Small-Scale Weaving (ILO - WEP, 1983, 144 p.)
CHAPTER V. SOCIO-ECONOMIC EVALUATION OF ALTERNATIVE WEAVING TECHNOLOGIES
I. Introduction
II. Impact of alternative weaving technologies
III. Policy measures for the promotion of appropriate weaving technologies

Small-Scale Weaving (ILO - WEP, 1983, 144 p.)

CHAPTER V. SOCIO-ECONOMIC EVALUATION OF ALTERNATIVE WEAVING TECHNOLOGIES

I. Introduction

Textile production constitutes an important economic sector for a large number of developing countries for the following reasons. Firstly, if backward linkages (e.g. cotton production, spinning) and forward linkages (e.g. garments production and marketing) were to be taken into consideration in addition to weaving, the employment generated by this sector would constitute a relatively large fraction of total employment in manufacturing. Secondly, textile constitutes one of the most important basic needs after food and shelter. Thus, a high priority is usually attached to the production of sufficient quantities of inexpensive textiles to cater for the need of low-income groups. Thirdly, local textile production may contribute to the improvement of the balance of payments through both import substitution and export. Finally, this sector may also contribute to rural industrialisation whenever it is feasible to locate weaving mills in rural areas.

Given the importance of the textile sector, great care should be taken in formulating and implementing policy measures which would maximize benefits which may be derived from textile production. In particular, policy measures should ensure that appropriate weaving technologies would be adopted by private and/or public weaving mills since the choice of weaving technology may have important repercussions on employment, foreign exchange savings, rural industrialisation, etc. However, this choice

is often difficult to make since weaving technologies which favour a given socio-economic objective (e.g. employment generation) may conflict with other objectives (e.g. satisfaction of the basic needs of low-income groups). Thus, the adopted technology must often strike a balance among conflicting objectives with a view to maximizing social welfare.

The following section provides some indications on the potential socio-economic effects of the 8 weaving options considered in this memorandum. Subsequently, section II suggests a few policy measures which could ensure the adoption and implementation of suitable weaving technologies.

II. Impact of alternative weaving technologies

The impact of alternative weaving technologies is analysed, in this section, with respect to the following factors:

- **employment generation;**
- **improvement of the balance of payments;**
- **basic needs satisfaction; and**
- **rural industrialisation.**

This analysis is based on the following hypothetical case:

- **An average per capita consumption of 20 m of cloth per year. This average may be somewhat higher than the over-all average for developing countries.**

- **A total population of 5,000,000 inhabitants.**

- **Technical and economic data used in chapter IV for the economic comparison of the 8 weaving options.**

- **Low degree of amenity assumed for the estimation of building costs.**

- **The same type of cloth as that described in chapter IV, in relation to the economic comparison of weaving options, is also used in this analysis.**

Thus, the various effects of alternative weaving technologies are analysed with respect to a total annual production of 100,000,000 metres of cloth of the type described in chapter IV. Table V.1 provides

estimates of these effects for each weaving option and scale of production.

II.1 Employment Generation

Direct employment generated per 100,000,000 metres of cloth ranges from 3,060 man-years for option 6 (large-scale production) to 92,000 man-years for option 1 (small-scale production). Weaving option 2 ranks second in terms of employment generation with 38,000 man-years (small-scale production) and 35,400 man-years (medium-scale production). Thus, as to be expected, the two hand-looms options generate a great deal more employment than the remaining six weaving options. Among these latter options, the non-automatic and low-cost automatic looms (options 3, 4 and 5) generate two to five times more employment than the three shuttleless looms (options 6, 7 and 8), depending on the scale of production considered. Option 3 ranks first (in terms of employment generation) in the engine-powered looms category.

If indirect employment were to be taken into consideration (e.g. employment generated by the production of looms), the hand-looms options 1 and 2 should generate much more employment than the other options since hand-looms may be manufactured locally while engine-powered looms are, with some exceptions (e.g. India) imported.

TABLE V.1
Socio-economic effects of alternative weaving technologies

Scale of production and weaving option	Number of Mills	Total Employment	Fixed capital requirements		Total Energy Costs	Unit production Cost (Pence)	Cost of cloth for family of five (£)
			Machinery	Buildings			
100,000 m/year							
option 1	1000	92,000	32,600,000	31,710,000	1,070,000	48.314	48.314
option 2	1000	38,000	35,600,000	15,640,000	610,000	37.174	37.174
option 3	1000	15,000	35,600,000	11,100,000	1,230,000	33.434	33.434
1,000,000 m/year (2 shifts)							
option 2	100	35,400	19,750,000	7,707,000	[illegible]483,000	31.775	31.775

option 3	100	9,000	18,300,000	4,947,000	1,040,000	27.289	27.289
option 4	100	6,800	20,450,000	4,819,000	1,035,000	27.395	27.395
option 5	100	6,600	20,400,000	4,899,000	1,036,000	27.366	27.366
5.000.000 m/year (3 shifts)							
option 3	20	7,380	8,120,000	2,337,000	930,200	24.344	24.344
option 4	20	5,640	9,740,000	2,212,800	922,400	24.476	24.476
option 5	20	5,280	9,680,000	2,272,000	920,000	24.350	24.350
option 6	20	5,060	27,980,000	1,467,200	449,800	27.013	27.013
option 7	20	3,360	20,940,000	1,551,200	486,600	25.730	25.730
option 8	20	3,420	12,160,000	1,372,200	810,400	24.317	24.317

II.2 Improvement of the balance of payments

Textile production may affect the balance of payments of a country in the following ways:

- Export of textiles

- Import of yarns

- Import of weaving equipment

- Import of building materials for the construction of the mills

- Import of fuel to generate the energy required by the equipment and for lighting, whenever no local sources of energy are available.

Exports will not be considered in this analysis as the types of cloth covered by this memorandum are intended for local consumption by low-income groups. The import of yarn will not also be considered since it is assumed that the same type and quality of yarn is used by the 8 weaving options. The shuttleless looms do use slightly more yarn than the other types of looms, but this should not substantially increase the amount of foreign exchange needed for the import of yarn.

The import of weaving equipment will apply mostly to weaving options 3 to 8 since few developing

countries produce non-automatic, automatic and shuttleless looms. Thus, it may be assumed that the total value of equipment, for these weaving options, will be in the form of foreign currency. It is, on the other hand, assumed that the hand-looms used in options 1 and 2 are manufactured locally. Table V.1 shows that foreign currency costs of equipment for the weaving options 3 to 8 range from £8,120,000 for option 3, large-scale production, to £35,600,000 for option 3, small-scale production. Option 3 (non-automatic looms) requires the least amount of foreign currency at both the medium-scale level (£18,300,000) and large-scale level (£8,120,000). Options 4 and 5 require 10% more foreign currency than does option 3, while the difference ranges between 50% to 300% for the shuttleless looms (options 6 to 8).

The import of building materials (in particular cement) for the construction of the mills depends on whether these materials are available locally. If this were not the case, 10% to 20% of building costs may be in the form of foreign currency. The largest users of imported materials would then be weaving options 1 and 2, while minimal amounts of imported building materials would be needed by the weaving options 6 to 8.

The import of fuel to generate the electricity needed by the equipment and for lighting will also depend on the availability of local sources of energy (e.g. fuel, hydro-electric power, coal)

If a fuel were to be imported, a large fraction of total energy costs will be in the form of foreign currency. In this case, weaving options 1, 3, 4, 5 and 8 may be considered as the largest users of imported fuel, the difference in energy use being relatively small among these weaving options. On the other hand, weaving options 2, 6 and 7 will use the least amount of imported fuel. It may seem paradoxical that hand-looms may use as much energy as semi-automatic or automatic looms. The reason for this is that lighting requirements are much more important for the large number of small-scale weaving mills (1000 mills are associated with options 1 and 2) than for the small number of medium-scale and large-scale mills (100 and 20 mills are respectively needed to produce the same amount of cloth as 1000 small-scale mills).

If all foreign currency expenditures were to be taken into consideration, options 1 and 2 (hand-looms) may be found to use the least amount of foreign currency, while option 3 (non-automatic looms) may be found to use less foreign currency than to the other engine-powered weaving options (4 to 8).

II.3 Basic needs satisfaction

The matter of basic needs satisfaction may be considered in terms of annual expenditures by low-income groups on textile products. Let us assume an average low-income family of five persons, each member of

the family consuming 20 metres of cloth per year. Estimated total yearly expenditure on cloth by such a family for each weaving option would then be as shown in Table V.1. These estimates range from £24.317 for weaving option 8 to £48.314 for option 1. In general, weaving options 3, 4, 5 and 8 are equally attractive from the point of view of basic needs satisfaction as total expenditures on cloth vary very little from one option to another (£24.317 for option 1 to £24.476 for option 4). If the other options were to be promoted (i.e. options 1, 2, 6 and 7), the average low-income family would have to spend between £1.254 to £23.838 more for its textile needs. Such an additional amount may constitute an important fraction of the total monthly income of such a family. Thus, the latter may either be forced to buy less textile or reduce the consumption of other important items.

II.4 Rural industrialisation

The promotion of rural industrialisation may constitute an important development objective for many developing countries. In general, such industrialisation may not take place if large-scale, capital-intensive plants are favoured over small-scale plants. This is particularly true for large-scale weaving mills which must generally be located in large urban areas for various reasons, including the need of reliable energy sources, good transport facilities and the availability of a large pool of highly skilled labour. On the other hand, small-scale mills could be, in general, located in rural or small urban areas.

Table V.1 shows that 1000 small-scale mills would be required to produce 100,000,000 m/year of cloth while 100 medium-scale mills and 20 large-scale mills would be required to produce the same amount of cloth. Thus, in terms of rural industrialisation, weaving options, 1, 2 and 3 should have a much greater impact than options 4 to 8. A limited impact on rural industrialisation may also be expected from options 4 and 5 should medium-scale mills be favoured over large-scale mills.

II.5 Summary remarks on the socio-economic effects of alternative weaving technologies

The above evaluation of alternative weaving technologies yields the following results:

- Weaving options 1 and 2 (hand-looms) are the most attractive from an employment point of view. Option 3 (non-automatic looms) is, on the other hand, the most labour-intensive when compared to weaving options 4 to 8.

- Weaving options 1 and 2 use relatively less foreign exchange than the other six weaving options, while weaving option 3 relies less on imports than weaving options 4 to 8. Energy use is approximately the same for weaving options 1 to 5 and 8, and decreases markedly for options 6

and 7.

- From a basic needs point of view, option 3 is the most attractive at the small-scale and medium-scale levels, and ranks second after weaving option 8 at a large-scale production level.

- In general, large-scale production is preferable to medium-scale or small-scale production with respect to foreign exchange savings and basic needs satisfaction. On the other hand, small-scale production is much more attractive from an employment point of view and with respect to rural industrialisation.

If the four development objectives considered in this evaluation (i.e. employment generation, improvement of the balance of payments, basic needs satisfaction, and rural industrialisation) were to be assigned equal weights, weaving option 3 (non-automatic looms) used at medium-scale production levels should be preferred to other options. It should, however, be noted that the above conclusion is based on a large number of assumptions which may not apply to many countries.

III. Policy measures for the promotion of appropriate weaving technologies

Depending on a country's socio-economic development objectives, one or more of the weaving options described in this memorandum may be found more suitable than the others. The next step will then be to ensure the adoption of these technologies by private and/or public weaving mills. However, as mentioned earlier, weaving technologies, which should be prefered from a socio-economic point of view, may not be profitable from the point of view of the producer. Governments may therefore need to implement a number of policy measures with a view to inducing producers to adopt weaving technologies consonant with stated development objectives. A number of such measures are briefly described below. It is, however, realised that political and economic constraints may not allow their implementation in all cases.

III.1 Restrictions on the import of machinery

One way of slowing down the adoption of inappropriate weaving technologies could be the imposition of restrictions on the import of machinery required by such technologies. For example, high tariff rates or quotas may be imposed on the import of weaving equipment. However, these measures may not always succeed or could be counterproductive. Instead, requests for equipment could be evaluated on a case by case basis since there may be many instances where the import of such equipment may be justified. If this were the case, the producer should not be penalised by high tariff duties or long delays in the aquisition of equipment.

III.2 Public purchases

In a number of countries, governments have influenced the choice of weaving technology through the purchase of cloth for the public sector (e.g. various categories of workers, the army) from weaving mills which adopt technologies promoted by the Government. This measure, which is relatively easy to apply, may be feasible as long as it does not imply a too high subsidisation of the mills.

III.3 Upgrading of local weaving technologies

Technological innovations in the textile sector have often taken place in industrialised countries and have generally reduced the need for expensive labour. These innovations are therefore often inappropriate for developing countries suffering from high unemployment rates and lack of foreign exchange. These countries should therefore attempt to upgrade the local weaving technologies with a view to improving efficiency and decreasing reliance on imported technologies and equipment. This may be achieved in a number of ways, including research and development work on hand-looms and non-automatic looms, promotion of the local manufacture of simple looms, obtaining information on weaving technologies from developing countries, such as India, which have already acquired a great deal of experience in this field, etc.

III.4 Fiscal and monetary policies

Fiscal and monetary policies may also help promote the adoption of appropriate weaving technologies by the private sector.

One measure which should slow down the use of unsuitable weaving equipment is the imposition of a tax on owned capital equipment. Such a tax will increase depreciation costs and, therefore, the unit production cost of cloth. On the other hand, a number of measures may be used as an inducement to those who wish to adopt appropriate weaving technologies. For example, small-scale weavers may be offered loans at low preferential rates, or may benefit from tax rebates. Wage subsidies may also be considered whenever these are needed in order to make the cloth produced by labour-intensive weaving technologies competitive with that produced by large-scale, capital-intensive plants.

III.5 Assistance to small-scale producers

Small-scale weaving mills may often need various types of assistance if they were to be competitive. Assistance measures may include the following:

- To facilitate the procurement of sufficient quantities of good quality yarn-whenever the latter is imported - as individual small-scale producers may find it difficult to overcome import restrictions and therefore ensure a steady supply of yarn. Thus, these producers would not be at a disadvantage vis-a-vis large-scale mills which do not generally face this type of constraint.

- To provide training and technical assistance to small-scale producers with a view to improving productivity and cloth quality. Technical assistance may consist in advice on the improvement of technology, organisation of production within the mill, marketing of new types of cloth, etc. Mill workers may also need further training, especially if new weaving techniques are being introduced. Such training may be provided on the spot or in trade schools whenever the latter are available and relatively close to the mills.

- To promote groupings of small-scale producers with a view to taking advantage of economies of scale in the preparation of, for example, warps. As indicated in earlier chapters, a small-scale producer may not afford the acquisition of a large capacity warping machine, and must therefore share it with other producers. The grouping of weavers (e.g. in the form of production or service cooperatives) may also be advantageous from an economic point of view as the price of raw materials may be lowered if large amounts of these may be ordered in bulk for the whole grouping of weavers. Similarly, better prices for the cloth may be obtained if marketing of the latter can be organised through a single marketing outlet set up by the producers.

- To promote the local production of spare parts for the weaving equipment with a view to avoiding long shut-downs of small mills if these spare parts were to be imported. In the long run and whenever demand for weaving equipment is sufficiently large, the local production of this equipment should be encouraged.

The above measures are only examples of the type of assistance which may be provided to small-scale producers. Depending on local circumstances pertaining to the weaving sector, other measures may be identified and implemented with a view to promoting weaving technologies consonant with adopted socio-economic objectives.

Home"" """"> ar.cn.de.en.es.fr.id.it.ph.po.ru.sw

Small-Scale Weaving (ILO - WEP, 1983, 144 p.)
APPENDICES
APPENDIX I. Compound interest, factors
APPENDIX II. Textile terms and definitions
APPENDIX III. Equipment manufacturers
APPENDIX IV. Institutions able to supply technological information related to textiles
APPENDIX V. Selected bibliography

Small-Scale Weaving (ILO - WEP, 1983, 144 p.)

APPENDICES

APPENDIX I. Compound interest, factors

	Interest Rate											
	5%		10%		12½%		15%		20%		25%	
	Factor											
Years	Present worth	Annual capital recovery	Present worth	Annual capital recovery	Present worth	Annual capital recovery	Present worth	Annual capital recovery	Present worth	Annual capital recovery	Present worth	Annual capital recovery
1	0.952	1.050	0.909	1.100	0.889	1.125	0.870	1.150	0.833	1.200	0.800	1.250
5	0.784	0.321	0.621	0.264	0.555	0.281	0.497	0.298	0.402	0.334	0.328	0.372
10	0.614	0.130	0.386	0.163	0.308	0.181	0.248	0.199	0.162	0.239	0.107	0.280
15	0.481	0.096	0.239	0.131	0.171*	0.151*	0.123	0.171	0.065	0.214	0.035	0.259
20	0.377	0.080	0.149	0.117	0.095	0.138	0.061	0.160	0.026	0.205	0.016	0.253
25	0.295	0.071	0.092	0.110	0.053	0.132	0.030	0.155	0.011	0.202	0.004	0.251
50	0.231	0.065	0.057	0.106	0.029	0.129	0.015	0.152	0.004	0.201	0.001	0.250

APPENDIX II. Textile terms and definitions

Term	Definition
Back Beam	A beam from which yarn is fed during the sizing process
Ball Warp	Parallel threads in the form of a leased twistless rope wound into a large ball by hand or by a mechanical balling machine
Beam	A cylinder (of wood or metal) on which yarn is wound, usually in sheet form
Beaming	The primary operation of warp-making in which ends withdrawn from a warping creel, evenly spaced in sheet form, are wound onto a beam to substantial length (usually a multiple of loom warp length)
Beating-Up	The third of the three primary motions involved in weaving. It consists in forcing the pick of weft yarn left in the warp shed up to the 'fell' of the cloth
Bobbin	A cylindrical or slightly tapered barrel, with or without flanges, on which yarn is wound
Carded Yarn	A yarn produced from fibres that have been carded but not combed
Combed Yarn	A yarn prepared from sliver which is first carded and later combed in order to produce a more regular and smoother final product
Continuous-filament yarn	A yarn composed of one or more filaments that run the whole length of the yarn. Note: Yarns of one or more filaments are usually referred to as monofilament or multifilament, respectively
Cop	A form of package of yarn such as is spun on a mule spindle
Creel	A structure for mounting supply packages in textile processing
Crimp	(a) The waviness of a fibre

Crimp	(a) The waviness of a fibre (b) The waviness or distortion of a yarn that is due to interlacing in a fabric
Dent	The unit of a reed, comprising a reed wire and a space between adjacent wires
Doubled Yarn	Yarns composed of two or more 'singles' yarns which are twisted (folded) together
Drawing-In	The process of drawing (threading) the warp ends through the eyes of the healds and the dents of the reed
Dressing (Warp)	The operation of assembling on a beam, yarns from ball warps, beam, or chain prior to weaving. 'Scotch dressing' (dry taping, Scotch beaming) - a method of preparing striped warp beams for weaving
Drop Wire (Pin)	One of a series of metal strips suspended on individual warp threads during warping or weaving. If a thread breaks its drop pin falls, causing the machine to stop
End	(a) Weaving - An individual warp thread (b) Fabric - A length of fabric of less than the customary unit (piece) length
Fell	The line of termination of the cloth in the loom formed by the last weft thread inserted
Fents	Short lengths of fabric (perfect or imperfect) cut from an end, piece, or lump of fabric
Gait or Gait-Up	General terms used to describe the positioning of the warp, healds and reed in the loom in readiness for weaving
Grey Goods (cloth)	Woven or knitted fabrics as they leave the loom or knitting machine - not bleached or finished
Hank	(a) A 'skein' of yarn in coiled form

	(b) A definite length of yarn, sliver or roving (cotton hank = 840 yards in the English (Ne) system)
Heald (heddle)	A looped cord, shaped wire, or flat steel strip with an eye in the centre through which a warp yarn is threaded so that its movement can be controlled in weaving
Heald Frame (shaft, stave)	A rectangular frame on which healds are mounted in the loom
Jacquard Mechanism (weaving)	A shedding mechanism, attached to a loom, that gives individual control of up to several hundred warp threads and thus enables large figured designs to be produced
Jean	A 2/1 warp-faced twill fabric used chiefly for overalls
Lease	A formation of the ends of a warp that maintains orderly arrangement of the ends during warping, preparation processes, and weaving
Leno Weave	A weave in which warp threads are made to cross one another between the picks
Let-Off Motion	A mechanism for controlling the delivery and tension of the warp during weaving
Loom Efficiency	The ratio of the average picks per minute actually inserted by the loom (taking account of normal stoppages) to the loom speed in picks per minute, expressed as a percentage
Looming	A term covering the processes involved in preparing the weaver’s beam for the loom
Loomstate	See Grey Cloth
Loose Reed	A reed so mounted in the loom sley as to yield under the pressure of the shuttle at beat-up should the shuttle fail to reach the receiving box

Lump	A length of fabric (usually unfinished) longer than the piece length
Negative shedding	An operation in which the movement of the healds in controlled in one direction only, the return movement being effected by springs or weights
Picker	The part of the picking mechanism of the loom that actually strikes the shuttle
Picking	The action of passing the weft through the warp shed during weaving
Piece (fabric)	A length of fabric of customarily accepted unit length
Plating machine	A machine for the continuous folding of fabric into fixed warp-way lengths; usually the folding is at 1 metre or 1 yard intervals
Positive-shedding	An operation in which the movement of the healds in both directions is under direct control
Reed	A device consisting of wires closely set between an upper and a lower baulk. In weaving the reed is used to maintain the required spacings of the warp threads between healds and cloth fell and to guide the shuttle and to beat-up the weft picks
Sateen	A weft-faced weave in which the binding places are arranged with a view to produce a smooth cloth surface, free from twill
Satin	A warp faced weave in which the binding places are arranged with a view to produce a smooth cloth surface, free from twill
Section-warping	A two-stage machine method of making a loom warp - there are a number of systems

Selvedge	The longitudinal edges of a fabric formed during weaving
Set, Sett	(i) A term used to indicate the spacings of ends and picks in a woven cloth (ii) The number of warpers' back beams, required to produce the final weavers beams in the sizing operation
Sizing (for weaving)	The application of size to warps on yarns, generally before weaving, to act as a protective film against abrasion
Slasher sizing	A method of machine warp sizing from back beams
Sley (slay)	That oscillating part of a loom, positioned between the healds and the cloth fell which carries the reed and shuttle boxes
Slubs	Short, abnormally thick places in a yarn
Sow-box	The container (trough, pan) of the size solution of a warp-sizing machine
Take-up Motion	A mechanism to control the winding - forward of the cloth during weaving
Taping	A term for 'slasher' warp sizing
Temple (weaving)	A means for holding the fabric out to width as it is woven in the loom and before it is wound onto the cloth roller
Twisting-in	The operation of twisting ends of a new warp to the corresponding ends of an old warp to enable the supply to be maintained without re-threading through the healds and reed
Voile	A light-weight, open textured, plain weave cloth made from fine yarns with sufficient twist to produce a,

Voile	A light-weight, open-textured, plain weave cloth made from fine yarns with sufficient twist to produce a, compact, round thread
Warp	Threads lengthways in a fabric as woven
Warpers' Beam	A beam on which yarn has been wound in a warping machine
Weave	The pattern of interlacing of warp and weft in a woven fabric
Weave Repeat	The smallest dimension, ends and picks, on which a weave interlacing can be represented
Weaving Shed Efficiency	The ratio of the 'Actual output' to the 'Possible output' expressed as a percentage
Weft	Threads widthways in a fabric as woven

APPENDIX III. Equipment manufacturers

Note on equipment manufacturers

The following list of equipment manufacturers is far from being exhaustive, and is only provided for illustrative purposes. The reader is therefore urged to obtain additional names of weaving equipment manufacturers from local equipment suppliers and international trade journals, some of which are listed in the bibliography. It must be stressed that reference to names of firms listed below does not imply endorsement of the latter by the International Labour Office, and any failure to mention a particular firm does not constitute a sign of disapproval.

I. Warping machinery

ARCT, 42300 Roanne, France
Hacoba GmbH, 56 Wuppertal-Barmen, Federal Republic of Germany

Central India Machinery Manufacturing Co. (CIMMCO), Gwalior, India
Comat SpA, Firenze, Italy
Tsudakoma Industrial Co., Nomachi, Kanazana, Japan
Benninger AG, 9240 Uzwil, Switzerland
George Hattersley and Sons Ltd, Keighley, United Kingdom
Wilson and Longbottom, Barnsley, United Kingdom
West Point Foundry and Machine Co., Georgia, 31833, United States

II. Warp sizing machinery and equipment

ARCT, 42300 Roanne, France
SACM, Mulhouse 68054, France
Hergeth, 2820 Breman-Farge, Federal Republic of Germany
Sucker GmbH, 4050 Monchengladbach, Federal Republic of Germany
ZELL J. Kruckels, 7863 Zell, Federal Republic of Germany
Ramallumin, 20025 Legano, Italy
TSUDAKOMA, Kanazawa, Japan
ASISA, Barcelona, Spain
Platt-Sizing, P.O. Box 13, Bolton, United Kingdom
WILSON and LONGBOTTOM, Barnsley, United Kingdom
Barber-Colman Co., Rockford, IL 61101, United Kingdom
West Point Foundry Co., Georgia, United States

III. Pirn winding machinery

HACOBA GmBH, 4050 Monchengladbach, Federal Republic of Germany
SCHLAFHORST, 4050 Monchengladbach, Federal Republic of Germany
SCHWEITER AG, 5620 Velbert 11 - Langenberg, Federal Republic of Germany
BRUGGER SpA, 22100 COMO, Italy
SCHARER AG, 8703 Erienbach, ZURICH, Switzerland
George Hattersley and Sons Ltd., P.O. Box 19, KEIGHLEY, United Kingdom
ABBOTT Machine Co Inc., WILTON, N.H. 03086, United States

IV. Looms (manufacturers and developers)

(a) Hand-looms with fly-shuttle motions

Nilus Leclers, l'Islet, Quebec, Canada.

Anders Ervad and Son A/S, Askow, DK-6600 Vejen, Denmark.

Vavstolsfabriken Glimakra AB, Box 125, S-28064 Glimakra, Sweden.

Harris Looms, Emmerich (Berlon) Ltd., Wotton Road, Ashford, Kent, United Kingdom.

George Hattersley and Sons Ltd., North Brook Works, Keighley, United Kingdom.

Intermediate Technology Industrial Services (Development Group Ltd.), Myson House, Railway Terrace, Rugby, United Kingdom.

Mailes Looms, 4620 Glen Haven Rd., Soquel, Calif 95071, United States.

Newcomb Loom Company, P.O. Box 3204, Davenport, Iowa 52808, United States.

Iris Engineering, Coimbatore, India.

AVL Looms, Chico, California, United States.

Balaju Yantra Shala, Kathmandu, Nepal.

(b) Non-automatic power looms

Non-automatic power looms are often supplied by manufacturers of automatic looms. In this case, the latter are simply stripped of the automatic weft replenishment means. Most of the non-automatic looms of this type used in developing countries have been converted from automatic looms of the shuttle-change type. However, a few manufacturers still offer low-cost, non-automatic power looms. Some of these are:

Central India Machinery Manufactures Company, (CIMMCO), Gwalior, India.
Cooper Engineering, Poona, India.
National Machinery Makers, Ltd., Kalwe Thana, India.
British Northrop, Ltd., Blackburn, United Kingdom.

(c) Automatic shuttle looms

'Hoeck', 4850 Ensival, Belgium.
Picanol N.V., 8900 Leper, Belgium.
Investa Ltd., 460 01 Liberec, Czechoslovakia.
Central India Machinery Manufacturing Co. Ltd., (CIMMCO), Honest Trading Co., India
Toyoda Automatic Loom Works Ltd., Aichi 448, Japan
Tsudakoma Industrial Co. Ltd., Kanazawa, Japan
Adolph Saurer Ltd., Arbon, Switzerland
Ruti A.G., 8630 Ruti, Zurich, Switzerland
Bently Weaving, Loughborough, Leicestershire, United Kingdom
British Northrop Ltd., Blackburn, Lancashire, United Kingdom
George Hattersley and Sons Ltd, P.O. Box 19, Keighley, United Kingdom

(d) Second-hand and reconditioned looms suppliers

Joseph Kruckels, Munchengladbach, Federal Republic of Germany
Bestex Textile Machinery, Blackburn, United Kingdom
Reconditioned looms, Blackburn, United Kingdom

V. Looming equipment manufacturers

Titan Textile Machines, 2750 Ballerup, Denmark
Exacta-Maschinenbau KG, 7410 Reutlingen 24, Federal Republic of Germany
Schultheis GmbH, 6400 Fulda, Federal Republic of Germany
Zellweger Uster AG, 8610 Uster, Switzerland
Macart Textiles Ltd., Bradford, United Kingdom
Barber-Colman Co., Rockford, IL 61101, United States

APPENDIX IV. Institutions able to supply technological information related to textiles

AUSTRALIA

Commonwealth Scientific and Industrial Research Organisation, Division of Textile Industry
GEELONG, Victoria 3216

School of Textile Technology, University of New South Wales
KENSINGTON, N.S.W.

BELGIUM

Centre Scientifique et Technique de l'Industrie Textile Belge,
B-1040 BRUXELLES

International Institute for Cotton,
BRUXELLES 4

CZECHOSLOVAKIA

Statny Vyskumny Ustav Textilny (State Textile Research Institute),
Svut Liberec

FRANCE

Institut Textile de France,
BOULOGNE SUR SEINE

HUNGARY

Textilipari Kutato Intezet (Textile Research Institute)
BUDAPEST X

INDIA

Ahmedabad Textile Industry's Research Association (ATIRA)
ATIRA AHMEDABAD

The Bombay Textile Research Association,
BOMBAY 86

The South India Textile Research Association,
SITRA COIMBATORE

INDONESIA

Institut Teknologi Tekstil,
318 BANDUNG

ISRAEL

Israel Fibre Institute
JERUSALEM

ITALY

Instituto Tecnico Cotoniero dell' Associazione Cotoniera Italiana,
MILANO

NETHERLANDS

Vazelinstituut TNO "De Voorzore",
Entschede Hengelosestraat 715,
THE HAGUE

PAKISTAN

Pakistan Institute for Cotton Research and Technology,
KARACHI 1

POLAND

Centralne Laboratorium Przemyslu Bawelnianego
(Central Laboratory for Cotton Industry)
LODZ, Piotrkowska 276

ROMANIA

Textile Research Institute,
BUCHAREST

SPAIN

**Institute Textile y de Curtidos - Centro de Investigacin y Desarrollo, Patronato Juan de la Cierva,
BARCELONA 17**

SWITZERLAND

**Institut Batelle,
GENEVE**

**Institut fr Textilmaschinenbau und Textilindustrie,
ZURICH**

THAILAND

**Fibre Experimental Centre,
BANGKOK 11**

UNITED KINGDOM

**Shirley Institute,
Didsbury,
MANCHESTER M20 8RX**

**Department of Textile Industries of the University of Leeds,
LEEDS**

**University of Manchester, Institute of Science and Technology (UMIST)
MANCHESTER**

**The Textile Institute,
Blacksfair Street,
MANCHESTER**

UNITED STATES

Arthur D. Little Inc.
CAMBRIDGE, Mass. 02140

The Franklin Institute Research Laboratories,
PHILADELPHIA, Pa 19105

Lowell Technological Institute,
LOWELL, Mass. 01854

USDA Agricultural Research Service,
Southern Utilisation and Development Division,
NEW ORLEANS, Louisiana 70119

FEDERAL REPUBLIC OF GERMANY

Institut fr Textiltechnik der Rhein-Westf.,
HOCHSCHULE AACHEN

TURKEY

Bolgne Pamul Arastirma (Regional Cotton Research Institute)
ADANA

APPENDIX V. Selected bibliography

Aitken, J.B.: Automatic weaving (Blackpool, United Kingdom, Columbine Press, 1964)

Bjorg, Kristiansen White: Weaving guide - Lesotho (Geneva, ILO, 1981)

Bruce, R.: A search for an appropriate technology for decentralised cotton spinning industry in rural India (Lucknow, India, Appropriate Technology Development Association, 1977)

Cooper, C.; Kaplinsky, R.: Second-hand equipment in a developing country (Geneva, ILO, 1974)

Duxbury, V.; Wray, G.R.: Modern developments in weaving (Blackpool, United Kingdom, Columbine Press, 1962)

Lord, P.R.; Mohamed, M.H. Weaving: Conversion of yarn to fabric (Durham, United Kingdom, Merrow Press, 1976)

Marks, R.; Robinson, A.T.C.: Principles of weaving (Manchester, Textile Institute, 1976)

Pack, H.: "The choice of technique and employment in the textile industry", in A.S. Bhalla (ed.): Technology and employment in industry: A case study approach (Geneva, ILO, 2nd. ed., 1981)

Pickett, J.; Robson, R.: "A note on operating conditions and technology in African textile production" in World Development. Vol. 5, 1977, No. 9/10

Snowden, D.C.: The production of woven fabrics (Manchester, Textile Institute, 1972)

Tairo, B.: Automatic looms (India, Textile and Allied Industries, 1974); published in English and Gujarati.

United Nations: Weaving and associated processes, Report of the Lodz Textile Seminars, No. 3, Volume 4 (New York, United Nations, 1970)

UNIDO: Report of the Expert Group Meeting on the Selection of Textile Machinery (Vienna, United Nations, 1967)

UNIDO: Appropriate industrial technology for textiles (New York, United Nations, 1979)