirement per garment is very low in this sector and hence sub-standard fabric pieces available only in short lengths but at a discount can be profitably used to produce children's garments. The cottage level industry, which enjoys lower labour costs, is particularly active in this area. Children's garments are probably the only sector patronised by almost all income groups.

There appears to be a vast potential for further growth in the garment industry. Higher labour productivity and, more importantly, changes in the distribution system should bring down the cost of the readymade garments and help the industry in penetrating the domestic market deeper. A greater demand would in turn pave way for higher capacity utilisation in the bigger units and bring down the costs further.

The present limitations of the small scale sector could be overcome by a modified structure in which a cluster of small stitching units operate in combination with a common unit for bulk procurement of fabric and accessories and centralised cutting. The feasibility of such a structure needs to be explored.

There is a wide variation in the per capita consumption of textiles amongst the various regions of the world, reflecting in the main the differences in affluence and standards of living, and in part at least differences in climatic conditions. The consumption figures for 1970 are shown in Table 18.

TABLE 18 : PER CAPITA FIBRE CONSUMPTION IN 1970

	Per Capita fibre consumption (kg)
DEVELOPED COUNTRIES	
Western Europe	12.7
North America	20.5
Other Developed Countries*	13.6
Oceania (Developed)	17.9
SOCIALIST COUNTRIES	
U.S.S.R.	13.3
Eastern Europe	12.5
China	1.9
DEVELOPING COUNTRIES	
Asia and Far East (Excluding Japan)	2.3
Africa (Excluding S.Africa)	1.9
Latin America	4.3
Middle East (excluding Israel)	4.7
Total World	6.0

* Japan, South Africa, Israel

SOURCE : FAO, Rome (Publication, May 1972)
as given in
Integrated Programme for Cotton Research and Development (INT/71/0321)
Report to the Administrator, Vol. III

A striking feature of the consumption pattern in recent years is the erosion of the position of cotton as the major fibre. Non-cellulosic synthetic fibres have steadily penetrated the market held by cotton so long. This shift is most prominent in the developed countries; over the period 1960 - 70, the share of cotton in the total fibre consumption fell from 68% to 49% while that of the non-cellulosic synthetic fibres increased from 9% to 32%, in spite of the research efforts to increase the competitiveness of cotton and intense promotional activity. A similar trend, although less pronounced, is apparent in the developing countries as well.

The world demand for textiles will increase, in response to growths in population as well as incomes. Several projections in this respect are available, two of which are reproduced in Table 19.

TABLE 19 a : WORLD-WIDE FIBRE DEMAND

	1976-1990 Growth per annum %			Additional Fibre Demand Million Tonnes	
	Population	Income	Fibre Demand	All Fibres	Synthetic Fibres
Developed Countries	0.8	3.8	2.4	5.0	4.8
Socialist Countries	1.4	5.4	4.0	5.9	4.4
Developing Countries	2.5	7.6	5.0	6.8	5.6
Total	1.9	4.9	3.6	17.7	14.8

SOURCE : Manmade Fibres - Future Patterns in Growth and Technology
M.H. Winger, Jr.
Cotton and Allied Textile Industries (IFCATI)
Vol. 18/1977.

TABLE 19 b : GLOBAL FIBRE PRODUCTION

(Million Tonnes)

	1970	1980	1990	2000
Cotton	12.0	13.0	14.5	15.0
Wool	1.5	1.7	1.7	1.8
Cellulosic	3.5	3.7	3.7	3.7
Non-cellulosic	4.6	12.7	24.6	37.3
Total	21.6	31.1	44.5	57.8

SOURCE : IFCATI

As given in
Marketing of Textiles until the Year 2000
A. Engelsman
Future Perspectives for the Textile Industry
Ahmedabad Textile Industry's Research Association
Ahmedabad (1975)

According to these estimates, the global fibre consumption will nearly double in the next two decades. The current trend of non-cellulosic synthetic fibres increasing their share in the total fibre consumption is expected to continue; non-cellulosics will account for 54% of the aggregate consumption in 1990 and 65% in 2000.

The projections are based on several assumptions and their accuracy will depend on how far these assumptions come true. Even so, the broad directions indicated by these forecasts should hold good and be of help in planning in terms of production capacity and choice of technology for the future.

Increases in domestic consumption and shifts in consumer preferences are two considerations in planning. Changes in the pattern of international trade may also have to be taken into account. A reference was made earlier to the rising wage costs in the developed countries and to the progressive diversion of the labour force from the textile to other industries. If these factors continue to operate, it is conceivable that textile manufacture will increasingly shift to countries which still enjoy advantages of low wage costs. If such a relocation occurs, as it already has to some extent in the garment industry, exports of textiles from the developing to the developed countries will rise further. The requirements of the export market will then become an added criterion in the choice of technology in the developing countries.

Forecast of Textile Demand in India

The per capita availability of textiles in India has been declining over the last few years. From about 15.6 metres in 1970, the per capita availability came down to 13.7 metres in 1976. The per capita availability of cotton cloth reduced by approximately 2.2 metres over this period, accounting for practically the total drop, and that of blended and manmade fibre fabrics remained steady around 2 metres.

Higher durability of fabrics from manmade fibres and blends has been cited as one reason for the drop in textile consumption. It has also been suggested that other consumer items such as household appliances have moved ahead of textiles in the competition for a share in the disposable income. Both these explanations have some validity, particularly in respect of consumer preferences in urban and semi-urban areas. However, inadequate purchasing power, specially in the rural areas, is the single important reason for the low level of textile consumption.

The sixth Five Year Plan seeks to reduce unemployment and accelerate economic development in rural areas. It is hence to be expected that the downward trend in per capita textile consumption will be arrested and reversed.

On the basis of postulated growths in income and population, different studies have been made to forecast the textile consumption in India. The results of some of these studies are summarised in Table 20. It is seen that the projected requirements vary substantially depending on the basic set of consumptions. The most optimistic estimates presage an increase in consumption of over 200% by the end of this century; according to the more conservative estimates, per capita consumption will increase by 20 to 40% in the next 20 years or so. No significant changes in the relative consumption of manmade fibres are foreseen, although this situation is likely to change if the requisite quantities of cotton are not available.

On the basis of the least optimistic estimates, the aggregate textile requirements in 2000 to meet domestic consumption and exports will be around 16500 million metres which represent an increase of around 75% over the production in 1976.

TABLE 20 : ESTIMATES OF TEXTILE CONSUMPTION IN INDIA

(per capita consumption in metres)

Source	1982-83		1983-84		1985		1990		2000	
	Cotton Textiles	All Textiles	Cotton Textiles	All Textiles	Cotton Textiles	All Textiles	Cotton Textiles	All Textiles	Cotton Textiles	All Textiles
National Commission On Agriculture[1]										
High	-	-	-	-	20.0	-	-	-	40.2	-
Low	-	-	-	-	31.9	-	-	-	24.3	-
Textiles Committee[2]	-	-	13.2	15.4	13.5	15.[illegible]	-	-	-	-
ATIRA[3]										
High	-	-	-	-	13.7	16.4	14.5	17.5	17.0	21.1
Low	-	-	-	-	12.9	15.3	13.1	15.5	13.5	16.1
Planning Commission[4]	-	17.2	-	-	-	-	-	-	-	-

1 Report of National Commission on Agriculture (1976) Part III
As given in : Productivity Trends in Cotton Textile Industry in India
National Productivity Council, (1976), New Delhi

2 Report on Income and Price Elasticities for Textiles
Textiles Committee, Government of India (1977)

3 Forecast of Textile Requirements
Ahmedabad Textile Industry's Research Association (ATIRA)

4 6th Five Year Plan
Planning Commission, Government of India

These quantitative and qualitative aspects of future requirements become the backdrop for considerations of technology choice. Textile manufacture in India, traditionally and almost exclusively confined to cotton, will have to equip itself to handle an increasing quantum of manmade fibres. Technologies such as knitting which are particularly suitable to manmade fibres are likely to gain importance. Conversely, technologies that are basically unsuitable for, or inefficient in, processing manmade fibres will need to be modified.

These technological considerations have to be integrated with the overall national objectives in evolving a strategy for development. A number of action areas for this purpose are discussed in the next chapter.

CHAPTER 8 : CONCLUSIONS AND RECOMMENDATIONS

As seen in the earlier chapters, vastly different technologies exist side by side at almost all stages of textile production in India. This evolution has been moulded by history, tradition, economic forces and social conditions. The two sectors - organised and decentralised - are interdependent and have a rightful place in the Indian economy.

The organised sector has the advantages of low labour cost per unit volume of production and better coordination of individual operations, arising out of its technology and process integration respectively. The size of the unit and scale of operations also confer on the organised sector significant marketing and financial strengths. On the other hand, the technology of the organised sector is relatively capital intensive and offers fewer employment opportunities.

The new technologies which are highly capital-intensive and labour-displacing cannot be socially justified; nor are they economically viable for the majority of the mills in the organised sector. This situation is likely to persist as long as factors such as, parity of capital and labour costs, quality expectations, and technological adaptability remain unchanged.

While it appears that conventional technology will dominate in the organised sector in the foreseeable future as well, it needs to be more efficiently utilised and modified for increased productivity, reduced costs, and improved quality. Simultaneously, there is a case for selective adoption of advanced technology to meet the needs of special markets within and outside the country.

The decentralised sector in India apart from holding a major share in fabric production, fulfills the important social objective of providing employment. It has the advantage of being better equipped to handle small volumes of production. Therefore, its strengths are in products or markets where short runs of distinctive designs are in demand. Forging of closer local linkages between production and consumption will add to the viability of this sector. Because of the favourable capital/employment ratio, the decentralised sector has social attractions

The non-integrated nature of operations and the small size of the units pose several technical and organisational problems in the decentralised sector. In an integrated mill, the operations of spinning, weaving and finishing are carried out under one management and most often in the same premises. A coordination of the activities in each of the sections is possible for maximum efficiency and quality. The decentralised sector on the other hand is restricted to one in a series of manufacturing stages. The small size of units in the decentralised sector makes them particularly vulnerable to market fluctuations. Lacking the organisational, financial or marketing strengths of the bigger units in the organised sector, these units are the hardest hit when there is a shortage of raw material or a fall in demand for the fabric.

Lack of flexibility in handling different varieties of yarns and fabrics is a limitation in some of the decentralised sectors. For instance, cottage-scale finishing in its present set up will not be suitable for processing fabrics from non-cellulosic fibres or their blends. Such fabrics require fairly high temperature and close temperature control in dyeing, printing, and heat-setting, neither of which is possible with the methods currently in use. Yarn-dyeing in the handloom sector will also present problems.

While the investment per work place in the decentralised sector is very much lower than in any of the technologies of the organised sector, the decentralised sector technology does not compare equally favourably with the intermediate technologies of the organised sector, in terms of the total investment for a given volume of production. In other words, the present-day technologies of the decentralised sector are highly labour intensive, and at the same time, require a fairly high level of capital investment. This aspect needs to be recognised, especially in the context of the general capital scarcity.

It should be also pointed out that the competitiveness of the decentralised sector vis-a-vis the organised sector rests at present largely on the product reservation and preferential excise duty structure. The low labour productivity and consequently the high labour cost per unit output would make the decentralised sector economically unviable in the absence of the present incentives. The application of narrow economic yardsticks to the exclusion of broader social considerations can be justifiably questioned. The need for continued government support in the near future is undisputed; nevertheless, there is a strong case for facilitating increased self-reliance in the decentralised sector, as a long term goal.

Although the wage cost per unit output is high in the decentralised sector, the wage levels are low in absolute terms. Such levels are acceptable only against the background of immense unemployment in the country. As aspirations of the people rise, the current wage levels will no more be satisfying and social conflicts will arise. Only a higher level of output can offer a meaningful increase in the earnings of the labour force in the decentralised sector. Therefore, narrowing the technological gap between the organised and decentralised sectors without seriously disturbing the capital/employment components of the decentralised sector becomes an urgent task.

RECOMMENDATIONS

The fiscal and development policies of the government are the most powerful tools in shaping the future pattern of growth. Clear enunciation of a long term and comprehensive policy is necessary. The policy should cover : raw material supply, targets, time schedules, alternative approaches, and the role of different manufacturing sectors and other agencies. Linkage between the textile and other industries should be identified.

Supply of raw material in adequate quantities and at reasonable prices is vital to all sectors of textile production. A parity in prices of raw materials and finished product is a prerequisite for economic viability of production and its growth.

A higher utilisation of the existing capacity in the organised sector should be strived for. Government, management and labour need to take concerted action to remove the impediments in the higher utilisation. Judicious renovation and modernisation, correction of imbalances in the present capacity, stricter attention to machinery maintenance are all steps which by themselves would generate a substantial volume of additional production required to meet increased consumption. Therefore, they should receive priority over capacity expansion.

The technology in the decentralised sectors needs to be improved. This area has not received sufficient attention and the efforts so far have been uncoordinated. The objective should be to enhance labour productivity and product quality with only marginal increases in capital costs. Favourable features of the more advanced technologies can be adapted to suit the requirements of this sector. The Ambar Charkha, which is a striking example of such amalgamation of technologies, can itself be further improved. Similarly, as discussed in Chapters 3 and 6, a combination of selected stages of the more advanced technology, in miniature if necessary, with labour-intensive cottage scale operations can also be the basis for an appropriate technology. The concept of Lok Vastra (people's cloth) which is still in an experimental stage, is based on this approach. The textile research institutions, the textile machinery manufacturing industry and other agencies should jointly take up this challenging and rewarding task.

Institutionalised arrangements need to be strengthened to extend on-the-spot consultancy, training, and technical services to the decentralised sector. The storehouse of knowledge built up by textile research associations in optimisation, cost reduction, and quality improvement is largely relevant to the decentralised sector as well. A more extensive transmission of this know-how is called for, to raise the overall level of technological awareness and capability. In parallel with this, centralised facilities need to be set up for machinery maintenance and supply of spare parts.

The formation of cooperatives should be encouraged to reduce the present vulnerability of the decentralised sector in raw material procurement, finance and marketing. The structures of several such cooperatives which are at present working successfully can be used as guidelines.

Technologies of knitting and garment-making, which combine a fair degree of mechanisation with labour intensiveness, can be advantageously used for meeting the internal demand and for exports. Facilities for expansion of these segments should be created.

Possibilities of reducing the distribution cost of textiles from both the organised and decentralised sectors require examination. Concentration on zonal markets by the decentralised sector which is geographically more wide spread appears to be one solution. The market size and pronounced differences in dress pattern also argue in favour of such a rationalisation.

Several issues raised in this report warrant a more detailed analysis which should be initiated as part of a comprehensive policy formulation.

There is scope for regional cooperation on several of the recommendations made above, particularly amongst countries which because of similarity in their factor endowments are guided by broadly identical considerations in the choice of technology. The Indian experience with a blend of intermediate and cottage level technologies can serve as a model for other countries where the textile industry is of a comparatively recent origin.

ANNEXURE

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