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APPROPRIATE TECHNOLOGY FOR THE PRODUCTION OF TEXTILES

APPROPRIATE TECHNOLOGY FOR COTTON YARN SPINNING IN RURAL AREAS

Background Paper

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APPROPRIATE TECHNOLOGY FOR COTTON YARN SPINNING IN RURAL AREAS

by

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CHAPTER I

Background and need.

The manufacture of cloth has got the biggest employment potential after agriculture in any country. There are two separate divisions of the working.

1. Spinning of cotton into yarn
2. Weaving of yarn into cloth

Prior to industrial revolution, which in fact means introduction of mechanical power into industry, these two divisions were carried out manually in separate cottages scattered in villages and small towns. One set of cottages was spinning the yarn and the other weaving it into cloth. With the introduction of mechanised technology in cloth manufacture both spinning and weaving became centralised, known as Textile Industry, and was concentrated in urban areas. One of the major potential was thus lost to the rural areas.

The impact of mechanization on Cottage Textile Industry was much more on the spinning side. Cottage hand-spinning was not able to compete with the cost of production and also failed to produce the quality of yarn produced by mechanised technology. As a result the hand-spinning technology was almost whiped out all over the world.

Handloom weaving was also discontinued in the developing countries, but it continued on a subsistence level in many of the developing countries because of a large heriditory artisan class which could not find employment outside their trade. These artisans shifted from producing largely acceptable type of cloth to special

cloth either, which could not be mass produced, as their production was not as well remunerative as other types of cloth in large scale mills. The cloth was produced from the yarn obtained from large scale mills. Based on this demand a number of spinning mills were established for supply of yarn to the handloom weavers.

In a composite textile mill i.e. having its own spinning and weaving, the yarn is taken directly from the spinning department to the weaving department. But for supplying to the handloom weavers the yarn has to be packed and it passes through a number of intermediaries before it reaches the handloom weavers. During this process at least 25 - 30 per cent extra cost is added, which thus decreases the earnings of the weavers to a subsistence level. The capital formation was completely stopped throwing the weavers to work on borrowed capital. The interest rate of this borrowed capital further lowered the earnings to starvation level. The weavers are not left with any strength to make any improvement or development in their trade. No textile unit in the world can operate economically by not producing yarn in its own spinning department and purchasing it from outside. The continuance of handloom weaving on purchased yarn in developing countries shows the inherent strength and stability of self-employed labour as against centralised employed labour.

For initiating a programme of cottage or small scale cloth production in rural area on a decentralised basis or for any upgrading of the existing handloom weavers, the handicap is the lack of the proper technology for decentralised cottage spinning. The necessary weaving technology is available. Many types of looms from traditional to improved varieties to semi-automatic power-looms together with Dobi and Jacquard arrangements to weave more complex pattern cloths are available. Given the parity in the cost of yarn both qualitatively and economically the handloom weavers in rural cottages can withstand the

mill production. Some reductions in the cost of various ancillary operations - beam winding, sizing, reeling, dyeing and calendering are no doubt needed but again there is no great technical problem involved; it is more an organizational problem of getting groups of weavers to come together and collectively make use of machinery that is already available, but which has a minimum operating capacity more than sufficient for an individual weaving family.

So if a break-through can be made and a technologically sound and economically viable decentralised cottage spinning could be evolved then the textile industry could be decentralised in cottages in developing countries. The economic conditions of the cottage weavers where they still exist, as in India, could be improved from starvation level to a viable level.

INDIAN BACKGROUND

From ancient times India has a well established cloth production or decentralised textile industry on cottage basis. Both, spinning and weaving were separately carried out in family groups in homes or cottages of the artisans. The artisans were scattered mostly in villages and small towns. Finest type of cloth called 'Muslin' was manufactured and exported to many of the countries outside India. The activity not only provided very large number of jobs in rural areas but the income of the artisans was sufficient for meeting their various needs and left some surplus and thus provided enough cash flow and capital resources for rural communities for developing other productive activities. The wealth distribution was much more even than it is now because of decentralised dispersal nature of activities. The technology developed was of quite high degree. As a matter of fact some of the present day large scale techniques in textile industry are the mechanised version of hand operated technique developed in ancient India.

The industry suffered a set back after the industrial revolution in U.K. New quality of cloth at a more economical price from U.K. started competing with Indian cloth and gradually ousted it from the world market and later on a major portion of the home market was also captured by the imported cloth. Cloth produced from hand-spun yarn, because of its quality, did not find acceptance except in some limited areas. Perhaps these conditions could have been avoided if appropriate mechanisation on cottage level could have been developed and introduced.

The cottage weavers changed over to mill yarn and kept up their production, though on a subsistence and declined level, but strength of the decentralised cottage weaving, specially as self-employed person, is demonstrated by the fact that even now 50% of the total Indian cloth is produced by cottage weavers as can be seen from the following table :-

Cloth Production (Million Metres, 1973)

	Composite Mills	%	Cottage Weavers	%	Total
Cotton	4168.85	(53.6)	3601.58	(46.4)	770.43
Man made fibre	0.65	(0.1)	886.02	(99.9)	886.67
Blends and mixed	129.81	(60.5)*	85.00	(39.5)	214.81
Total	4299.31	(48.5)	4572.60	(51.5)	8871.91

*Estimated on the basis of blended yarn sold to weavers.

Although the handloom industry is basically in a good position, technologically, and well organized as regards marketing, representation etc., its Achilles Heel has always been yarn supply as already stated. The cottage weaver being at the end of a long distribution chain the weavers frequently suffer problems from discontinuity of supply and excessive traders selling margins. The weavers' associations claim that they pay 25 - 30% over the ex-mill price for their yarn; a figure which has been verified by government investigations*

*(Powerloom Inquiry Commission Report 1964)

in the past. Furthermore there is frequent scarcity in the supply of yarn and many times the prices go very high. The lack of adequate working capital at reasonable rates then becomes another problem that besets the weavers.

The total number of persons employed in large scale textile industry in India, both spinning and weaving, is about one million while that in the cottage weaving sector, based on the number of installed handlooms, the employed persons are estimated to be seven million. The large scale labour gets on an average about Rs.15/- per day. Then there are other social costs involved because of their being concentrated in urban areas.

The labour employed in the cottage weaving sector is self-employed and hardly gets Rs.3 to Rs.5 per day. The centralised labour is always a liability on the state while the self-employed labour looks after itself. It is for this very reason that the seven million people are more or less neglected.

The Government has come out with a number of schemes to ease the financial and marketing situation of the handloom weavers. A number of cooperative spinning mills have also been established to supply yarn to the weavers but the price again is the same as by any other commercial mill. No doubt there is some relief in the availability of yarn but the efforts fall very much short of upgrading the handloom weaver from starvation or subsistence level to a really viable level.

If these weavers can be supplied yarn at the same price as it is available to the weaving section of the mills with greater surity of supply their income will increase and they can be in a position to look after their financial and other needs for future development. The only solution appears to be to develop a spinning technology in

villages preferably within the weavers families so that much of the marketing and transport expenses on the yarn could be avoided. These efforts will further create approximately one million jobs in rural areas in India.

REVIEW OF REPORTS MADE TO REVIVE THE SPINNING TECHNOLOGY

Mahatma gandhi started the movement to revive hand spinning and other village industries in India in the early 1920's. He was greatly concerned at the devastating effects on the Indian rural population of the collapse of the traditional village industries in the face of competition from the new large scale industries set up at the end of the nineteenth century. He argued that the social costs of the introduction of mass production techniques (which were largely borne by the rural majority) were much greater than the economic benefits which anyway accrued mainly to the privileged urban minority and to urban areas. He therefore advocated the revival of village industries, particularly the manufacture of hand spun and hand woven cloth later on known as 'Khadi'.

Gandhi ji's efforts for revival of spinning in villages resulted in the establishment of Gandhi Ashrams all over the country. The Ashrams got yarn spinned on hand-spinning wheels (Charkha) in villages by distributing cotton and fixing a minimum wage rate. The spun yarn was taken back and was given to village weavers for cloth manufacture. The manufactured cloth was then marketed.

The technology of hand spinning was simple and low cost. The cotton was opened by a professional class of artisan called 'Dhunia' with a single hand appliance which opened and cleaned the cotton either at his house or could be called to any other place to work. The opened cotton then was rolled by hand on a rod with a small wooden plank. The rolled cotton was then used by cottage worker spinning on a hand driven one spindle wheel 'Charkha' which was made by the village carpenter. The hand spinning could not come up to produce uniform, smooth yarn of fine count and of sufficient strength acceptable by handloom weavers for producing the generally acceptable quality of cloth. The 'Khadi' cloth manufactured from the hand-spun yarn was coarse and of uneven type, though it has its own distinction as wearing apparel. It became the dress symbol in the national movement. But as the product was not to the required standard and the productivity and economies were low,

the cloth was costlier than mill cloth and was not accepted by masses as the usual daily wear. At present only 1% of the total cloth production in India is of the Khadi type.

Cotton yarns - Khadi and Mills (1973)

	Million Kgs.	%
Khadi	9.15	0.9
Mills	998.20	99.1
	1007.35	100 %

Inspite of subsidies, the wage rate in the hand spinning was hardly Rs.2 to Rs. 3 a day.

To meet the situation, development work on Charkha and spinning frame was initiated in 1950. The spinning of yarn consists of two operations (1) giving a motion to the spindle (2) drawing of yarn, twisting and winding it on the spindle. In hand spinning, the right hand is used for giving the motion and with left hand the yarn in drawn, twisted and wound on the spindle. Considereble skill is required for these operations even then the quality of yarn is not uniform and the strength is low. The ring spinning frames used in the mills are fully mechanised i.e. both operations of the spindle as well as drawing, twisting and warping of yarn is done mechanically. The attendant labour has only to watch and correct if any yarn is broken or some other fault comes in the working. One person looks after about 216 spindles. The productivity per person is therefore very high, though the difference in the output per spindle is about 2 ½ times only.

To increase the productivity per person as well as per spindle and to improve the quality of yarn, a textile mechanic designed a four spindle wooden charkha, later on known by his name as Ambar Charkha. This charkha or spinning frame was hand-operated but the drawing of yarn, twisting and warping on the spindle was automatic without

requiring the oth r hand of the worker. More or less the principle of the ring spinning frame of large scale technology was followed. Inspite of employing four spindle per person in place of one spindle, the productivity did not rise in the same proportion and this workin o. the 4 spindle Ambar Charkha by hand was very tiring for the op rator. The quality of the yarn improved to some extent. Besides the need of better method of power input the basic reason was found to be the need of very well pre-processing of cotton before being sent for spinning on Ambar Charkha.

Efforts were made to design the machinery for pre-processing of cotton before spinning. Two types were developed - one by Sri Arvind Pandya marketed by Saurashtra Rachnatmak Samiti in Rajkot Gujarat state and the other by Sri D. Balasundaram, a mechanical engineer who after the Second World War turned his hands to textile machinery an produced the first wholly Indian design large-scale spinning machinery. Sri Balasundaram further improved the four spindle charkha into six spindle model charkha incorporating many features of standard mill machinery. Later on he designed a 12 spindle charkha in which the power in ut was through a foot driven treadle like a sewing machine. This machinery made a big improvement in the spinning of Khadi yarn. The quality nd productivity both improved but it was still far from adequate, specially to be adopted to produce the type of yarn, the cottage handloom workers were getting from the mill-spun yarn.

Sri Balasundaram remained devoted to make further improvements in the machinery and gradually progressed in the direction of developing a scaled down version of the pre-spinning machinery used in large scale mills. The Appropriate Technology Development Association played an important role in the final stage of development and initiated improvement in the design to achieve almost the same productivity and quality of yarn as that of the

large scale spinning. The trial production of yarn of 20 count has been made on this machinery. The quality of the yarn was almost identical with that of large scale mills and found acceptance with the handloom weavers. The projected cost of production based on the trials indicate that the yarn will be 12 - 15% cheaper to the weaver if the spinning is carried out in separate cottages by different class of artisans in rural areas. If the spinning can be integrated within the weavers' family, the yarn can be about 20 - 22% cheaper.

With the adoptation of the newly developed machinery an appropriate technology of cottage spinning in rural areas on a centralised basis is possible to be set up and operated efficiently in the developing countries. In India the handloom sector is already well established and is working in rural areas in cottages. The incorporation of the cottage spinning technology will go a long way to improve the conditions of the weavers and put them on a viable basis. Integrated cottage complexes both with spinning and weaving can also be initiated in new locations.

CHAPTER II

PRODUCT SELECTION

Excluding the woollen cloth the general wearing cloth could be classified as follows :-

1. Cotton
2. Man made fibre
3. Blends

In most of the developed countries the shift has been more and more to man made fibre and blends, but lately the use of cotton cloth is again coming back. In developing countries there is still predominance on the use of cotton cloth in the daily wear. It could not be possible to obtain figures from other developing countries about the use of the various types of cloth but the following table gives the trend in India :-

Table 1.

All figures are on the basis of data available in the year 1973

	Yarn production by fibre type (1973)			
	Yarn (Million Kg.)	%	Cloth (Million Metres)	%
Cotton	998.20	(86.5)	7770.43	(87.5)
Man made fibre	124.77	(10.8)	886.67	(10.1)
Blends	30.83	(2.7)@$	214.81	(2.4)
	1153.80	(100.0)	8871.91	(100.0)

@-includes mill cloth made from mixed yarn.
$-Figures for cloth made from blended yarns in the decentralized sector are not available, so have been estimated on basis of sales of blended yarn.

This feasibility study is for producing cotton yarn and blended yarn. Once the production is well established the production of man made fibre yarn will also be introduced

The basic classification of yarn is its fineness. The fineness is specified by its count number. There are two systems - English and Metric. In the English count system the count number of yarn is the number of hanks, each containing 840 yards of yarn that weigh 1 lb. The higher the count number the finer the yarn. In this study only English count system is used.

The cloth produced and marketed by large scale Indian textile mills is classified in the following table :-

Table 2

Gradewise production of cotton mill cloth(1973)

Count of yarn used	Million Metres	%	Cumulative %
Coarse (upto 17s)	604.51	14.6	14.6
Medium B (18s-26s)	1270.73	30.6	45.2
Medium A (27s-35s)	1558.91	37.4	82.6
Fine (36s-47s)	368.	8.8	91.4
Superfine (48s +)	358.41	8.6	100.0
Total	4168.85	100.0	

The utilisation of the count-wise yarn by large scale textile mills are given in the following table :-

Table 3

Countwise utilisation of cotton yarn by weaving mills(1973)

Counts	In million Kgs.	In million Hanks	%	Cumulative %
1s - 10s	39.47	435	1.5	1.5
11s - 20s	165.12	5450	18.3	19.8
21s - 30s	191.53	10510	35.2	55.0
31s - 40s	100.45	7700	25.8	80.8
41s - 60s	28.08	3200	10.7	91.5
60s - 80s	6.40	985	3.3	94.8
80s +	7.23	1540	5.2	100.0
Total	540.03	29820	100.0	

The consumption in large scale textile mills is 80.8%, upto 10 count. It tallies with the production of coarse Medium B and Medium A whose total percentage comes to 82.6. Table No.4 gives the countwise yarn sold to cottage weavers.

Table 4

Countwise sales of cotton yarn to weaver(1973)

Counts	Hanks			Cones			Hank+ Cones	
	In m. Kg.	In m. hanks	%	In m. Kgs.	In m. hanks	%	In m. hanks	%
1s - 10s	61.46	675	(6.7)	9.19	101	(1.0)	776	(3.9)
11s- 20s	69.14	2280	(22.2)	21.66	715	(7.4)	2995	(15.1)
21s- 30s	23.99	1320	(12.9)	27.97	1540	(15.9)	2860	(14.4)
31s- 40s	33.25	2560	(25.0)	32.45	2500	(25.9)	5060	(25.4)
41s- 60s	16.23	1790	(17.5)	19.40	2140	(22.2)	3920	(19.7)
61s- 80s	6.13	995	(9.3)	10.86	1670	(17.3)	2625	(13.2)
80s +	3.02	660	(6.4)	4.47	990	(10.5)	1650	(8.3)
Total	213.22	10240	(100.0)	125.98	9656	(100.0)	19896	(100.0)

The lower consumption of yarn upto 10 count by the cottage weavers appears to be due to higher production of sarees in decentralised sector - a common women apparel in India - sarees are difficult to be produced in mass scale. A frequent change of pattern and design is necessary. This is easier to be carried out on the handloom rather than on mill loom.

No doubt, if the whole range of the count of yarn needed by handloom worker could be covered it will meet the situation excellently. But there are certain problem, at least initially, for producing count higher than 80s. The humidity is a essential factor to be controlled when spinning yarn generally after 40 but definitely after 60.

This feasibility report limits to production of 40 counts yarn in cottage with the possibility of weaving upto 60. Thus a minimum of 59% of the total requirement and possibly upto 78.5% will be covered by the technology developed. In the

blended yarn the cover ge would be practically the same.

YARN QUALITY DEMANDED BY WEAV RS

There are many sophisticated tests for measuring the dif.erent characteristics of cotton yarn objectively, and so precise standards of quality could in principle be laid down, though they would no doubt fail to catch all the different features of a yarn. However, in practice, most commercial 'testing' of yarn is done subjectively on the basis of appearance, in India at least. A simple method is used - the yarn is wound regularly onto a black card, with an 1/8th " or so between turns, so that unevenness, dirt particles, naps, tufts etc., can be easily spotted. For their own purposes some mills are starting to use Uster evenness testing machines, which give a precise statistical measure of the variation in thickness of the yarn. But this percentage unevenness factor is very seldom, if ever, measured or quot d for commercial sales purposes. In fact the only objective test in use is the Lea Test of yarn breaking strength. A small hank of 120 yards length, known as a Lea, is subjected to tension and the breaking strength measured in pounds. The strength however is not usually specified simply in pounds breaking strength, because this varies between Counts - obviously finer yarns have lower breaking strengths, other things being equal. Therefore, a composite measure the Coun. Strength Product - simply the numerical product of English Count Number X Lea breaking strength in pounds - is normally used. The Indian Standards Institute lays down official standards for the Count Strength (C.S.P.) of different yarns, which are given in Table 5.

Table 5

Count Lea strength product (CSP) of grey cotton yarn official Indian standards

Cotton Count	Count Lea Strength Product					
	Grade A (Automatic & Non-automatic looms)		Grade B (Power Looms)		Grade C (Handlooms)	
	Warp	Weft	Warp	Weft	Warp	Weft
8s to 10s	..	..	..	..	1100	1000
12s to 16s	1450	1400	1450	1350	1350	1250
18s to 24s	1600	1450	1500	1400	1400	1300
26s to 30s	1750	1550	1500	1450	1450	1350
31s to 40s	1800	1600	1600	1500	1500	1400
44s to 50s	..	..	1650	1550	1550	1450
60s to 64s	..	..	1700	1600	1650	1500
70s to 80s	..	..	2000	1800	1900	1700
90s to 100s	..	..	..	..	2100	1900

N.B. Automatic looms have higher shuttle speeds and so require stronger yarns to avoid breakages.

In practice, however, handloom weavers will accept yarns of anything over 1200 CSP and very few mills specify the CSP of the yarn they sell. CSP is very simple to measure and the mills do measure it for their own purposes, so presumably their yarns are not up to official standards, or otherwise they would quote figures openly.

A comparative test was carried out by producing yarn from some rovings on the spinning machinery developed by Shri Balasundaram and that of the spinning frame of a large scale industry. The cotton blend was identical, the followingis the test result:-

Table 6

Test Results - Balasundaram Centre Test Yarn

Test Bobbin No.	Spindle No.	Weight (gms)	Strength (lbs)	Count (English)	T.P.I.	C.S.P.
1	1	3.290	69	19.7	20.0	1360
2	2	3.290	69	19.7	19.5	1360
3	3	3.255	71	19.9	18.0	1420
4	4	3.250	71	19.9	18.5	1420
5	5	3.300	74	19.6	18.5	1450
6	6	3.220	69	20.1	19.5	1390
7	7	3.210	71	20.2	20.0	1440
8	8	3.215	70	20.2	20.0	1410
9.	9	3.235	78	20.0	20.5	1560
10	10	3.240	78	20.0	20.5	1560
11	11	3.240	72	20.0	20.5	1440
12	12	3.235	73	20.0	20.5	1460
13	1	3.200	60	20.2	19.8	1220
14	2	3.070	61	21.1	20.0	1290
15	3	3.250	74	19.9	20.5	1470
16	4	3.260	70	19.9	20.3	1390
Average				20.0	19.8	1415

Table 7

Test Results - Radhakrishna Mill yarn

Sample	Weight (gms)	Count	Strength (lbs)	T.P.I.	C.S.P.
1	3.400	19.0	79	18.5	1500
2	3.275	19.8	84	19.5	1660
3	3.275	19.8	81	18.5	1600
4.	3.360	19.3	84	18.0	1620
5	3.302	19.6	78	20.0	1530
6	3.250	19.9	84	21.0	1670
Average		19.6		19.2	1600

By referring to the Indian standard it appears that the yarn produced on the cottage spinning machine developed meets with the official standard of handloom yarn both warp and weft.

It is also very near to the requirement of powerloom. Latest changes made in the machinery will further raise the C.S.P. of the yarn because of better pre-spinning carried out. Therefore, it can be said that this machinery can confidently produce the quality of yarn required by handloom and powerloom. In general appearance it was noted that on very close inspection only some marginal difference was found in the uniformity and thequantity of tufts and neps. The improvement carried in the machinery will practically remove this difference also.

CHAPTER III

Technology

The following table gives the various processes used under spinning technology in large scale mills :-

process	Nature of Operations
Pre-spinning	
1. Blow-Room	1. Mixing different qualities of cotton; opening out fibres, removal of dirt and some inferior fibres.
2. Carding	2. Removal of dirt and inferior fibres individualization and partial parallelization of fibres, formation of 'sliver'.
3. Drawing	3. Parallelization of fibres, making 'sliver' of uniform thickness.
4. Combing	4. Further parallelization; removal of inferior fibres (used only for higher count of 60 & above)
5. Roving	5. Initial drawing out of sliver into a sort of thick threads called 'roving', slight twisting, winding on to bobbin.
Spinning	
6. Spinning	6. Final drawing out of 'roving' into yarn, twisting, and winding on to bobbin.
7. Reeling or cone winding	7. Removing yarn from spinning bobbin, winding either into hanks or onto cones.

For producing drills, bed-covers, towels and other furnishing fabrics another process called 'doubling' is also used. Two yarns after being spun and before sending for reeling and

BLOW ROOM

The cotton after separation from the seed in the ginning machinery is pressed tightly into high density bales. The bales are supplied to the textile mills. It is necessary to remove the effect of pressure (opening). During harvesting and in ginning, impurities like leaves, part of the pod and dust get mixed up with the cotton. This also has to be removed (cleaning), otherwise the quality of yarn will not be uniform and specks will appear on the cloth.

The quality of cotton from bale to bale also vary. The fibre length, colour and luster of the various cottons differ. Then for effecting economy in the price of yarn, some yarn waste has also to be mixed (blended) specially for lower counts. For producing blended yarn, fiber is also mixed with cotton at this stage.

Opening, cleaning and blending of cotton is done in the section called 'Blow Room' because during various operations the cotton is transferred through pipes by means of air (blown) from one portion to the other. The smallest size of the Blow Room Machinery available, is for meeting the requirement of 12,000 spindles which is too big a capacity for any cottage complex.

The Blow Room machinery can be divided into the following sections :-

1. Feed Hoppers and Blending Hoppers,
2. Conveying system i.e. blowing cotton with air from operation to operation,
3. Beating points,
4. Scutcher,

Feed Hopper and Blending Hopper

The number of feed hoppers is dependent on the number of types of cotton to be blended. Weighed amount of each type of cotton is put in these hoppers and they drop proportionate

weights on the feed lattice or conveying screen feeding to the beaters.

Conveying system i.e. Blowing type system with air -

This sort of conveying is necessary for handling very large quantity of cotton but for smaller quantities even the depreciation cost of the system is higher than labour cost by manual conveying.

Beating points

The function of beating points is to open out and clean the cotton. This is generally done by a series of beaters whose number is generally six. A variety of spikes, rods are used in different machines, but the principle of all is the same - to tear open the tufts of cotton and beat them against grid bars to shake the dirt clear. Even then by this modern arrangement only 70-75% of the waste matter is removed from the baled cotton.

Scutcher

The cotton after beating is passed through this machinery and is formed into a continuous and flat sheet of uniform thickness called 'lap', which is made into a large roll on a cylinder to be fed to the next operation i.e. Carding. Modern blow rooms tend to dispense with the scutcher and directly blow the cotton to the carding engine.

Carding

The purpose of carding is to open the cotton further until each fibre is disentangled from its neighbour to remove the remaining impurities and inferior fibres and 'neps' (small tufts that can not be disentangled). This action is produced between two surfaces, each covered with small wire-hook or metallic saw teeth. The tufts of fibres are caught by both sets of teeth as they move in opposite direction. A very thin heap of cotton then goes out over reeling cylinder of 50" diameter. This heap is led through a metallic tube to form about 1" thick rope called which is collected and sent to the next operation of Drawing.

Drawing

The purpose of drawing is to even out variations in the thickness of the carded sliver and to make all the fibres lie parallel to the axis of the sliver. Six slivers from the carding engine are passed to the first head of the drawing machine where they are pulled together at a differential speed to come out again as one sliver of the same diameter but of longer length. The process is repeated two more times and finally a single emerging sliver of approximately the same thickness as that of the carding engine but of much longer length is obtained in which the variations of thickness has been averaged out and the fibres be parallel to the axis.

Combing

The above process only removes about 92-96% of the foreign material or impurities and parallelization is also not 100%. For spinning yarn of 60 counts and over, a further process called 'Combing' is generally used. As the name suggests the individual fibres are literally combed to remove the remaining dirt particles and 'nepe', fibres below certain length are also discarded to raise the average length of the remaining fibres. Action of combing also ensure high degree of parallelization of fibres. The removal of impurities is taken to about 99%-100%, on a machine called 'fly frame or flyer'.

Roving

Sliver from drawing or combing is then drawn out into thin thread known as roving. The thread is given a small amount of twist and wound neatly on Robbins. This action can be called a part spinning also. The multi-spindle spinning frames work nicely with uniform drawn out roving than directly from the sliver.

Ring spinning

The roving is then spun out into yarn of required count on a ring spinning frame. The slightly drawn and partly twisted thread from the roving bobbin is drawn to a set of rollers and passed to a ring and traveller mechanism to a spindle rotating at 10,000 to 15,000 R.P.M. The normal size of a ring spinning frame in large scale mills is 400-432 spindles 200-216 on each side. Generally one operator tends 200-216 spindles for 20 counts and 400 for higher counts. In the highly automated Japanese, U.S., and European mills each operator will tend 1000 spindles or more. The number of spindles that one worker can tend and increasing production per spindle by raising spindle speeds, have been the main way of reducing yarn cost in large scale mills. The spinning stage alone accounts for 40% of the total manufacturing cost (i.e. excluding cotton costs but including capital costs).

Reeling and Cone winding

The yarn to be used for making warp for weaving has to be taken over from the spindles of the ring frames and would either as hanks or on cones. Cone winding yarn gives a higher quality warp than hanks. The operational cost of hanks or cone winding do not differ much but capital cost of cone winding machinery is very high. Handloom weavers mostly obtain their yarn as hanks so there is further difference of about 10-15% between a unit weight of yarn in the shape of hanks or cones.

One important general point about present day mill technology is that it has not changed fundamentally for over a century - the main trend of technical improvement has been to introduce auxiliary labour saving devices rather than to change the basic technology. The large scale of a modern plant is not due to there being some technologically minimum feasible size, but is rather due to economies of scale in the use of labour and management and in cotton purchasing, and also to the security afforded by the ability to diversify production into a wide range of items. A large modern plant

consists (except for the blow room) of manifold repetitions of smaller basic units - S.I.T.R.A.'s quote for a 20s Count mill of 25,000 spindle included :

(1) 2 blow room lines,
(2) 77 carding engines,
(3) 16 drawing frames,
(4) 17 fly frames of 104 flyers each,
(5) 58 ring frames of 432 spindles each, and
(6) 196 reeling machines.

Thus provided cheaper labour is available and it is possible to scale down the blow room, it should be technologically possible to produce a small scale unit using basically the same techniques as mill.

Now supposing if we base this rural spinning complex on one drawing centre then the capacity of the complex would be 25,000 ÷ 16 = 1506 spindles/or on one fly frame 25,000 ÷ 17 = 1470 and except the Blow Room all the large scale machinery could be used in the Rural Spinning Complex. This basically what has been kept in view in designing and selection of the machinery for rural spinning complex. The capacity has been kept at 12,00 spindles calculated on the basis of 20 count yarn. Many sophisticated and automation devices for labour saving have been eliminated to reduce the capital cost per spindle.

The estimate for 25,000 spindle large scale mill as given in the above para was Rs.45.2 millions in 1973. Due to price increase the present price estimated to Rs. 50 millions. The cost works out to be 50,000,000 ÷ 25,000 = Rs.2,000-00 per spindle. The investment on 1200 spindle spinning complex is as follows :-

Cost of pre-spinning machinery	Rs.	5 Lac
Cost of building	Rs.	2.2 Lac
Cost of spinning frames (50 Nos of 24 spindle)		3 Lac
Other expenses of installation of spinning frame in cottages		0.60Lac
		10.80 Lac

This divided by 1200 gives the total cost as Rs.900/- per spindle or 45% of the large scale cost.

From economic point of view, a small-scale unit could be in disadvantage with regard to labour and overhead cost. The labour factor could be balanced by lower wage rate in rural areas as against urban mills. The lower capital investment of 45% will give enough margin to balance the overhead factor.

The following is the brief description of the various machines finalized for a Rural cottage Spinning Complex by ATDA :-

Blow Room

Initially, in the design put up by Sri Balasundaram, the blow room machinery consisted of one beating point operated by electric motor. The cotton was opened by hand and then fed to the beating point which prepared a fluffy mass. This was taken over and made into small lap in a mammoth wooden box and then fed to the carding machine. In the design, now worked out around a mill type scrutcher, opener and a beating point and one feed hopper have been built up. The cotton will be opened from bales, spread on a floor and various other layers of cotton to be blended will be spread over in layers proportionately. This mass is then fed by hand to a percoupine opener and then fed to feed hopper and finally passes through beater to the scutcher. In the first passing no roles of the lap is formed and the cotton is fed back to the percoupine opener and the feeding hopper to scutcher beat and finally rolled on the lap cylinder. The speed of the feed latiss has also been lowered. Thus the effects of six beatings will be utilised but the capacity of scutcher will be reduced. The quality of lap formed has been found in the blow room of the same level as done by standard mill blow room. But the capacity is still higher and 8 - hour working of the scutcher will provide enough lap cylinder for the 3-shift working of other machines. The cost of the Blow Room machinery design as above has been reduced to about 20% of the sophisticated machinery used in large scale mills.

Carding Engine

Initally the design of carding engine was very simple one. The lap was not drawn out into fine web but after passing the machine was drawn into a sliver. Thus very little cleaning and parallelization was effected. In the design now worked out standard model of mill carding engine has been adopted fitted with metallic cloth, thus making a semi high production card. Another model of Bettoni card has also been manufactured. This has got a 20" cylinder in place of 50" in the standard card. The speed has been increased from 165 to 410 r.p.m. This design can be manufactured easily in small workshops and occupied less space. The design is based on the machine first time used in Italy by the firm of M/s Bettoni & Carminetti. The capacity of this machine is equivalent to high card machine and the quality is not poor. After it has been tested under commercial conditions for about six months, this design may be standardized for future working. The cost of the machine will be 33% of those of large mill.

Drawing Frame

Initially the machine was having only one head and only one passing of six card sliver were carried out. It has now been changed to three heads and provided with stop motion mechanism.

Fly Frames

Fly frames involve some sort of spinning also. The Khadi Commission did not accept any mechanisation in fly frame. So, initially only hand-operated simple machine was adopted but it gave a very uneven rovings. Now the design has been completely remodelled. A machine having 7" spindle in place of 4" to save the doffing time has been finalised. Winding arrangement in the earlier model was uneven which gave too many breakages on the spinning frames. This has been now corrected.

Spinning Frame

The earlier development has already been given in the previous paras. The present machine is of a 12 spindle frame which can be driven either by foot driven treadle or a motor of .25 H.P. or ½ H.P. A number of these frames can be put together into units of 24 spindles. The spindle length has also been

increased from 4" to 6" and ball-bearings and treadle bearing have been provided to operate at high speed.

To summarise, the machinery now manufactured in the cottage spinning technology is identical in principle and performance to that of large scale and can give quality production. The economic feasibility is available by reducing overall capital cost to 45% to that of large-scale mills.

CHAPTER IV

Infrastructure and Organisation Pattern

A suitable infrastructure is as important for any industrial production as proper product selection and efficient technology. The infrastructure fulfills in general the following needs :-

1) Supply of raw material,
2) Marketing of goods,
3) Provision of finances.

The traditional or indigenous technology was having its own infrastructure in rural areas, but due to gradual development of mechanised large scale technology it broke down. The rural entrepreneur, engaged in providing the infrastructure facilities to the traditional technology got a better and expanding opportunity in working for large scale technology. The fiscal policies of the nation were gradually changed so as to draw the capital to urban areas to meet the growing demand of large scale industry.

At present, it can be said there is hardly any infrastructural facilities available for rural artisans. The capital cost is high. The raw material supply is from urban areas mostly on credit at high rate of interest and profits charged by the supplier so also the markets. This has lead many artisan workers e.g. leather, shoe-maker, blacksmith and carpenter to shift to urban areas either for search of new employment or to carry out the production activities under slum conditions in cities. Further due to decline of the artisans to starvation level, their inbuilt skill and ability for new innovations, both technological and product development, has been lost up. The technology and the product became static, resulting in further decline in the economics and of market acceptability of the product. So, in any rural industrial programme, the following further needs will have to be met with by the organisational pattern :-

1. Initiation of suitable technology and its extension by providing the technological know-how and operational advice.
2. Carrying out part of the production activities which cannot be scaled down to the cottage and individual artisan level.
3. Product development and diversiification.
4. Training and demonstration programme.
5. Research and development.

A review of the schemes and programmes being executed for rural industrialisation by Government, semi-government and volantary organisations brings out the lack of comprehensive coverage of all the above infrastructural needs in these programmes. The needs are provided in isolated manner and not as an integrated package. Government schemes are mostly for providing financial and marketing facilities and that too on cooperative basis, (only recently individual financial facilities are being given to artisans) which because of poor management and lack of sufficient resources is limited to higher section of artisans specially in urban or semi-urban areas. The technological research and product development do not get exploited because of the lack of finances, ready available technical advice etc. The impact of these programmes have, therefore, been very much limited and the conditions of the rural artisans have not improved to any marked degree. At best from starvation level, they may have come to subsistance level.

But on the other hand some examples are available where by a comprehensive coverage of all the infrastructual needs by a suitable organisational pattern, success has been achieved to a marked degree. Gandhi Ashrams have organisational pattern with comprehensive coverage of needs which inspite of lower technology is producing 1% of the total cloth production in very widely dispersed rural cottages. The dairy development schemes also provide a full coverage and reach distant rural areas. The introduction of withewares at Khurja and Chinhat was successfull because of the full coverage provided for all infrastructural needs. The work carried out under P.R.A.I. in

in the field of rural industrialisation has also brought out the importance of full coverage of the intrastructural needs in any industrial programme.

The organisational pattern worked out in P.R.A.I. is divided into two parts :-

(1) Service Centre,
(2) Cottage units

The infrastructural needs as listed in the previous paras are organised under the Service Centre and the production work is carried out in cottages.

The A.T.D.A. is adopting the same organisational pattern for the decentralised cottage spinning project. The Service Centre will have two sections, one looking after supply of raw materials, guild its pre-processing and the other section will look after marketing and finances through a co-operative organisation of the artisans.

This organisational pattern has proved its effectiveness to initiate and establish the technology but there are few important issues when the extension stage is considered. For extension purposes, a large number of Service Centres will be required to be put up in various locations in the country. Who is going to own and operate them ? From where the financial resources would come ? Will it require some Government-statutory body or non-government or voluntary institutions like Gandhi Asharams to carry out the extension work and later on look after operations by organising a large number of Service Centres in any one technology. Could the extension be taken up by rural artisans or the unit under the Co-operative movement or small private entrepreneurs will take it over in the extension stage. All the possibilities appear to be workable but each have some lacunas. Statutory bodies, because of their organisation structure, gradually overlook the interest of the artisans. The voluntary organisations need a dedicated team of workers with strong philosophical background which may not be available in each and every case.

The Co-operative organisation as at present being organised have failed to prove effective media for improving the conditions of artisans. The Co-operative societies are formed without proper assessing the needs and ensuring that they can operate in a menner so as to make a meaningful increase in the income of the artisans. The artisans' contribution as share money is nominal because of their lack of resources with them. Many times even the share money is paid by backdoor by loaning the amount by the organisers. To raise enough share money, so as to get sufficient government loans and subsidies, the membership is increased to an extent that only a very small need of each of the members can be met and the members do not remain interested in the society. Small cooperatives cannot afford the right type of managerial skills needed for its efficient organisations. The artisan members being themselves weak and dependent, are not in a position to exercise any control on the management. Mostly outsiders take control and work it in their own interest. Lastly, the loan obtained by the society has to be paid back at high rate of interest and within a short re-payment time. No thought about the re-payment capacity of the society from its own earnings are given at the time of fixing the re-payment period. The management of the society then tries to squeeze the artisans by increasing the service charges, and the artisan finds himself in a worse position from the net income point of view than he was otherwise.

Once a productive activity is well established and its economic is proved under the actual field conditions then the private entrepreneurship gets interested in it and take it up. But he brings an element of exploitation. The entrepreneur works in a way so as to keep most of the surplus with himself.

The reason, in both cases i.e. Co-operative Societies as well as private entrepreneur, appears to be the big difference between the financial conditions of artisan and the private entrepreneur and consequently complete dependence on the part of the artisan on the entrepreneur for his daily needs.

A private entrepreneur can keep his operations suspended for sufficient time and still have enough for his daily needs. The artisans are not in that position and even one week's closure brings them to starvation level. This weakness is exploited by private entrepreneurs as well as by co-operative management.

Dr. J.W. Powell, a visiting Professor from Technical Consultancy Centre, University of Science & Technolo Kumasi, Ghana who spent four months with the Association and helped considerably in designing and planning of the de-centralised spinning project was of the opinion that the project should aim to raise the income of the artisans to a level where besides providing decent wages to meet daily living expenses, some reserves may be built up with the artisan to fall back upon while facing the private entrepreneur or to exercise and share some control on the co-operative organisation.

An analysis made indicated that by working with 24 spindle spinning frame; the artisan will be able to have just a subsistance level of wage rate of Rs.5/- to Rs.6/- or may be slightly higher, about Rs.7/- to Rs.9/- after deduction of instalment for share capital. When working with 72-spindle spinning frame, the wage rate will be about Rs.20/- net after meeting the instalment of the spinning frame as well as other expenses. This will, thus, give him enough to become financially viable and fight the poor management of the co-operative or the exploitation of the entrepreneurship. If this could be achieved, then it will definitely create conditions whereby the extension can be carried out both as a cooperative organization or through private etrepreneurship. Inspite of the immediate financial limitations and also keeping in view initiate teething troubles, a beginning is proposed to be made with 24-spindle frame in cottages but gradually the successfull cottages will be upgraded to operate a 48 to 72 spindle frame.

CHAPTER V

ATDA PILOT PROJECT

The Appropriate Technology Development Association with the co-operation of Intermediate Technology Development Group, London, and with the generous funding provided by Christian Aid has established a pilot project on Decentralised Cottage Spinning.

OBJECTIVES:

The objectives of the pilot project are as follows :-

1. To operate the cottage spinning technology in actual field conditions and to demonstrate its technical feasibility as well as economic viability;
2. To demonstrate and prove the availability of higher income to cottage weaver by providing cottage spinning technology in rural areas, preferably on an integrated basis;
3. To provide pre-weaving facilities for increasing the output and the quality of the cloth and thus improving the economy and income of the cottage weavers;
4. To carry out diversification of the product of the cottage weavers by developing varieties of cloth with improved designs and patterns;
5. To organise training programme both in spinning technology as well as for improved weaving ;
6. To carry out research and development for further increasing efficiency in plant and machinery of cottage spinning as also of cottage weaving.
7. To develop a strong co-operative organisation to take over the entire activities and run it on a self-sustaining and self-generating basis.

The first objective will directly create employment potential of about one million jobs on all India basis. The other objective will directly result in improving the income of cottage weavers by balancing the adverse factor of higher yarn cost and also by improving the productivity of the weavers. Over-all the pilot project will make available two kinds of integrated package plants. The first will be for introducing decentralised spinnin, technology in those areas where already cottage weavers are working. The other package plant would be to establish a cottage textile complex in rural areas in family groups in the developing countries. Both these package plants will prove the effectiveness and desirability of the appropriate technology in the real world of productive activities.

LOCATION

The project has been located at Kushmi Kalan in district Ghazipur. This is about 70 Kms. from Varanasi and about 25 Kms. from district headquarters. Within 8 Kms. of the location, there are about 200 handloom weavers. The capacity of the centre will be sufficient to give them a full coverage. In the whole district there are about 600 handloom workers and also Khadi cloth worth one crore rupees is produced. It is also proposed to extend the activities in other areas gradually.

OPERATIONAL DETAILS

The project is divided into two sections :-

(i) Service Centre

(ii)Cottage Units

(iii)Co-operative organisation for supply and marketing.

The service centre is to serve as an infrastructure to supply the following needs of the cottage units :-

1) Pre-spinning section

2) Pre-weaving section,

3) Training section,

4) Research and Development section.

1. **Pre-spinning section** : The cotton will be purchased and processed into rovings. These rovings will be supplied to the cotta e units through co-operative society on cash or credit basis.

2. **Pre-weaving section** - Mention has been made that certain reduction of cost to the cottage weavers can be possible if pre-weaving facilities of warping and sising are made available. The hand warping carried out by weavers do not stretch the yarn properly and many time weak yarn are passed to the handloom. This leads to more breakage at the loom and productivity of the weaver is reduced. By mechanised warping weakened yarn is exposed and rectified. Similarly the hand sizing is uneven, and it also leads to frequent breakage. If a mechanised warping and sizing could be provided, the beams so made will give higher productivity at the loom of 12 - 15 % and the quality of cloth will be better. Slight higher cost of mechanised warping and sizing can be met with by high productivity and still leaving 7 - 10% extra income for the weaver. Another facility which could improve quality of product of the worker is dyeing of the yarn. But in Indian conditions, dyeing facilities are generally available and no dyeing is proposed to be established at least initially

Shri Balasunderam carried out also the development of warp and sizing machines alongwith the pre-spinning machines. Initially warping machine was a section winding type operated by hand and it did not work satisfactorily and now mechanised creel winding machine have been developed on the same principle as used in the large scale mills. The workability and economics have much improved.

An efficient sizing machine requires steam for its operation. The provision of steam only for sizing in such small complex is uneconomic. So, initially a kerosene burner was utilised for the sizing machine, but now it has been replaced by electric heaters which is giving satisfactory

results. Apart from warping, yarn for weft has to be wound on the shuttle bobbin. Hand winding again is costlier and tension is low. For this purpose pirn-winding machine already developed will be installed. Similarly, for producing drills, bed apparels and furnishing fabrics, towels etc. doubling of the yarn is required. This machine has also been developed and will be installed in the service centre.

Training - The training will be carried out on the same type of spinning frames as will be installed in the cottages. The trainees will be drawn from rural areas preferably from weaving families. There will be no stipends and they will be made to work commercially. Yarn produced by them will be marketted to realise the expenditure, but it may not be possible to take out full cost. The cottage weavers will also be provided training on improved looms so as to produce more diversified and better quality cloth. The cost of training will be met from the earnings of the service centre as far as possible. This will keep the expenditure low and training realistic.

Research & Development - The centre will carry out research and development work both in further improving the efficiency of plant and machinery already developed and also in the weaving machine to improve the quality of cloth. The expenditure will be borne from the funds already provided. The work is proposed to be carried out partly in the project and partly in the A.T.D.A. workshop which is being established. Any augmentation of the fund as and when needed will be met by seeking research grants from government and non-government bodies. Research and development carried in actual field conditions are more productive and realistic.

The service centre has been built up at a capital cost of Rs.6½ lakhs and with an operations and research and development and training fund of Rs. 2 lakhs. The whole amount of Rs. 8½ lakhs has been donated by Christian Aid - a Church organisation of U.K. through the kind cooperation and collaboration of Intermediate Technology Development Group Ltd., London. The centre will be managed and operated directly by A.T.D.A.

Cottage units - The cottage units will be of two types -

(1) Mechanised -
   (a) integrated with the cottage weavers
   (b) separate spinning unit.

(2) Non-mechanised -
   (a) Separate spinning unit in Khadi area.

In the mechanised cottage units, electric driven 24-spindle ring frame will be initially installed. Later on a number of spindles will be increased so as to ultimately reach within 3 - 5 years to a total of 72 spindles per cottage. In the non-mechanised, a foot-driven 12 spindle ring frame will be installed. A person can operate only 12 spindles foot driven machine for 8 hours. The increase in the number of spindles in this case may not be possible, except by increasing the number of operators in a family to operate one machine on 2 - 3 shifts basis or by owning more machines and working as a family group to operate them.

The finances to meet the capital cost of the cottage being arranged from the nationalised banks on loans sanctioned directly to the cottage artisans at 4% rate of interest under the differential rate of interest scheme already in operation for helping the village artisans. The cost of an electric driven 24-spindle frame is Rs.5,000/- and that of non-mechanised 12-spindle frame is Rs.2,200/-. From the daily earnings of the artisan, suitable deductions will be made to re-pay back the loan. The handicap is that the re-payment period is only five years and for this purpose the deductions will reduce the earnings of the cottage spinners to a level where it may not be proved a sufficient incentive. Therefore, attempt will be made to either get the re-payment period increased or to extend the period by supplimenting the repayment through the co-operative societys

Co-operative Organisation for supply and marketing and for providing operational capital.

A cooperative organisation is being set up in which each of the cottages will have a share capital of Rs.100/-. This

amount will be subsequently raised to Rs.1,000/- for each cottage. The ATDA and O.R.P. is purchasing shares also worth about Rs.5,000/- each. Negotiations are also being held with the Government to purchase shares. A total share capital of Rs. 50,000/- is to be raised against which working capital loan of 8 - 10 times i.e. 4 - 5 lakhs would be available from the Handloom Department of the Government. Thus a capital built up of 4.5 to 5.5 lakhs will be available.

The co-operative organisation will obtain rovings from the Service Centre and distribute them on cash or credit to the cottage spinners. The yarn produced in the cottages will be either taken back and got turned into warp and size beams in the pre-weaving section of the service centre and if any surplus is left it will be marketed.

The sized beams will be supplied to the cottage weavers and the cloth produced either will be taken for marketing by the society.

The marketing of cloth is proposed to be handled in two ways i.e. either at the risk of the weavers who will give the cloth to the society for marketing it at whatever price is available. The society will deduct a service charge for this purpose. In many cases, weavers may require immediate money, so outright purchase of cloth may also have to be carried out and the cloth sold at the risk of the society.

The operation and control of the society will be with the Organisation of Rural Poor (a development agency working in this area). The A.T.D.A. will collaborate, help and advice in the operation of this organisation. The society will be kept a compact one and the benefits will be so managed as to make the sufficient increase in the income of weavers. The coverage will not be too big which will dilute the benefits. Attempts will also be made to built up the capital of the society by service charges and raising the share capital of each workers gradually so that within

3 - 5 years it might be able to take over the service centre from A.T.D.A.and the whole achievement may be conducted under co-operative organisation.

SUMMARY OF THE APPENDIX

Employment

(1) The project will create job employment in rural areas for 150 families as cottage spinners.

(2) The project will provide economic benefits by way of increased income of 20% to 150 cottage weavers.

(3) Training to 30 persons in cottage spinning and 20 persons in handloom weaving will be provided annually.

Capital Investment

(a) Service Centre

(i) Pre-spinning	Rs.5,17,650	.. 9.9%	) return on capital
(ii) Pre-weaving	Rs.1,77,900	.. 11.6%	) after deduction 11.6% interest on capital
(iii) Training	Rs. 50,500		
(iv) Working capital	1,50,000		
	Rs.8,96,050		
or	Rs.9,00,000		

(b) Cottage spinning

Units 150 @ Rs.5,000/- each Rs.7,50,000

Income - Rs.7/- per day after deducting Rs.3/- per day as instalment for the loan & paying of elec.charges.

(c) Cooperative Society

(i) Operational capital for supply and marketing of spinning activity annually	Rs.1,50,000
(ii) Operational capital for cloth marketing	Rs.3,00,000
	Rs.4,50,000

Income on supply of roving	Rs.	37,500
Income on marketing of cloth	Rs.	50,000
	Rs.	87,000
Expenses ...	Rs.	48,000
Net saving ...	Rs.	39,500

(d) Cottage weaving

In case handloom weaving is also to be set up e.g. in other developing countries, investment of Rs.4,50,000 will be further needed for setting of 150 workshop @ Rs.3,000/- each.

An income of Rs.9/- per day will be available to cottage weaver after deducting the instalment on the loan.

APPENDIX I

PROJECT ESTIMATE OF THE SERVICE CENTRE FOR THE COTTAGE SPINNING COMPLEX.

The capacity of the Service Centre would be -

(a) 500 Kgs. of rovings per day on 3 - shift basis, and

(b) 300 Kgs. of warp & sized beams per day on one-shift basis.

Number of working days will be 300 in a year.

Capital Investment

Land & Buildings

			Rs.
1. Land - 1 acre @ Rs.25,000/- per acre			25,000/-
2. Buildings			
(a) Pre-spinning			
(i) Working shed 80' x 30' = 2,400 sq. ft. @ Rs.25/- per sq. ft.		60,000/-	
(ii) Cotton & Roving Store 4' x 30' = 1200 sq.ft. @ Rs.250/- per sq.ft.		30,000/-	
(iii) Other constructions like Mixing bins and foundation		10,000/-	
		1,00,000/-	1,00,000/-
(b) Pre-weaving			
(i) Working shed 60' x 30' = 1800 sq.ft. @ Rs.25/- per sq. ft.		45,000/-	
(ii) Other constructions		5,000/-	
		50,000/-	50,000/-
(c) Training			
Shed 20' x 3 ' = 600 sq. ft. @ Rs.25/- per sq.ft.		15,000/-	15,000/-
(d) Office - 30' x 20' = 600 sq. ft. @ Rs.18/-		18,000/-	18,000/-
(e) Boundary Walls		20,000/-	20,000/-

The expenditure is common to all the sections

Land	...	25,000
Office	...	18,000
Building	...	20,000
		63,000

For calculation of operational cost this is divided as given below:-

60%	on spinning	37,800/-
30%	on weaving	18,900/-
10%	on training	6,300/-
		63,000/-

The land and building cost of various sections therefore, will be

Pre-spinning	Pre-weaving	Training	
Rs.	Rs.	Rs.	
1,00,000/-	50,000/-	15,000/-	
37,800/-	18,900/-	6,300/-	
1,37,800/-	66,900/-	21,300/-	2,03,000/-

3. Machinery

(a) Pre-spinning

(i) Blow room equipment percu, ing opener, feed hopper and mixing scutcher 50,000/-

(ii) Totally enclosed electric motor

Percussion opener - 2 H.P., 1440 rpm complete with switch & starter One no. 1,200/-

Hopper Feeder - 3 H.P., 1440 rpm complete with switch & starter - one nos. 1,350/-

Scutcher - 5 H.P., 1440 rpm complete with switch & starter - one no. 1,700/- 4,250/-

54,250/- 54,250/-

(ii)	Card - 4 Nos.		
	Standard or Lattoni fitted with metallic wire @ Rs.25000 each	1,00,000/-	
	Totally enclosed electric motor 3 H.P., 1440 rpm complete with switch & starter 4 Nos. @ Rs.1.350/-each	54,000/-	1,54,000/-
(iii)	Drew frame - 3 heads with 6 feed -3 nos. @ Rs.11,000/-each.	33,000/-	
	Totally enclosed elec.motor 1 H.P., 1440 rpm complete with switch & starter 6 nos. @ 1000/- each	6,000/-	39,000/-
(iv)	Fly frame - 3 frames of 32 spindles each with 8" x 4" flier @ Rs.17,000/- each	51,000/-	
	Totally enclosed elec.motor 2 H.P., 1440 rpm complete with switch & starter - 3 nos. @ Rs.1200/- each	3,600/-	54,600/-
Miscellaneous			
(i)	Humidity control device yarn testing equipment	25,000/-	
(ii)	Freight, forwarding charges, sales tax	30,000/-	
(iii)	Erection charges	5,000/-	
(iv)	Electrical installation charges	10,000/-	
(v)	Accessories -		
	(a) Bobbins, lap cylinder and other accessories	3,000/-	
	(b) Laboratory and testing equipment	5,000/-	78,000/-
			3,79,800/-

(b) **Pre-weaving:**

Machinery -

		Rs.	
(i)	Creel warping machine - one no. @ Rs.8,000/-	8,000/-	
(ii)	Sizing machine with elec. heated drum - one no.	25,000/-	
(iii)	Cone winding machine - three nos. @ Rs.5000/-each	15,000/-	
(iv)	Pirn winding machine 32 spindle - one no.	6,000/-	
(v)	Double framer - 24 spindles, 6" lift- 4 nos.@3400/-each	13,600/-	67,600/-

Electric motors(Totally enclosed)

Doubling - 1 H.P., 1440 rpm - 4 4 nos. @ Rs.1000/- each	4,000/-	
Cone winding - 2 H.P.1440 rpm - 3 nos. @ Rs.1200/- each	3,600/-	
Warping - 2 H.P., 1440 rpm - one no. @ 1200/- each	1,200/-	
Pirn winding - ½ H.P., 1440 rpm - one no. @ Rs.900/- each	900/-	11,400/-

Miscellaneous

Accessories ..	2,000/-	
Forwarding, packing, Sles tax etc. ..	15,000/-	
Erection charges	5,000/-	
Electric installation	5,000/-	
Mill stores	3,000/-	30,000/-
		1,09,000/-

(c) Training Centre

(i) Ring frames of 24 spindle 6" lift - 3 Nos. 12 spindle frame will be worked by 2-end shaft motor of ½ H.P. Each frame will have foot-driven treadle system in case of electric failure - Three nos. @ Rs.4,500/- each	13,500/-	
(ia) Totally enclosed motor ½ H.P., 1440 rpm. with two end shaft complete with switch & starter @ Rs.900/- each 3 Nos.	2,700/-	
(ii) Improved looms automatic shuttle throw arrangement capable to be worked by 1 H.P. motor and also having foot operated treadle driving arrangement in case of electric failure - 2 nos. @ Rs.2,000/- each	4,000/-	
(iib) Totally enclosed electric motor 1 H.P., 1440 rpm. one no. @ Rs.1000/- (only one loom will be mechanised)	1,000/-	21,200/-
Packing, forwarding, Sales tax etc.	4,000/-	
Electric installation	2,000/-	
Accessories	1,000/-	
Millstores	1,000/-	8,000/-

ABSTRACT OF FIXED CAPITAL

Pre-spinning		
Land & Building	1,37,800/-	
Machinery	3,79,850/-	5,17,650/-
Pre-weaving		
Land & Building	68,900/-	
Machinery	1,09,000/-	1,77,900/-
Training Section		
Land & Building	21,300/-	
Machinery	29,200/-	50,500/-
		7,46,050/-
Working Capital	-	1,50,000/-
		8,96,050/-
		or
		9,00,000/-

APPENDIX II

Operational details (based on an average of 20 counts).

Daily roving production	- 500 Kg.	
Monthly production on 25 days a month basis.	-12500 Kg.	
Annual production on the basis of 300 working days.	-1,50,000 Kg.	

I. **Raw material and Stores** -

Cotton requirement of various quality and waste yarn for blending (including wastage at 12-13% upto roving stage). - 14,000 Kg. @ average price of Rs.9.75 per Kg.	Rs.1,36,500/-	
Other stores	500/-	1,37,000/-

Power Consumption -

24 H.P. for 24 hours -432 Units
10 H.P. for 8 hours 60 Units
492 or 500 Units per day @ Rs.0.40 per unit — 5,000/- — 5,000/-

Daily labour -

	1st shift	2nd shift	3rd shift
Open Scutcher	3	6	-
Carding	1	1	1
Draw frame	1	1	1
Speed frame	1	1	1
	6	3	2

= 12 @ average Rs.6/- per day-Rs.72/- x 25 = Rs.1,800 — 1,800/-

Rs.1,43,800/-

Overhead expenses of the Service Centre

		Rs.		
Spinning Superintendent	1	1,500/- p.m.		
Manager ..	1	600/- "		
Accountant ..	1	500/- "		
Store Keeper ..	1	400/- "		
Head Mechanic ..	1	600/- "		
Assistant Mechanic ..	1	300/- "		
Supervisor @ Rs.500/- each	3	1,500/- "		
Watchman @ Rs.150/- each	3	450/- "		
General Attendants @ Rs.150/- each ..	2	300/- "		
Electrician ..	1	300/- "	6,450/-	6,450/-

Office Expenses

Stationery, postage and other misc. expenses	200/- "		
T. A. ..	300/- "		
Other office expenses	150/- "	650/-	650/-
			7,100/-

The expenditure is divided as follows :-

	Rs.
60% Pre-spinning	4,260/-
30% Pre-weaving	2,130/-
10% Training	710/-
	7,100/-

Pre-spinning

1. Cotton Rs.1,36,500/- x 12 =		16,38,000/-
Stores - Rs. 500/-		
Power 5,000/-		
Labour 1,800/-		
7,300/- x 12 =		87,600/-
2. Indirect expenses		
Overheads Rs.4260/- x 12 =		51,120/-
3. Depreciation		
Buildings -Rs.1,37,800 @ 5% = 6,890/-		
Machinery -Rs.3,79,850/- @ 10% = 37,985/-		
		44,875/-

4. Repairs & renewal

Buildings Rs.1,37,800 @ 2% = 2,756/-
Machinery Rs.3,79,850 @ 4% = 15,194/- 17,950/-

5. Interest -

Interest on the total investment -

(Fixed - Rs.5,17,650/-
(Capital

(Working Rs.1,50,000/-
(Capital

6,67,850/- @ 11% 73,441/-

18,82,986/-
or
18,83,000/-

Production of rovings

500 Kg. per day X 300 1,50,000 Kg.

Cost of rovings per Kg.	Rs.12.56
Sale price per Kg.	Rs.13.00
Net profit per Kg.	Rs.00.44
or	
on annual basis	Rs.66,000/-

Net return on capital invested - Rs.6,67,650/- 9.9

II. Pre-weaving

No raw material will be purchased as the yarn spun in the cottages will be made into beams.

Daily capacity for 1 shift operation will be 300 Kg. of prepared beams per day or 90,000 Kg. per annum.

Sizing and other stores 5,000/-

Labour requirement

Pirn winding	- 1
Doubling	- 2
Cone winding	- 3
Warping	- 2
Sizing	- 1

9 @ Rs.6/- per day

= Rs.54/- x 25 = 1,350/- 1,350/-

Rs. 6,350/-

		Rs.
Direct expenses -Rs.6,300 x 12 =	75,600/-	75,600/-
Indirect expenses Rs.2,130 x 12 =	25,560/-	25,560/-
Depreciation		
Buildings-Rs. 68,900 @ 5% =	3,445/-	
Machinery-Rs. 1,09,000 @ 10% =	10,900/-	14,345/-
Repairs & Renewal		
Buildings 2% on Rs.68,900 =	1,378/-	
Machinery 4% on Rs.1,09,000 =	4,360/-	5,738/-
Interest on investment Rs.1,77,900/- @ 11%		19,569/-
		1,40,812/-

Total production of beam in Kg. 300 x 300
= 90,000 Kg.

Process cost per Kg. Rs.1.57
Sale price per Kg. Rs.1.80

Net Income = Rs.0.23 x 90,000/- 20,700/-

Net return on capital Rs.1,77,900/- = 11.6%.

III. Training

3 ring frames of 24 spindle will be used in one shift per day per trainee.

10 Kg. of rovings @ Rs.13/-per Kg. Rs.130/-
No wages will be paid to trainee.
75% saleable yarn will be obtained
= 7.50 Kg. @ Rs. 15/- per Kg. recovery Rs.112.50

	Daily	Monthly
Daily expenses - Rs.17.23 x 25 =	437.50	
Training supervision 1 No. @ Rs.300/- per month.	300.00	
Power consumption	180.00	
Material taken on loan	500.00	
	1,418/-	
Over-head	710.00	
	2,127.00	25,524/-
		3,185/-

Depreciation

On buildings -Rs.21,300 @ 5% =	1,065/-	
On machinery-Rs.21,200/- @ 10%	2,120/-	
	3,185/-	3,185/-
Repairs & renewals		
Buildings Rs.21,300/- @ 2%	426/-	
Machinery Rs.21,200/- @ 4%	828	1,274/-
		29,983/-
		or
		Rs.30,000/-

...

APPENDIX III

Cottage Spinning

2 Spinning frame of 12 spindles each will be worked together by installing double end motors. They will also be fitted with foot-driven treadle arrangement in case of electric failure.

Cost of machinery including motor ..		Rs.5,000/-
Electric installation charges will be paid by the cottage workers.		
Yarn produced on an average 20 counts		
3.5 Kg. roving will be used by each unit @ Rs.13/-	Rs.	45/50
Sale from 3.4 Kg. of yar @ 16/50 per kg.	Rs.	56/10
Gross income	Rs.	10/60
Deduct Elec. charges -/60		
Instalment for the loan 3/-	Rs.	3/60
	Rs.	7/-

APPENDIX IV
COOPERATIVE SOCIETY

A Cooperative Society will be organised and a share capital of Rs.35,000/- to Rs.40,000/- will be raised by collecting share money from the cottage artisans and also contributed by developing organisation and other sympathetic parties.

Against this a loan of Rs.1,25,000 will be obtained from the Cooperative Bank.

Capital of the Society ...		Rs.1,50,000
Income from roving supplied @ -/25p for Rs.1,50,000 ...	Rs. 37,500	
Income from marketing cloth worth Rs.10,00,000 @ 5% commission ...	Rs. 50,000	
	Rs. 87,500	
Expenditure Rs.4000/- p.m.	Rs. 48,000	
	Rs. 39,500	
Interest payment @ 11%	Rs. 16,500	
Net income	Rs. 23,000	

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