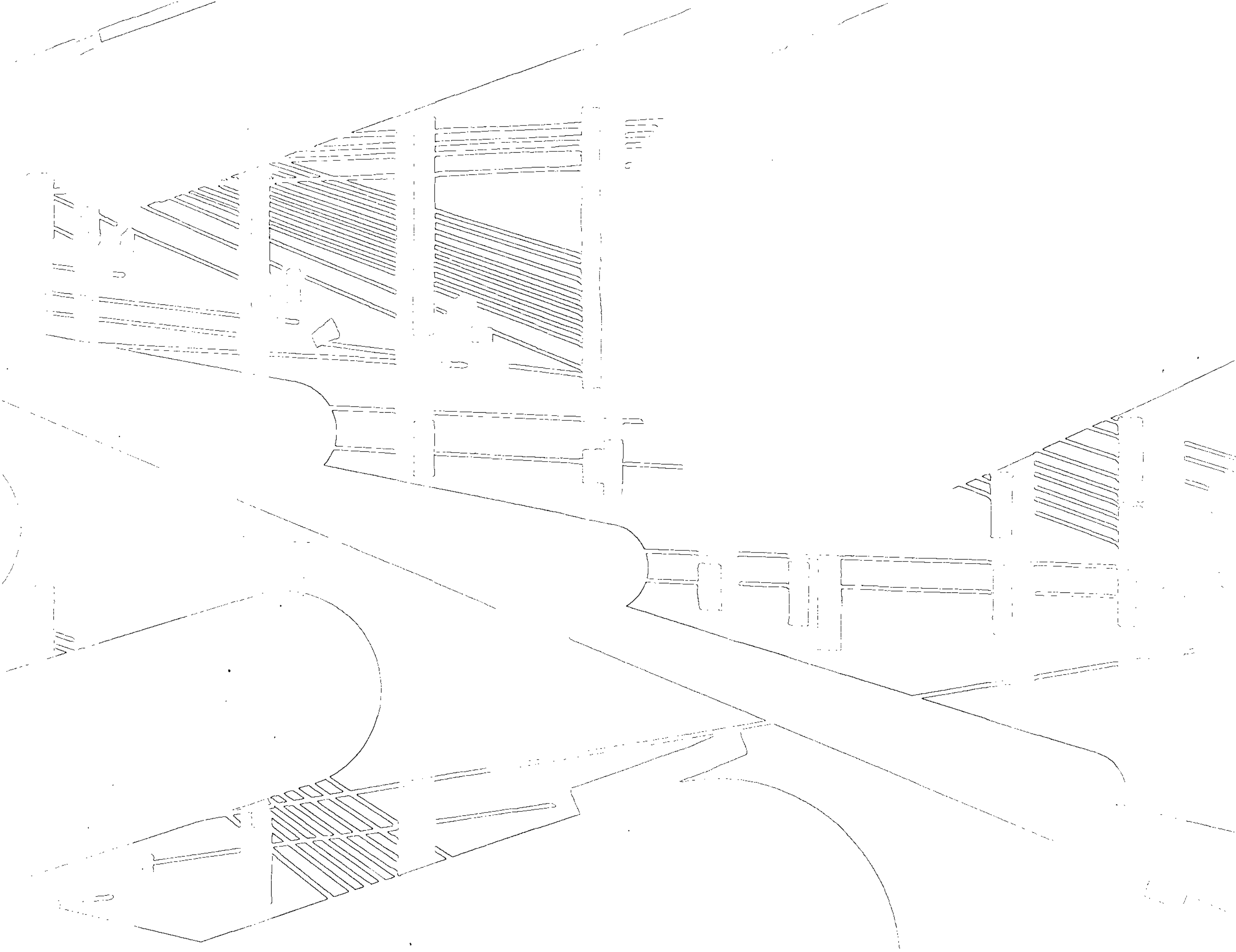

# THE TEXTILE INDUSTRY IN LATIN AMERICA

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## CHAPTER I

# INTRODUCTION AND CONCLUSIONS

### 1. INTRODUCTION

The present study is the second in a series that is being carried out by the secretariat of the Economic Commission for Latin America (ECLA) in compliance with the pertinent resolutions of the Commission, especially resolution 201 (IX), adopted at its ninth session, which took note of the fact that the secretariat had embarked upon "studies on the textile industries in some countries of the region in response to requests made by institutions in those countries," and recommended to the secretariat "that it extend such studies to other countries of the region which have expressed interest in the matter". This undertaking is also consistent with resolution 3, adopted by the Provisional Committee of the Latin American Free-Trade Association on 29 April 1960, in which ECLA was requested to carry out a study on the production, import and export of manufactured goods and the corresponding raw materials in the member countries, with a view to the provision of background data on the possibilities for trade and complementarity in that field.

It should be placed on record that the initiative and generous co-operation of textile manufacturers' associations are making a decisive contribution to the implementation of this project. Both in the first study, on Chile,[1] and in the present report on Brazil, the textile industry has actively co-operated in the preparation of the relevant surveys, as well as by furnishing data without which the studies could not have been carried out. Mention must also be made of the help given by the United Nations Bureau of Technical Assistance Operations (BTAO), which has collaborated with the ECLA secretariat through a regional project under the technical assistance programme, lending the services of one of its textile experts.

In respect of the present study, the co-operation of the Spinners' and Weavers' associations of the Centro-Sul region of Brazil was of invaluable assistance in the carrying out of a survey which covered more than 800 textile establishments in that part of the country, and served as a basis for the analyses and conclusions presented here. The Nordeste of Brazil was not included in the survey, since a comprehensive study of the textile industry in that area had previously been undertaken on lines essentially similar to those pursued in the present report. The study in question, made by the Superintendencia do Desenvolvimento do Nordeste (SUDENE), also benefited by the co-operation of a textiles expert from the United Nations technical assistance programme. Its conclusions were reflected in a programme for the reorganization and modernization of the textile industry in the Nordeste, which is already under way. The data for this region that are included in the present document for purposes of comparison are based on the SUDENE study.

In view of the felicitous results achieved through co-operation between the ECLA secretariat and the textile manufacturers, it is deemed of interest to outline the various stages of the work carried out.

In the first phase of the project, the coverage and methodology of the survey were defined, on the basis of direct contact between representatives of the Brazilian textile industry and technical experts from ECLA. To this end, a mission headed by the Chief of the Re-equipment Commission of the Textile Manufacturers' Association of the State of São Paulo went to ECLA headquarters to discuss matters relating to the organization and execution of the work. Draft questionnaires for use in the survey, prepared on this occasion, were subsequently submitted for criticism to representatives of the various branches of the textile industry in Brazil. At the same time, the manufacturers of textile machinery supplied data both on the technical characteristics of the various types of up-to-date machinery manufactured at home or abroad, and on the corresponding production standards. These technical characteristics and production standards were used as a basis for estimating a future inventory of textile machinery.

The second phase of the work comprised the field survey, during which the questionnaires were filled up by means of direct visits made by several teams of enumerators to more than 800 textile establishments in the states covered by the survey. At this stage, the collaboration of the Spinners' and Weavers' associations in several states was particularly valuable.

The final phase of the project consisted in analysis and interpretation of the data collected which were supplemented with Brazilian and international official statistics. This stage of the work was carried out at ECLA headquarters. Lastly, a small group of textile manufacturers from several states co-operated in the preparation of this provisional version of the study by offering their comments and criticisms.

### 2. CONCLUSIONS

(1) The textile industry represents one of Brazil's most important sources of productive employment, providing work directly for more than 300,000 operatives —i.e., approximately one-fourth of the total labour force employed by manufacturing industry in Brazil—and indirectly for about another 500,000 persons engaged in the production of the raw materials used. According to estimates, it directly contributes 14 per cent of value added in the manufacturing sector, which accounts for 25 per cent of national income. Thus, levels of productivity and wages in the textile industry are important

[1] *La industria textil en América Latina. I. Chile.* (United Nations publication, Sales No.: 63. II.G.5)

## Chapter I

# INTRODUCTION AND CONCLUSIONS

### 1. Introduction

The present study is the second in a series that is being carried out by the secretariat of the Economic Commission for Latin America (ECLA) in compliance with the pertinent resolutions of the Commission, especially resolution 201 (IX), adopted at its ninth session, which took note of the fact that the secretariat had embarked upon "studies on the textile industries in some countries of the region in response to requests made by institutions in those countries," and recommended to the secretariat "that it extend such studies to other countries of the region which have expressed interest in the matter". This undertaking is also consistent with resolution 3, adopted by the Provisional Committee of the Latin American Free-Trade Association on 29 April 1960, in which ECLA was requested to carry out a study on the production, import and export of manufactured goods and the corresponding raw materials in the member countries, with a view to the provision of background data on the possibilities for trade and complementarity in that field.

It should be placed on record that the initiative and generous co-operation of textile manufacturers' associations are making a decisive contribution to the implementation of this project. Both in the first study, on Chile,[1] and in the present report on Brazil, the textile industry has actively co-operated in the preparation of the relevant surveys, as well as by furnishing data without which the studies could not have been carried out. Mention must also be made of the help given by the United Nations Bureau of Technical Assistance Operations (BTAO), which has collaborated with the ECLA secretariat through a regional project under the technical assistance programme, lending the services of one of its textile experts.

In respect of the present study, the co-operation of the Spinners' and Weavers' associations of the Centro-Sul region of Brazil was of invaluable assistance in the carrying out of a survey which covered more than 800 textile establishments in that part of the country, and served as a basis for the analyses and conclusions presented here. The Nordeste of Brazil was not included in the survey, since a comprehensive study of the textile industry in that area had previously been undertaken on lines essentially similar to those pursued in the present report. The study in question, made by the Superintendencia do Desenvolvimento do Nordeste (SUDENE), also benefited by the co-operation of a textiles expert from the United Nations technical assistance programme. Its conclusions were reflected in a programme for the reorganization and modernization of the textile industry in the Nordeste, which is already under way. The data for this region that are included in the present document for purposes of comparison are based on the SUDENE study.

In view of the felicitous results achieved through co-operation between the ECLA secretariat and the textile manufacturers, it is deemed of interest to outline the various stages of the work carried out.

In the first phase of the project, the coverage and methodology of the survey were defined, on the basis of direct contact between representatives of the Brazilian textile industry and technical experts from ECLA. To this end, a mission headed by the Chief of the Re-equipment Commission of the Textile Manufacturers' Association of the State of São Paulo went to ECLA headquarters to discuss matters relating to the organization and execution of the work. Draft questionnaires for use in the survey, prepared on this occasion, were subsequently submitted for criticism to representatives of the various branches of the textile industry in Brazil. At the same time, the manufacturers of textile machinery supplied data both on the technical characteristics of the various types of up-to-date machinery manufactured at home or abroad, and on the corresponding production standards. These technical characteristics and production standards were used as a basis for estimating a future inventory of textile machinery.

The second phase of the work comprised the field survey, during which the questionnaires were filled up by means of direct visits made by several teams of enumerators to more than 800 textile establishments in the states covered by the survey. At this stage, the collaboration of the Spinners' and Weavers' associations in several states was particularly valuable.

The final phase of the project consisted in analysis and interpretation of the data collected which were supplemented with Brazilian and international official statistics. This stage of the work was carried out at ECLA headquarters. Lastly, a small group of textile manufacturers from several states co-operated in the preparation of this provisional version of the study by offering their comments and criticisms.

### 2. Conclusions

(1) The textile industry represents one of Brazil's most important sources of productive employment, providing work directly for more than 300,000 operatives —i.e., approximately one-fourth of the total labour force employed by manufacturing industry in Brazil—and indirectly for about another 500,000 persons engaged in the production of the raw materials used. According to estimates, it directly contributes 14 per cent of value added in the manufacturing sector, which accounts for 25 per cent of national income. Thus, levels of productivity and wages in the textile industry are important

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with the formula that would represent the biggest reduction of costs in relation to the present situation.

The general plan of the study having thus been outlined, some of the most important data relating to the re-equipment problem are set forth below.

(3) The comprehensive survey undertaken (covering 855 establishments) affords a fairly detailed picture of labour productivity and the unit output of machinery in the spinning and weaving industries in Brazil. To facilitate evaluation of the present state of affairs, standards of comparison were adopted which represented levels of performance considered to be fairly easily attainable in conditions with respect to size of markets, degree of automatic control of machinery and training of manpower that would, broadly speaking, be appropriate in Latin America. These Latin American standards are, moreover, substantially inferior to those reached, on an average, in the corresponding industries in western Europe, not to mention the United States, where the special conditions prevailing would make the comparison less significant.

According to the findings obtained, the output of the existing machinery in cotton spinning mills—14 grammes per spindle/hour—represents only 58 per cent of what was taken as the standard for Latin America. Similarly, in cotton weaving mills the unit output of the machinery—2.93 metres per loom/hour—is only a fraction of the standard figure, not exceeding 54 per cent of the yield that could be obtained with up-to-date and efficiently utilized machinery in Latin American conditions. In the processing of wool, the indices are equally unfavourable, showing only 38 per cent of the theoretical output per spindle/hour for the spinning industry, and 56 per cent of the standard output per loom/hour for the weaving industry.

For productivity, even lower levels are registered. In cotton processing, output per man/hour was 1,995 grammes in the spinning industry (or 46 per cent of the standard volume) and 8.18 metres in the weaving industry (or 30 per cent of the standard length). To show that the standards of comparison adopted are realistic, it will suffice to mention that the standard level of productivity for spinning mills is 4,300 grammes per man/hour, whereas the corresponding figures rise to over 5,500 grammes in western Europe and to 12,400 grammes in the United States, for the same yarn count.

A comparison between levels of productivity in Brazil's spinning and weaving industries and in those of other Latin American countries, such as Chile and Peru, is also unfavourable to the former.

These low levels of machine output and manpower productivity are imputable partly to the high degree of obsolescence of the machinery in use and partly to the marked shortcomings in the internal organization of the industry, including the failure to train the workers properly to operate even the existing out-of-date equipment.

The machine inventory in the spinning and weaving industries is characterized by a high degree of obsolescence. The obsolescence of machinery (measured both in terms of age and by certain technical characteristics), in the various phases of the production process and according to the fibres handled, was analysed in detail for the purposes of the present study, with results which bear eloquent witness to the unsatisfactory operational conditions prevailing in the industry. In the cotton sector, the classification of machinery (establishment by establishment) reveals that approximately 80 per cent of the spindles and nearly 70 per cent of the looms are obsolescent. In wool processing, the state of the equipment is not quite so bad, 48 per cent of the spindles and 62 per cent of the looms being obsolete. The situation is more favourable where the spinning of man-made fibres and of flax is concerned, but is equally serious in the weaving of these fibres and in both the spinning and the weaving of jute. According to the findings of the survey, it is not only in the production machinery (spindles and looms) that the degree of obsolescence is high. The same is true of the machinery used in the other phases of the textile production process, such as preparation for spinning and for weaving, and, to a lesser extent, fabric processing, in respect of the several kinds of fibres worked by the industry.

The marked obsolescence of the machine industry in Brazil's spinning and weaving industries is the result of conditions deriving from the history of this branch of manufacture, which are unfavourable to a systematic policy for the renewal of machinery, but which were not analysed. The present study is confined to observation of the existing state of affairs and to investigation of the incidence of the obsolescence of the machinery in the low levels of machine output and labour productivity observed. Despite the difficulties inherent in attempts to measure this incidence, an estimate prepared for the cotton industry, which is the largest sector in the Brazilian textile industry as a whole, shows that approximately one-third of the total operational deficiency is due to the obsolescence of the machinery, while under-utilization of the existing machinery (irrespective of its age and technical characteristics) as a result of defective internal organization accounts for the remaining two-thirds. The generic term "internal organization" includes such physical elements as balance of production, distribution of work loads and lay-out of factories, and such human elements as efficiency of administration and manpower training.

(4) A re-equipment programme entails substantial investment. Moreover, by virtue of the higher degree of automatic control introduced in the plant, and the improvement of productivity, much less manpower is required to obtain the same volume of output. These two aspects of the problem must be quantitatively assessed, and then weighed against the benefits obtained in the form of increased machine yield and labour productivity, and reduced costs. Again, a comparison of costs and benefits will only acquire its proper significance if due consideration is given to the practical prospects of improving operational conditions in the industry without new investment, that is, on the basis of continued use of the same machinery.

In order to make such a comparison possible, as well as to quantify, for illustrative purposes, a specific re-equipment programme, two alternative technologies were defined, the first based on the reconditioning of those obsolete machines which were capable of satisfying certain minimum performance criteria after modernization and replacement of worn-out or hopelessly out-of-date machines by new units, and the second on the substitution of new equipment for all the units classified as obsolete in each sector. The value of a reconditioned machine, including the cost of reconditioning, does not as a general rule exceed 50 per cent of the value of the with the formula that would represent the biggest reduction of costs in relation to the present situation.

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The marked obsolescence of the machine industry in Brazil's spinning and weaving industries is the result of conditions deriving from the history of this branch of manufacture, which are unfavourable to a systematic policy for the renewal of machinery, but which were not analysed. The present study is confined to observation of the existing state of affairs and to investigation of the incidence of the obsolescence of the machinery in the low levels of machine output and labour productivity observed. Despite the difficulties inherent in attempts to measure this incidence, an estimate prepared for the cotton industry, which is the largest sector in the Brazilian textile industry as a whole, shows that approximately one-third of the total operational deficiency is due to the obsolescence of the machinery, while under-utilization of the existing machinery (irrespective of its age and technical characteristics) as a result of defective internal organization accounts for the remaining two-thirds. The generic term "internal organization" includes such physical elements as balance of production, distribution of work loads and lay-out of factories, and such human elements as efficiency of administration and manpower training.

(4) A re-equipment programme entails substantial investment. Moreover, by virtue of the higher degree of automatic control introduced in the plant, and the improvement of productivity, much less manpower is required to obtain the same volume of output. These two aspects of the problem must be quantitatively assessed, and then weighed against the benefits obtained in the form of increased machine yield and labour productivity, and reduced costs. Again, a comparison of costs and benefits will only acquire its proper significance if due consideration is given to the practical prospects of improving operational conditions in the industry without new investment, that is, on the basis of continued use of the same machinery.

In order to make such a comparison possible, as well as to quantify, for illustrative purposes, a specific re-equipment programme, two alternative technologies were defined, the first based on the reconditioning of those obsolete machines which were capable of satisfying certain minimum performance criteria after modernization and replacement of worn-out or hopelessly out-of-date machines by new units, and the second on the substitution of new equipment for all the units classified as obsolete in each sector. The value of a reconditioned machine, including the cost of reconditioning, does not as a general rule exceed 50 per cent of the value of the partly offset, however, by the expansion of apparent consumption that would gradually take place in the course of execution of the re-equipment programme.

The projection of demand formulated in the present study shows that apparent consumption of textiles is increasing in Brazil at an annual rate of approximately 5 per cent, so that by 1970 the market will presumably be about one-third as large again as at present.

With due allowance for the partial reabsorption in the industry itself that would result from the expansion of the market, it was estimated that the displacement of manpower at the conclusion of a re-equipment programme such as that quantified would roughly correspond to a little over 40 per cent of the volume of employment currently provided. This is a manifestly unfavourable aspect of any re-equipment programme for the spinning and weaving industries, where the result of deficient operational conditions is precisely a high proportion of redundant manpower.

It is largely the peculiar nature of technology in the textile sector that determines this situation. The difference between a unit of equipment which is obsolete (i.e., old and technically outdated) and another which is completely up-to-date lies not so much in the latter's higher yield per hour as in the much smaller volume of manpower required for its operation. Thus in the cotton sector, for example, the difference between a power loom and an automatic loom,[6] measured in terms of picks per minute, does not exceed 32 per cent (an increase from 144 to 190 picks), whereas the workloads corresponding to these units increase by 233 per cent (from 6 to 20 looms per operative), so that the manpower required decreases accordingly by 43 per cent (from 7 to 4 operatives per 20 looms). That is, the evolution of the technology of textile manufacturing has been primarily governed by the desire to save labour rather than capital; in other words, its direction has been determined by the requirements of the more highly industrialized countries, where—relatively speaking—capital is plentiful and labour in short supply.

In practice, the magnitude of the manpower displacement problem which might derive from the implementation of a modernization and re-equipment programme for the spinning and weaving industries might not prove as great as indicated above, since, on the one hand, the programme would be gradual in its execution and slow to yield results in the shape of improved productivity, and, on the other, the textile market might expand still further in consequence of the increasing efforts to promote a more balanced regional and personal distribution of income. In any event, given the fact that in the textile industry the annual rate of labour turnover deriving from normal dismissals or withdrawals is about 10 per cent, it might be possible to co-ordinate the gradual implementation of a re-equipment programme with a total or partial suspension of labour recruitment, as a means of cushioning the impact of the displacement of manpower on the economy.

(7) The foregoing considerations clearly demonstrate the need for efforts to reorganize and modernize the textile industry, comprising a consistent body of measures designed to raise its levels of productivity. These measures might take the form of an over-all plan, including both administrative reforms and improvements in internal organization and manpower training, and such provisions for the modernization of equipment as might in due course be considered feasible and timely. In any case, measures relating to equipment, by their very nature, would probably come to constitute in practice the nucleus and the dynamic factor of the whole reorganization and modernization programme. Their effective application might then be contingent (as are, in point of fact, their full benefits) upon the parallel adoption of measures concerning administrative reorganization or other aspects of the question.

[6] Assuming that both are operating in optimum conditions of efficiency (80 per cent in the first case and 95 per cent in the second).

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hammock and fishing net industry, and some other special textile branches.

In all, the textile industry is composed of nearly 4,000 plants of every size of which 1,200 are artisan and semi-artisan units employing less than five persons. These include nearly 700 artisan establishments in the Nordeste which make lace and hammocks and have an annual output of less than 0.05 per cent of the value of total production. Table 1 shows the relative participation of the above groups, excluding artisan establishments (employing less than five persons), in the Brazilian textile industry as a whole.

TABLE 1. STRUCTURE OF THE TEXTILE INDUSTRY

| Branch | *Establishments* Number | *Establishments* Percentage | *Operatives (Monthly average)* Number | *Operatives (Monthly average)* Percentage | *Value added* Millions of cruzeiros | *Value added* Percentage |
|---|---|---|---|---|---|---|
| Fibre processing and preparation | 683 | 23.8 | 9,988 | 3.2 | 3,217.4 | 7.3 |
| Spinning, weaving and yarn and fabric processing | 1,336 | 46.6 | 240,619 | 77.5 | 36,589.5 | 83.3 |
| Knitting and hosiery | 498 | 17.4 | 19,098 | 6.1 | 2,648.5 | 6.0 |
| Others[a] | 353 | 12.2 | 40,919 | 13.2 | 1,464.5 | 3.4 |
| TOTAL | 2,870 | 100.0 | 310,624 | 100.0 | 43,919.9 | 100.0 |

*Source:* Instituto Brasileiro de Geografia e Estatística, *Produção Industrial Brasileira,* 1958.
[a] Mannfacture of trimmings, ribbons, tulle, felts, etc.

As defined here, the spinning and weaving sector covers spinning, weaving, printing, the dyeing of yarn and fabrics, and other final processing sections, including the finishing and packaging of sewing and embroidery cottons. This is the principal sector in the textile industry, comprising 47 per cent of the plants and 78 per cent of the labour force employed in that industry, and 83 per cent (even more in some states) of the total value added in production.

Next in importance is the knitting and hosiery industry, which accounts for 17 per cent of the plants, 6 per cent of the operatives and 6 per cent of the value added in the textile industry. Santa Catarina is the state where the knitting and hosiery industry makes the largest contribution (22 per cent) to the total value added in the textile sector.

Fibre preparation and processing (considered as part of this manufacturing sector although essentially a rural activity) comprises cotton ginning and the preparation of other fibres for textile manufacturing, including the treatment of furs, skins and other fibres of animal origin, and the recovery of residues for industrial uses. Although it comprises about 683 establishments (24 per cent of the total), it employs only 3 per cent of the operatives working in the textile industry, and contributes only 7 per cent of the total value added in the textile sector.

The other specialized branches of textile manufacture play a fairly minor part in the industry as a whole, except in the State of Rio de Janeiro where the manufacture of trimmings, lace, felts, net and other textile specialties absorbs more than 10 per cent of the labour force engaged in textile production there, and accounts for 19 per cent of the value added.

Table 2 shows the structure of the textile industry in the different states by value added.

TABLE 2. STRUCTURE OF THE TEXTILE INDUSTRY FOR THE DIFFERENT STATES
(*Percentage of total value added*)

| State | Fibre preparation and processing | Spinning, weaving and yarn and fabric processing | Knitted goods and hosiery | Others | Total |
|---|---|---|---|---|---|
| Guanabara | 0.4 | 93.7 | 2.9 | 3.0 | 100.0 |
| Minas Gerais | 3.8 | 89.6 | 6.4 | 0.2 | 100.0 |
| Rio Grande do Sul | 2.7 | 87.7 | 5.3 | 4.3 | 100.0 |
| Rio de Janeiro | 0.1 | 79.5 | 1.3 | 19.1 | 100.0 |
| Santa Catarina | 0.2 | 70.5 | 21.7 | 7.6 | 100.0 |
| São Paulo | 5.6 | 84.5 | 7.4 | 2.5 | 100.0 |
| Nordeste States | 25.6 | 74.4 | — | — | 100.0 |
| Others | 48.7 | 47.3 | 1.2 | 2.8 | 100.0 |
| TOTAL | 7.3 | 83.3 | 6.0 | 3.4 | 100.0 |

*Source:* As for table 1.

hammock and fishing net industry, and some other special textile branches.

In all, the textile industry is composed of nearly 4,000 plants of every size of which 1,200 are artisan and semi-artisan units employing less than five persons. These include nearly 700 artisan establishments in the Nordeste which make lace and hammocks and have an annual output of less than 0.05 per cent of the value of total production. Table 1 shows the relative participation of the above groups, excluding artisan establishments (employing less than five persons), in the Brazilian textile industry as a whole.

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| Branch | *Establishments* | | *Operatives (Monthly average)* | | *Value added* | |
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| Others | 48.7 | 47.3 | 1.2 | 2.8 | 100.0 |
| TOTAL | 7.3 | 83.3 | 6.0 | 3.4 | 100.0 |

*Source:* As for table 1.

TABLE 4. DISTRIBUTION OF THE SPINNING AND WEAVING LABOUR FORCE, BY FIBRE AND BY STATE
(*Percentage*)

| *Fibre* | *Rio-Guanabara* | *Minas Gerais* | *Rio Grande do Sul* | *Santa Catarina* | *São Paulo* | *Total* |
|---|---|---|---|---|---|---|
| | | | A | | | |
| Cotton . . . . . . . . | 86.2 | 99.6 | 12.6 | 100.0 | 57.4 | 71.3 |
| Wool . . . . . . . . | 4.5 | 0.1 | 63.1 | — | 16.7 | 11.3 |
| Man-made fibres . . . | 2.8 | 0.3 | 5.9 | — | 15.2 | 9.0 |
| Jute . . . . . . . . . | 4.8 | — | 15.0 | — | 6.9 | 6.0 |
| Flax and ramie . . . . | 1.7 | — | 3.4 | — | 3.8 | 2.4 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | | | B | | | |
| Cotton . . . . . . . . | 23.5 | 20.0 | 0.5 | 6.9 | 49.1 | 100.0 |
| Wool . . . . . . . . | 9.1 | 0.1 | 13.3 | — | 77.5 | 100.0 |
| Man-made fibres . . . | 7.2 | 0.5 | 1.5 | — | 90.8 | 100.0 |
| Jute . . . . . . . . . | 18.5 | — | 6.0 | — | 75.5 | 100.0 |
| Flax and ramie . . . . | 15.9 | — | 3.4 | — | 80.7 | 100.0 |
| TOTAL | 22.8 | 16.3 | 2.4 | 4.9 | 53.6 | 100.0 |

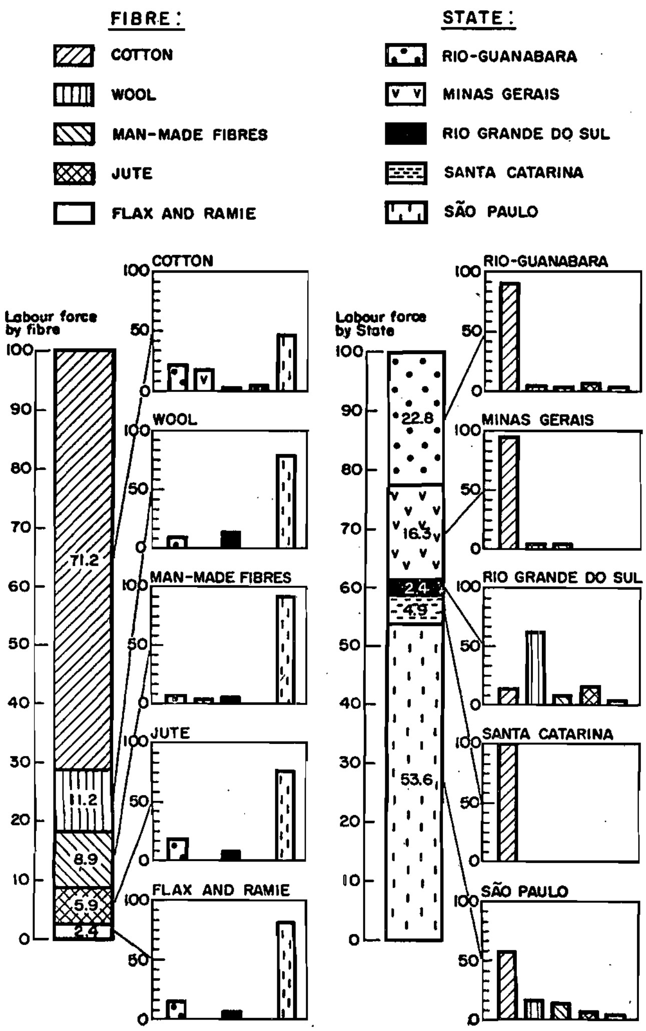
*Source:* ECLA survey.

FIGURE I

DISTRIBUTION OF LABOUR FORCE, BY FIBRE AND BY STATE, 1960

(*Percentage*)

Natural scale




*Source:* ECLA survey.

In 1960 the monthly average for manpower employed in the cotton spinning and weaving industry surveyed, including the yarn and fabric processing sections, was 147,624 persons, made up of 6,221 administrative and office staff, 132,237 operatives (including foremen and assistant foremen), and 9,166 other workers. The data in table 6 indicate the pattern of employment in the different states.

Since the amount of labour employed by the textile industry in the Nordeste must have remained about the same as at the time of the SUDENE survey in 1959, when it numbered 31,759 persons, it is estimated that the total number of workers in 1960 was 180,000. About 51 per cent of the total was employed in spinning, including preparation for spinning, and the remaining 49 per cent in the weaving mills.

Table 7 shows the different types of fibres used as raw materials in 1960 by the cotton spinning mills, in terms both of the different types of cotton and of the other fibres that are mixed with cotton to produce yarn and fabric blends in which cotton predominates.

The seridó and sertao types of cotton account for 37.2 per cent of the cotton consumed in the States of Guanabara and Rio de Janeiro. This percentage tallies perfectly with the quality of the fabric produced in those states, made largely from combed yarns for which long-fibre cotton is preferred. In Minas Gerais, 43 per cent of all cotton fibre consumed was seridó and sertao cotton. This high consumption of semi-long and long-fibre cotton is not justified by the composition of textile production there, only 15 per cent of which is based on combed yarns, and is probably related to the relatively high indices of productivity and unit output achieved. As textile machinery in Minas Gerais is not particularly up to date, manufacturers try to compensate for its shortcomings by using high quality raw materials to make the production process more efficient. The cost of the better quality cotton is thus offset by the larger yields obtained. This is probably why the textile industry in Minas Gerais prefers to use Nordeste long-fibre cotton.

In the State of São Paulo only 19.6 per cent of the cotton used is of the seridó or sertao type, because of the small proportion of combed yarn in the state's yarn

TABLE 4. DISTRIBUTION OF THE SPINNING AND WEAVING LABOUR FORCE, BY FIBRE AND BY STATE
(*Percentage*)

| *Fibre* | *Rio-Guanabara* | *Minas Gerais* | *Rio Grande do Sul* | *Santa Catarina* | *São Paulo* | *Total* |
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| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| | | | B | | | |
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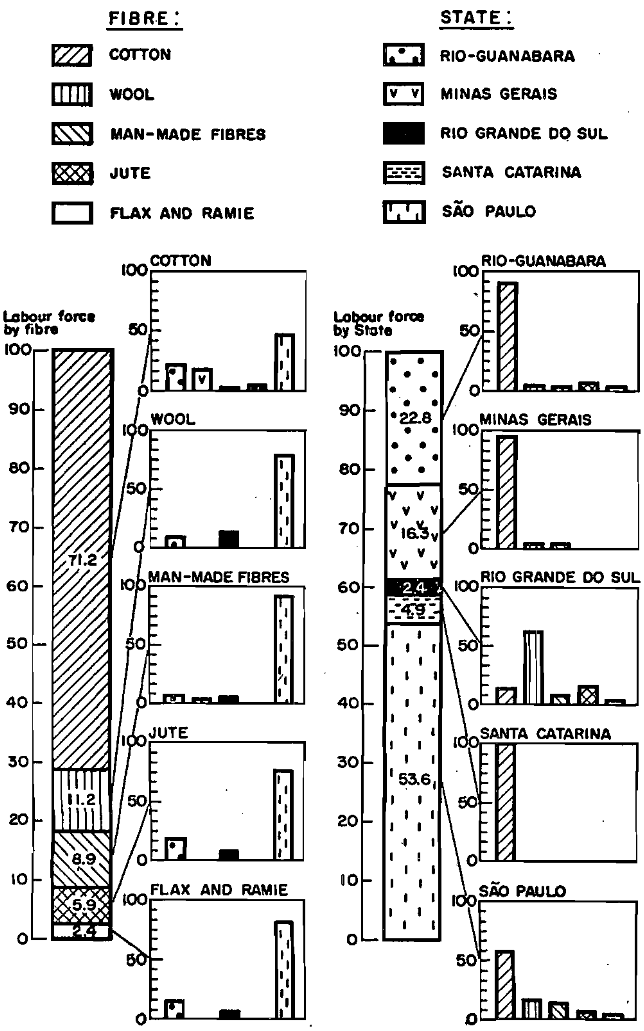


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In the State of São Paulo only 19.6 per cent of the cotton used is of the seridó or sertao type, because of the small proportion of combed yarn in the state's yarn output, and also because the locally-grown cotton meets the requirements of the spinning mills there. In Santa Caterina the proportions of the different kinds used are much the same as in São Paulo, except for matas cotton, which represents a higher percentage.

In total consumption Paulista cotton predominates, followed by sertao and seridó, and then by a tiny percentage of matas cotton. The proportion of other fibres (natural or man-made) used in cotton mixtures is very small, amounting to only 1.3 per cent of the total volume of raw material consumed by the cotton textile industry, of which only 0.4 per cent represents man-made fibres.

Comparison of the annual output of cotton yarn for 1946 and 1960 shows that production increased by about 54,000 tons, or 43 per cent (see table 8 and figure II). There was an increase in the percentage of cotton yarn produced in Minas Gerais and Santa Caterina, and a decrease in the percentage produced in Rio-Guanabara and São Paulo.

Production of carded and combed cotton yarns did not expand to the same extent in the different states, despite the marked and widespread improvement in quality in the post-war period, as indicated by the evolution of carded and combed yarn production shown in table 9. Between 1946 and 1960 there was some expansion of the proportion of combed yarn in total cotton output in every state, but the most marked increase was in Minas Gerais.

### (c) *Wool sector*

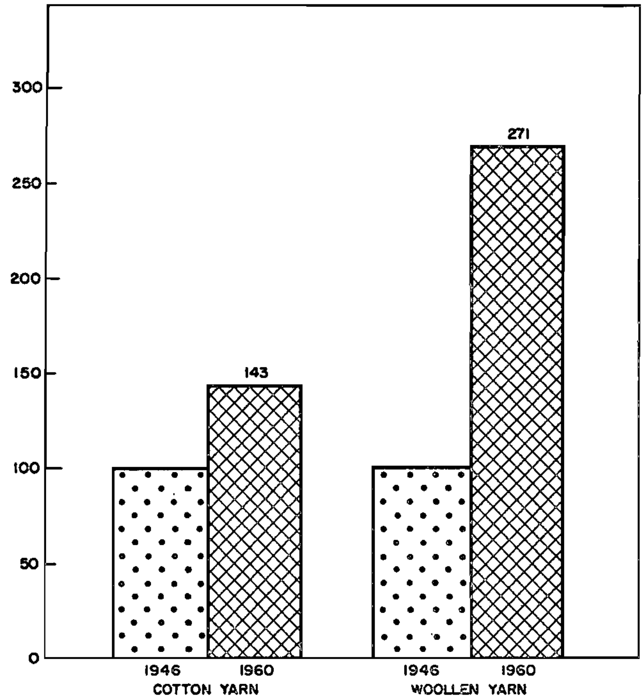
The survey covered 42 spinning mills and 85 weaving mills, which represented respectively 81.3 and 82.4 per cent of total spindle and loom capacity in the Brazilian textile industry. In 1960, 98.1 per cent of the spindles included in the sample were in use, and 94.8 per cent of the looms.

FIGURE II

COMPARISON OF THE GROWTH OF COTTON AND WOOLLEN YARN PRODUCTION, 1946-60

(*Index: 1946=100*)

Natural scale




*Source:* ECLA survey.

Table 10 shows the production of wool fabric in the different states in 1960; once again, the bulk of the output is in São Paulo.

TABLE 8. PRODUCTION OF COTTON YARN, 1946 AND 1960

| State | *Production of cotton yarn* | | | | *Increase between 1946 and 1960* | |
|---|---|---|---|---|---|---|
| | *1946* | | *1960* | | | |
| | *Tons* | *Percentage* | *Tons* | *Percentage* | *Tons* | *Percentage* |
| Rio-Guanabara . . | 27,977.3 | 22.3 | 35,707.2 | 19.9 | 7,729.9 | 27.6 |
| Minas Gerais . . . | 20,477.0 | 16.4 | 35,660.4 | 19.9 | 15,183.4 | 74.1 |
| São Paulo . . . . | 73,229.3 | 58.5 | 97,698.0 | 54.6 | 24,468.7 | 33.4 |
| Santa Catarina . . | 3,015.4 | 2.4 | 9,310.8 | 5.2 | 6,295.4 | 208.8 |
| Rio Grande do Sul . | 533.9 | 0.4 | 768.0 | 0.4 | 234.1 | 43.8 |
| TOTAL | 125,232.9 | 100.0 | 179,144.4 | 100.0 | 53,911.5 | 43.0 |

TABLE 9. PRODUCTION OF CARDED AND COMBED COTTON YARNS, BY STATE, 1946 AND 1960

| State | *Percentage of total cotton yarn production* | | | |
|---|---|---|---|---|
| | *1946* | | *1960* | |
| | *Combed* | *Carded* | *Combed* | *Carded* |
| Rio-Guanabara . . . | 69.5 | 30.5 | 55.8 | 44.2 |
| Minas Gerais . . . . | 92.3 | 7.7 | 84.7 | 15.3 |
| São Paulo . . . . | 88.3 | 11.7 | 83.9 | 16.1 |
| Santa Catarina . . . | 87.7 | 12.3 | 83.8 | 16.2 |
| Rio Grande do Sul . . | 100.0 | — | 100.0 | — |
| TOTAL | 84.7 | 15.3 | 78.3 | 21.7 |

TABLE 10. WOOL FABRIC PRODUCTION, BY STATE

| *State* | *Thousands of square metres* | *Percentage* |
|---|---|---|
| São Paulo . . . . . . . | 32,319.0 | 75.0 |
| Rio-Guanabara . . . . . | 4,869.4 | 11.3 |
| Rio Grande do Sul . . . . | 4,697.0 | 10.9 |
| Minas Gerais . . . . . | 1,206.6 | 2.8 |
| TOTAL | 43,092.0 | 100.0 |

The monthly average for the number of persons employed in 1960 was 28,557, consisting of 1,696 administrative staff, 25,296 operatives (including foremen and output, and also because the locally-grown cotton meets the requirements of the spinning mills there. In Santa Caterina the proportions of the different kinds used are much the same as in São Paulo, except for matas cotton, which represents a higher percentage.

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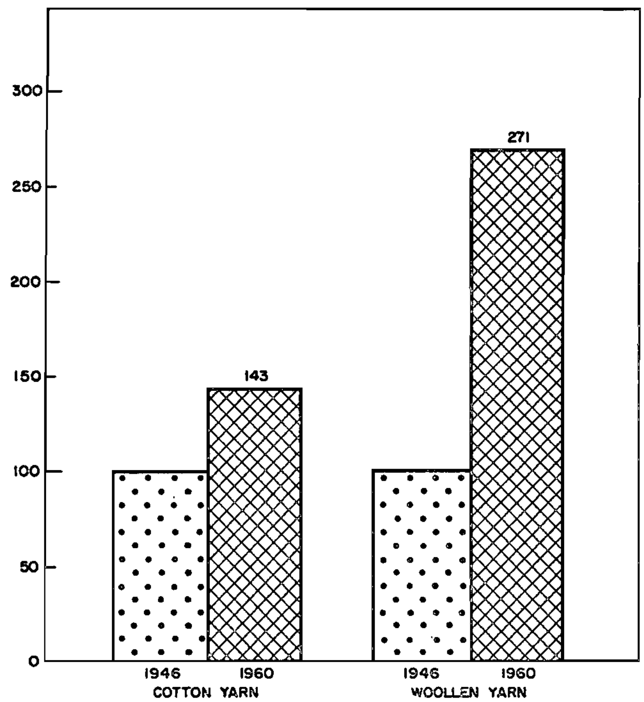


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Table 10 shows the production of wool fabric in the different states in 1960; once again, the bulk of the output is in São Paulo.

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| State | Production of cotton yarn 1946 Tons | 1946 Percentage | 1960 Tons | 1960 Percentage | Increase between 1946 and 1960 Tons | Increase Percentage |
|---|---|---|---|---|---|---|
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Yarn consumption in the weaving mills of the Centro-Sul region was 11,000 tons in 1946 and 14,000 tons in 1960, an increase of 27 per cent during that period.

TABLE 13. PRODUCTION OF FABRICS FROM MAN-MADE FIBRES, BY STATE, 1960

| State | Thousands of square metres | Percentage of total |
|---|---|---|
| São Paulo | 116,671.0 | 95.2 |
| Rio-Guanabara | 3,921.7 | 3.2 |
| Rio Grande do Sul | 1,225.6 | 1.0 |
| Minas Gerais | 735.3 | 0.6 |
| TOTAL | 122,553.6 | 100.0 |

(e) *Sector comprising jute and similar fibres*

The jute industry in the sample is centred in the State of São Paulo, Rio-Guanabara and Rio Grande do Sul. The survey covered 23 establishments, employing a monthly average of 11,505 persons in 1960, of which 10,737 were operatives (including foremen and assistant foremen), 382 administrative and office staff and 386 other types of workers.

Production of fabrics in the different states was as shown in table 15; São Paulo contributes the largest proportion, but Rio-Guanabara also supplies a substantial percentage.

In 1960 the spinning mills consumed 47,688 tons of jute and similar fibres, as shown in table 16. Jute accounts for 62.8 per cent of the total volume of fibre inputs in this sector. Another fibre used in fairly large quantities is mallow. Most of the sector's activities are

TABLE 14. FIBRE IMPUTS IN THE MAN-MADE FIBRE SECTOR, BY STATE, 1960
(*Percentage*)

| State | Rayon: Continuous filament | Rayon: Staple | Nylon | Other synthetic fibres | Natural fibres | Total | Total (tons) |
|---|---|---|---|---|---|---|---|
| São Paulo | 64.3 | 17.2 | 2.4 | 6.2 | 9.9 | 100.0 | 13,332 |
| Rio-Guanabara | 47.4 | 19.6 | 0.9 | 10.7 | 21.4 | 100.0 | 672 |
| Rio Grande do Sul | 92.9 | — | — | — | 7.1 | 100.0 | 168 |
| Minas Gerais | 66.7 | — | — | — | 33.3 | 100.0 | 72 |
| TOTAL | 63.8 | 17.0 | 2.4 | 6.2 | 10.6 | 100.0 | 14,244 |

concentrated in the State of São Paulo. In 1960, the state, and those of Guanabara and Rio de Janeiro taken together used over 99 per cent of the sector's total fibre inputs.

(f) *Flax sector*

A survey was made of 34 mills, employing a monthly average of 5,848 persons in 1960. Of these 340 were administrative or office staff, 5,342 operatives (including foremen and assistant foremen), and 166 other types of workers.

The production of linen goods in 1960 is shown in table 17. In this sector, too, virtually the whole of the output is in the State of São Paulo.

TABLE 15. PRODUCTION OF FABRICS FROM JUTE AND SIMILAR FIBRES, BY STATE, 1960

| State | Thousands of square metres | Percentage of total |
|---|---|---|
| São Paulo | 88,483.7 | 72.2 |
| Rio-Guanabara | 25,000.9 | 20.4 |
| Rio Grande do Sul | 9,068.9 | 7.4 |
| TOTAL | 122,553.6 | 100.0 |

TABLE 16. FIBRE CONSUMPTION IN THE JUTE SECTOR, BY STATE, 1960

| State | Jute (Percentage) | Mallow (Percentage) | Other hard fibres (Percentage) | Total (Percentage) | Total (tons) |
|---|---|---|---|---|---|
| Rio-Guanabara | 55.3 | 39.8 | 4.9 | 100.0 | 11.400 |
| Rio Grande do Sul | 65.9 | 27.9 | 6.2 | 100.0 | 348 |
| São Paulo | 65.1 | 25.4 | 9.5 | 100.0 | 35,940 |
| TOTAL | 62.8 | 29.0 | 8.2 | 100.0 | 47,688 |

TABLE 17. PRODUCTION OF LINEN FABRIC, BY STATE, 1960

| State | Thousands of square metres | Percentage of total |
|---|---|---|
| São Paulo | 22,284 | 97.8 |
| Rio-Guanabara | 252 | 1.2 |
| Rio Grande do Sul | 240 | 1.0 |
| TOTAL | 22,776 | 100.0 |

## 5. MILL SIZE

Table 1 shows that the average size mill in the textile industry as a whole is one with 108 operatives, and in the spinning and weaving branch, one with 180 operatives. The ECLA survey shows that an average spinning mill has 207 operatives, and is therefore more than twice the size of an average weaving mill, which has 91.[6]

[6] These figures are not comparable with those of table 1, in which the integrated spinning and weaving mill is regarded as a single establishment. In table 6, on the other hand, each of the production processes is considered as a separate establishment, even when they are the same mill, and the figures represent operatives directly employed in the process.

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TABLE 20. CONCENTRATION OF SPINNING ACTIVITIES, BY FIBRE AND BY STATE

| Fibre | *Percentage breakdown of production by size categories (Number of spindles)* 1-9 999 | 10 000-49 999 | 50 000 and over | Total |
|---|---|---|---|---|
| | *By fibre* | | | |
| Cotton | 30.0 | 56.7 | 13.3 | 100.0 |
| Wool | 81.7 | 18.3 | — | 100.0 |
| Man-made fibres | 39.0 | 61.0 | — | 100.0 |
| Jute and similar fibres | 100.0 | — | — | 100.0 |
| Flax and ramie | 100.0 | — | — | 100.0 |
| TOTAL | 48.8 | 42.0 | 9.2 | 100.0 |
| | *By state* | | | |
| São Paulo | 49.2 | 41.2 | 9.6 | 100.0 |
| Rio-Guanabara | 40.2 | 42.1 | 17.7 | 100.0 |
| Minas Gerais | 50.2 | 49.8 | — | 100.0 |
| Rio Grande do Sul | 100.0 | — | — | 100.0 |
| Santa Catarina | 45.3 | 54.7 | — | 100.0 |
| TOTAL | 48.8 | 42.0 | 9.2 | 100.0 |

*Source:* ECLA survey.

TABLE 21. CONCENTRATION OF WEAVING ACTIVITIES, BY FIBRE AND BY STATE

| Fibre | *Percentage breakdown of production by size categories (Number of looms)* 1-99 | 100-999 | 1 000 and over | Total |
|---|---|---|---|---|
| | *By fibre* | | | |
| Cotton | 11.4 | 68.7 | 19.9 | 100.0 |
| Wool | 52.6 | 47.4 | — | 100.0 |
| Man-made fibres | 51.8 | 35.9 | 12.3 | 100.0 |
| Jute and similar fibres | 6.2 | 93.8 | — | 100.0 |
| Flax and ramie | 52.8 | 47.2 | — | 100.0 |
| TOTAL | 16.8 | 67.4 | 15.8 | 100.0 |
| | *By state* | | | |
| São Paulo | 23.7 | 61.2 | 15.1 | 100.0 |
| Rio-Guanabara | 6.0 | 55.8 | 38.2 | 100.0 |
| Minas Gerais | 5.4 | 94.6 | — | 100.0 |
| Rio Grande do Sul | 37.8 | 62.2 | — | 100.0 |
| Santa Catarina | 17.7 | 82.3 | — | 100.0 |
| TOTAL | 16.8 | 67.3 | 15.9 | 100.0 |

*Source:* ECLA survey.

## 6. VERTICAL INTEGRATION

Vertical integration in the textile industry occurs when more than one of the following main stages of processing are grouped together in a single enterprise—spinning, weaving and yarn and fabric processing, including printing and dyeing. Although detailed information was gathered by the ECLA survey only for spinning and weaving, it was also ascertained whether the enterprises had a section for further processing. Thus it was possible to determine how far the industry was vertically integrated,[8] firms confining themselves exclusively to one stage of processing being considered as non-integrated, those undertaking two stages (e.g. spinning and weaving, or weaving and further processing) as partially integrated, and those undertaking spinning, weaving and further processing as completely integrated. The percentage breakdown of mills according to the degree of integration given in table 22 is based on the survey data. This shows that most mills are non-integrated, i.e., they deal with one stage of processing only, but that the largest proportion of manpower is employed by the fully-integrated mills, in other words, the bigger establishments generally cover the whole range of processing. This pattern emerges even more clearly in the cotton sector. The figures in table 23 show the importance of the size factor in determining the degree of integration of the spinning and weaving industry.

Admittedly, the lack of any tradition in the marketing of intermediate production has been a contributory factor. In this respect, the textile economy of each

[8] Nevertheless, the fact that the survey did not cover independent mills specializing in yarn and fabric processing (undoubtedly few in number) is bound to have distorted the findings to a certain extent, i.e., the degree of vertical integration will have been overestimated.

TABLE 20. CONCENTRATION OF SPINNING ACTIVITIES, BY FIBRE AND BY STATE

| Fibre | *Percentage breakdown of production by size categories (Number of spindles)* | | | |
|---|---|---|---|---|
| | *1-9 999* | *10 000-49 999* | *50 000 and over* | *Total* |
| | *By fibre* | | | |
| Cotton | 30.0 | 56.7 | 13.3 | 100.0 |
| Wool | 81.7 | 18.3 | — | 100.0 |
| Man-made fibres | 39.0 | 61.0 | — | 100.0 |
| Jute and similar fibres | 100.0 | — | — | 100.0 |
| Flax and ramie | 100.0 | — | — | 100.0 |
| TOTAL | 48.8 | 42.0 | 9.2 | 100.0 |
| | *By state* | | | |
| São Paulo | 49.2 | 41.2 | 9.6 | 100.0 |
| Rio-Guanabara | 40.2 | 42.1 | 17.7 | 100.0 |
| Minas Gerais | 50.2 | 49.8 | — | 100.0 |
| Rio Grande do Sul | 100.0 | — | — | 100.0 |
| Santa Catarina | 45.3 | 54.7 | — | 100.0 |
| TOTAL | 48.8 | 42.0 | 9.2 | 100.0 |

*Source:* ECLA survey.

TABLE 21. CONCENTRATION OF WEAVING ACTIVITIES, BY FIBRE AND BY STATE

| Fibre | *Percentage breakdown of production by size categories (Number of looms)* | | | |
|---|---|---|---|---|
| | *1-99* | *100-999* | *1 000 and over* | *Total* |
| | *By fibre* | | | |
| Cotton | 11.4 | 68.7 | 19.9 | 100.0 |
| Wool | 52.6 | 47.4 | — | 100.0 |
| Man-made fibres | 51.8 | 35.9 | 12.3 | 100.0 |
| Jute and similar fibres | 6.2 | 93.8 | — | 100.0 |
| Flax and ramie | 52.8 | 47.2 | — | 100.0 |
| TOTAL | 16.8 | 67.4 | 15.8 | 100.0 |
| | *By state* | | | |
| São Paulo | 23.7 | 61.2 | 15.1 | 100.0 |
| Rio-Guanabara | 6.0 | 55.8 | 38.2 | 100.0 |
| Minas Gerais | 5.4 | 94.6 | — | 100.0 |
| Rio Grande do Sul | 37.8 | 62.2 | — | 100.0 |
| Santa Catarina | 17.7 | 82.3 | — | 100.0 |
| TOTAL | 16.8 | 67.3 | 15.9 | 100.0 |

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Vertical integration in the textile industry occurs when more than one of the following main stages of processing are grouped together in a single enterprise—spinning, weaving and yarn and fabric processing, including printing and dyeing. Although detailed information was gathered by the ECLA survey only for spinning and weaving, it was also ascertained whether the enterprises had a section for further processing. Thus it was possible to determine how far the industry was vertically integrated,[8] firms confining themselves exclusively to one stage of processing being considered as non-integrated, those undertaking two stages (e.g. spinning and weaving, or weaving and further processing) as partially integrated, and those undertaking spinning, weaving and further processing as completely integrated. The percentage breakdown of mills according to the degree of integration given in table 22 is based on the survey data. This shows that most mills are non-integrated, i.e., they deal with one stage of processing only, but that the largest proportion of manpower is employed by the fully-integrated mills, in other words, the bigger establishments generally cover the whole range of processing. This pattern emerges even more clearly in the cotton sector. The figures in table 23 show the importance of the size factor in determining the degree of integration of the spinning and weaving industry.

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## Chapter III

# THE MARKET FOR TEXTILES

### 1. Introduction

This chapter gives an account of the evolution and composition of the apparent consumption of textiles[1] in Brazil in the period 1950-60, together with estimates of consumption for the years 1965 and 1970. The structure of production is analysed for each fibre, using material from the surveys carried out by ECLA in the Centro-Sul of Brazil, and by SUDENE in the Nordeste, and on the basis of the average counts of yarn produced, and of the types of fabric processing. The section on the domestic market concludes with a general evaluation of the prevailing marketing conditions in each branch of textile production. This is followed by an examination, the evolution and composition of foreign trade, and the origin of imports and destination of exports. Lastly, some comments are made on the possibility and desirability of increasing the trade in textiles, especially in the Latin American market.

The main conclusions reached are as follows:

The *per capita* apparent consumption of textiles in Brazil increased by 4.9 per cent during 1950-60, rising from 4.2 to 4.45 kg. It is estimated that in 1970 *per capita* consumption will be 5.25 kg.

The structure of production in both the Centro-Sul and the Nordeste covers a wide range, as regards both the fibres and the thickness of the fabric, in accordance with the country's requirements. Cotton textiles predominate, as this fibre is plentiful and relatively cheap, and lends itself to most of the uses required for a country with extensive tropical regions. Fabric production covers all yarn counts, with the medium counts (from 16 to 30) predominating. Market trends appear to be in line with this structure, and hence a systematic re-equipment of the industry would probably not have to deal with the problem of providing for a future situation appreciably different, as regards the composition of demand, from the present situation.

To provide for the probable future demand, it would be necessary only to improve the quality of the fabrics now produced, which would require no more than an improvement in the spinning process to make possible cleaner, more regular and stronger yarns; in addition, in view of the growing demand for better-looking fabrics, processing would also have to be improved.

The distribution of fabrics is influenced to a great and still increasing extent by the clothing industry, as a result of the sharp increase in the demand for ready-made clothes. The difference between the producer's and distributor's price amounts to an average of 50 per cent, because of the inefficient distribution and marketing system, which needs to be reorganized.

[1] Consumption of the fibres classed as for personal use—cotton, wool, artificial and synthetic fibres, linen and ramie, excluding jute, sisal and other fibres that are mainly for industrial use.

Lastly, as regards foreign trade in textiles, it was confirmed that Brazilian imports have declined sharply (from 8 million dollars in 1956 to 1 million in 1960), while exports have increased (from 378,000 dollars in 1956 to 4 million dollars in 1960).

Brazil is practically self-sufficient in textile products (over 98 per cent of consumption being supplied from domestic production), and exports exceed imports. The main item in textile imports is linen yarn, and some cotton products are also imported for industrial use. Most Brazilian textile imports come from Europe, with the United States and Japan next in importance as suppliers; exports go mainly to South Africa, Venezuela and Bolivia. Only in imports of raw materials do the ALALC[2] countries occasionally furnish a relatively high proportion, since they export considerable quantities of wool to Brazil; nevertheless, the textile trade between Brazil and the ALALC countries is declining every year. However, there are good prospects that this trend might be reversed.

### 2. Evolution of apparent consumption

Total apparent consumption of textiles in Brazil during the period 1950-60 rose from 220,000 tons to 314,000 tons, representing an increase of 42 per cent.

As the data in table 24 show, the only reduction in total apparent consumption during the decade was between 1950 and 1951. The other years show a steady increase, strongest from 1953 to 1954 (an increase of 8 per cent) and weakest from 1956 to 1957 (1.6 per cent).

Table 24. Total apparent consumption of textiles, 1950-60

| *Year* | *Population (Millions)* | *Total*[a] *(Thousands of tons)* | Per capita *consumption (Kilogrammes)* |
|---|---|---|---|
| 1950 | 52.0 | 220.45 | 4.24 |
| 1951 | 53.4 | 219.73 | 4.11 |
| 1952 | 55.0 | 223.30 | 4.06 |
| 1953 | 56.6 | 233.41 | 4.12 |
| 1954 | 58.4 | 251.60 | 4.31 |
| 1955 | 60.2 | 269.47 | 4.48 |
| 1956 | 62.2 | 278.76 | 4.48 |
| 1957 | 64.2 | 283.3 | 4.41 |
| 1958 | 66.3 | 294.03 | 4.43 |
| 1959 | 68.4 | 304.39 | 4.45 |
| 1960 | 70.6 | 313.90 | 4.45 |

*Source:* ECLA, on the basis of the FAO *Commodity Bulletin*, No. 31.
[a] Moving three-year average.

The *per capita* series is less uniform, and shows that there were four phases, two rising and two descending. In 1951 and 1952 consumption was lower than in 1950,

[2] Latin American Free-Trade Association.

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This chapter gives an account of the evolution and composition of the apparent consumption of textiles[1] in Brazil in the period 1950-60, together with estimates of consumption for the years 1965 and 1970. The structure of production is analysed for each fibre, using material from the surveys carried out by ECLA in the Centro-Sul of Brazil, and by SUDENE in the Nordeste, and on the basis of the average counts of yarn produced, and of the types of fabric processing. The section on the domestic market concludes with a general evaluation of the prevailing marketing conditions in each branch of textile production. This is followed by an examination, the evolution and composition of foreign trade, and the origin of imports and destination of exports. Lastly, some comments are made on the possibility and desirability of increasing the trade in textiles, especially in the Latin American market.

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TABLE 24. TOTAL APPARENT CONSUMPTION OF TEXTILES, 1950-60

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| 1959 | 68.4 | 304.39 | 4.45 |
| 1960 | 70.6 | 313.90 | 4.45 |

*Source:* ECLA, on the basis of the FAO *Commodity Bulletin*, No. 31.

[a] Moving three-year average.

The *per capita* series is less uniform, and shows that there were four phases, two rising and two descending. In 1951 and 1952 consumption was lower than in 1950,

[2] Latin American Free-Trade Association.

## 3. Projection of the demand for textiles

During the period under review important changes took place that clearly reflected Brazil's economic evolution. *Per capita* income rose by about 29 per cent, and there was a sharp increase in industrialization, indicated by the index of the domestic product generated by the industrial sector, which rose from 100 in 1949 to 235 in 1958. During the same period the proportion of the urban population in the total increased by 9 per cent.

However, the development of the *per capita* consumption of textiles was not satisfactory, since the increase amounted to only 4.9 per cent, from 4.24 kg in 1950 to 4.45 in 1960. The world average *per capita* consumption for the period increased by 23 per cent, from 3.9 kg in 1950 to 4.8 in 1958. In 1938 the Brazilian average was 3.8 kg, which was slightly higher than the world average of 3.7 kg, but by 1952 the situation had already been reversed, the Brazilian rate being 4.06 kg and the world rate 4.21 kg, representing increases of 6.8 per cent and 13.7 per cent, respectively.[3] The world average, in turn, is rather low compared with apparent consumption in such regions as western Europe (7.6 kg), eastern Europe (8.7 kg), Oceania (8 kg) and North America (15.1 kg), and even in Latin America, where Argentina has a *per capita* consumption of 8 kg.

The increase in Brazil during 1950-60 was small, and may be wholly attributable to the increase in the urban population and the relative improvement in its standard of living, especially in the Centro-Sul. Thus, in view of the regional and sectoral plans for economic development that are either being carried out or are under study, it can be assumed that in the next few years there will be sharper increases in the *per capita* consumption of textiles, as reflected in the following estimates.

Bearing in mind that the series of data available on apparent consumption of textiles is too short to calculate the income elasticity of demand, it was considered preferable to use an income elasticity of demand coefficient of 0.65, that is, it was assumed that for each one per cent of increase in *per capita* income there would be an increase of 0.65 per cent in the consumption of textile products.

The coefficient of 0.65 was estimated on the basis of data from selected countries which give a clearer indication of the relation between the consumption of textiles and the income level, since this relation was obscured in Brazil in recent years by the distortions due to inflation, and also by excessive differences in income as between different regions and sectors. Figure III gives the position of the selected countries according to their income level and the *per capita* consumption of textiles, and it can be seen that the latter increases with the former, in the proportion represented by the coefficient.

Applying the selected coefficient to a hypothetical increase in *per capita* income of 2.69 per cent annually, estimates of future consumption were calculated,[4] as shown in table 27.

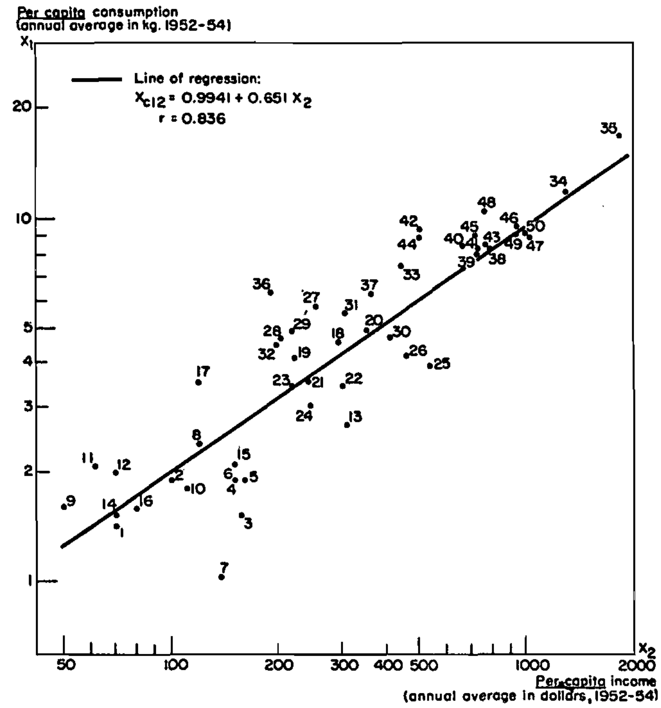
Table 27. Total and *per capita* consumption of textiles, 1960, and estimates for 1965 and 1970

| Year | Per capita consumption (kg) | *Percentage increase* | *Total consumption (tons)* | *Percentage increase* |
|---|---|---|---|---|
| 1960. . . | 4.45 | — | 313.9 | — |
| 1965 . . | 4.85 | 9.0 | 402.1 | 28.1 |
| 1970 . . | 5.25 | 18.0 | 507.7 | 61.7 |

Figure III

Relation between the consumption of textiles and *per capita* income, in selected countries

Logarithmic scale




1. Congo
2. Rhodesia
3. Dominican Republic
4. Ecuador
5. Guatemala
6. Honduras
7. Paraguay
8. Peru
9. Burma
10. Ceylon
11. India
12. Korea
13. Malaya
14. Pakistan
15. Philippines
16. Thailand
17. United Arab Republic (Egypt)
18. Union of South Africa
19. Brazil
20. Chile
21. Columbia
22. Cuba
23. Mexico
24. Panama
25. Venezuela
26. Israel
27. Lebanon
28. Turkey
29. Greece
30. Ireland
31. Italy
32. Portugal
33. Argentina
34. Canada
35. United States
36. Japan
37. Austria
38. Belgium/Luxembourg
39. Denmark
40. Finland
41. France
42. Federal Republic of Germany
43. Iceland
44. Netherlands
45. Norway
46. Sweden
47. Switzerland
48. United Kingdom
49. Australia
50. New Zealand

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[3] Instituto Cotoniero Italiano, *Annuario Statistiche Tessili*, 1960 and FAO Commodity Bulletin No. 31.

[4] As follows: if C is *per capita* consumption, $I_n$ is the GNP for year *n*, and E is the income elasticity of demand for textiles, then $C_{70} = C_{60} \left[\frac{I_{70}}{I_{60}}\right]^{E}$ and by substitution, $C_{70} = 4.45 \left[\frac{324.0}{250.9}\right]^{0.65}$ The use in the above equation of the values for the GNP instead of the values for the national income does not appear likely to affect the validity of the results, since during a relatively short period such as that considered here the national income and the gross product have parellel growth trends. The rate of growth of *per capita* income is based on estimates by ECLA.

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The coefficient of 0.65 was estimated on the basis of data from selected countries which give a clearer indication of the relation between the consumption of textiles and the income level, since this relation was obscured in Brazil in recent years by the distortions due to inflation, and also by excessive differences in income as between different regions and sectors. Figure III gives the position of the selected countries according to their income level and the *per capita* consumption of textiles, and it can be seen that the latter increases with the former, in the proportion represented by the coefficient.

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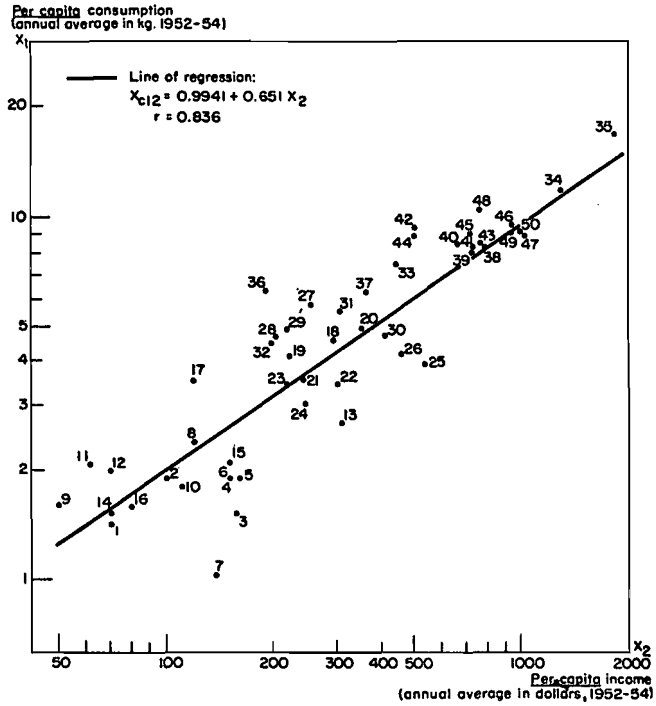


1. Congo
2. Rhodesia
3. Dominican Republic
4. Ecuador
5. Guatemala
6. Honduras
7. Paraguay
8. Peru
9. Burma
10. Ceylon
11. India
12. Korea
13. Malaya
14. Pakistan
15. Philippines
16. Thailand
17. United Arab Republic (Egypt)
18. Union of South Africa
19. Brazil
20. Chile
21. Columbia
22. Cuba
23. Mexico
24. Panama
25. Venezuela
26. Israel
27. Lebanon
28. Turkey
29. Greece
30. Ireland
31. Italy
32. Portugal
33. Argentina
34. Canada
35. United States
36. Japan
37. Austria
38. Belgium/Luxembourg
39. Denmark
40. Finland
41. France
42. Federal Republic of Germany
43. Iceland
44. Netherlands
45. Norway
46. Sweden
47. Switzerland
48. United Kingdom
49. Australia
50. New Zealand

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$$C_{70} = C_{60} \left[\frac{I_{70}}{I_{60}}\right]^{E} \text{ and by substitution, } C_{70} = 4.45 \left[\frac{324.0}{250.9}\right]^{0.65}$$

The use in the above equation of the values for the GNP instead of the values for the national income does not appear likely to affect the validity of the results, since during a relatively short period such as that considered here the national income and the gross product have parellel growth trends. The rate of growth of *per capita* income is based on estimates by ECLA.

Thus there is a trend in favour of better quality, and hence more expensive fabrics, which means that the value of textile production tends to increase more rapidly than its volume.

The breakdown of production for coarse cotton fabrics by type of processing is given in table 30. Sacks represent 52.1 per cent of this category and calicoes 47.9 per cent. The structure of production shown in the table is quite normal, even as regards the special process fabrics, which at first sight appear to account for a rather high proportion; in fact these consist mainly of fabrics for industrial use, such as plastic-coated or rubber-treated fabrics.

TABLE 29. PRODUCTION OF COTTON FABRICS, BY TYPE OF PROCESSING, 1956-60
(*Percentage*)

| *Type of fabric* | *1956* | *1957* | *1958* | *1959* | *1960* |
|---|---|---|---|---|---|
| *Unprocessed* | *27.7* | *23.9* | *25.0* | *25.1* | *25.5* |
| Sacks | 3.4 | 3.9 | 4.9 | 5.8 | 6.7 |
| Other | 24.3 | 20.0 | 20.1 | 19.3 | 18.8 |
| *Standard process* | *15.7* | *14.9* | *13.9* | *17.4* | *17.6* |
| *Dyed* | *33.4* | *33.8* | *37.3* | *33.6* | *32.8* |
| Unprocessed | 7.0 | 6.9 | 7.9 | 7.4 | 7.7 |
| Standard process | 16.5 | 16.1 | 15.5 | 14.4 | 14.4 |
| Mercerized | 9.9 | 10.8 | 13.9 | 11.8 | 10.6 |
| *Printed* | *15.9* | *20.6* | *17.3* | *17.5* | *17.5* |
| Standard process | 8.4 | 11.4 | 8.7 | 8.6 | 7.4 |
| Mercerized | 7.5 | 9.2 | 8.6 | 8.9 | 10.1 |
| *Special fabrics* | *7.3* | *6.8* | *6.5* | *6.4* | *6.6* |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* ECLA survey.

TABLE 30. PRODUCTION OF COARSE COTTON FABRICS, BY TYPE OF PROCESSING, 1956-60
(*Percentage*)

| *Type of fabric* | *1956* | *1957* | *1958* | *1959* | *1960* |
|---|---|---|---|---|---|
| *Unprocessed* | *42.5* | *41.4* | *47.1* | *48.5* | *49.4* |
| *Standard process* | *17.1* | *14.9* | *11.2* | *13.0* | *14.1* |
| *Printed* | *1.0* | *1.3* | *1.1* | *1.0* | *0.9* |
| *Dyed* | *19.5* | *23.8* | *22.7* | *21.0* | *18.7* |
| Unprocessed | 9.7 | 9.9 | 9.6 | 8.7 | 8.3 |
| Standard process | 7.3 | 8.8 | 8.4 | 7.4 | 7.9 |
| Mercerized | 2.5 | 5.1 | 4.7 | 4.9 | 2.5 |
| *Special fabrics* | *19.9* | *18.6* | *17.9* | *16.5* | *16.9* |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* ECLA survey.

The coarse-to-medium fabrics category (see table 31) which is the largest, also includes a high proportion of non-processed fabrics. This is probably because many of these fabrics are sold to other plants for processing, although some of the coarsest fabrics (yarn count 16) are also sold for household use or even for clothing to those in the lowest income groups. Standard-process fabrics, dyed fabrics and printed fabrics all bulk larger in this category than in the coarse category. The standard-process fabrics are mainly work clothes. Of the dyed fabrics, 18.2 per cent are unprocessed (yarn-dyed), 47.4 per cent are standard-process, and 34.4 per cent are mercerized. The printed fabrics consist mainly of standard prints (97.2 per cent), with a small amount of mercerized prints (2.8 per cent).

In the medium category (see table 32) the percentage is lower for unprocessed fabrics, about the same for standard-process fabrics, much higher for dyed fabrics, and also higher for printed and special-process fabrics. Thus it is clear that the finer the fabrics the more intensive the processing. Of the dyed fabrics, 20.5 per cent are unprocessed (yarn-dyed), 46.9 per cent standard-process and 32.6 per cent mercerized.

In the medium-to-fine category (table 33) printed fabrics predominate, and of these 75.5 per cent are mercerized and 24.5 per cent undergo standard processing after printing. Of the dyed fabrics 6.7 per cent are unprocessed, 50 per cent are standard-dyed and 43.3 per cent are mercerized.

Thus there is a trend in favour of better quality, and hence more expensive fabrics, which means that the value of textile production tends to increase more rapidly than its volume.

The breakdown of production for coarse cotton fabrics by type of processing is given in table 30. Sacks represent 52.1 per cent of this category and calicoes 47.9 per cent. The structure of production shown in the table is quite normal, even as regards the special process fabrics, which at first sight appear to account for a rather high proportion; in fact these consist mainly of fabrics for industrial use, such as plastic-coated or rubber-treated fabrics.

TABLE 29. PRODUCTION OF COTTON FABRICS, BY TYPE OF PROCESSING, 1956-60

(*Percentage*)

| *Type of fabric* | *1956* | *1957* | *1958* | *1959* | *1960* |
|---|---|---|---|---|---|
| *Unprocessed* | *27.7* | *23.9* | *25.0* | *25.1* | *25.5* |
| Sacks | 3.4 | 3.9 | 4.9 | 5.8 | 6.7 |
| Other | 24.3 | 20.0 | 20.1 | 19.3 | 18.8 |
| *Standard process* | *15.7* | *14.9* | *13.9* | *17.4* | *17.6* |
| *Dyed* | *33.4* | *33.8* | *37.3* | *33.6* | *32.8* |
| Unprocessed | 7.0 | 6.9 | 7.9 | 7.4 | 7.7 |
| Standard process | 16.5 | 16.1 | 15.5 | 14.4 | 14.4 |
| Mercerized | 9.9 | 10.8 | 13.9 | 11.8 | 10.6 |
| *Printed* | *15.9* | *20.6* | *17.3* | *17.5* | *17.5* |
| Standard process | 8.4 | 11.4 | 8.7 | 8.6 | 7.4 |
| Mercerized | 7.5 | 9.2 | 8.6 | 8.9 | 10.1 |
| *Special fabrics* | *7.3* | *6.8* | *6.5* | *6.4* | *6.6* |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* ECLA survey.

TABLE 30. PRODUCTION OF COARSE COTTON FABRICS, BY TYPE OF PROCESSING, 1956-60

(*Percentage*)

| *Type of fabric* | *1956* | *1957* | *1958* | *1959* | *1960* |
|---|---|---|---|---|---|
| *Unprocessed* | *42.5* | *41.4* | *47.1* | *48.5* | *49.4* |
| *Standard process* | *17.1* | *14.9* | *11.2* | *13.0* | *14.1* |
| *Printed* | *1.0* | *1.3* | *1.1* | *1.0* | *0.9* |
| *Dyed* | *19.5* | *23.8* | *22.7* | *21.0* | *18.7* |
| Unprocessed | 9.7 | 9.9 | 9.6 | 8.7 | 8.3 |
| Standard process | 7.3 | 8.8 | 8.4 | 7.4 | 7.9 |
| Mercerized | 2.5 | 5.1 | 4.7 | 4.9 | 2.5 |
| *Special fabrics* | *19.9* | *18.6* | *17.9* | *16.5* | *16.9* |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* ECLA survey.

The coarse-to-medium fabrics category (see table 31) which is the largest, also includes a high proportion of non-processed fabrics. This is probably because many of these fabrics are sold to other plants for processing, although some of the coarsest fabrics (yarn count 16) are also sold for household use or even for clothing to those in the lowest income groups. Standard-process fabrics, dyed fabrics and printed fabrics all bulk larger in this category than in the coarse category. The standard-process fabrics are mainly work clothes. Of the dyed fabrics, 18.2 per cent are unprocessed (yarn-dyed), 47.4 per cent are standard-process, and 34.4 per cent are mercerized. The printed fabrics consist mainly of standard prints (97.2 per cent), with a small amount of mercerized prints (2.8 per cent).

In the medium category (see table 32) the percentage is lower for unprocessed fabrics, about the same for standard-process fabrics, much higher for dyed fabrics, and also higher for printed and special-process fabrics. Thus it is clear that the finer the fabrics the more intensive the processing. Of the dyed fabrics, 20.5 per cent are unprocessed (yarn-dyed), 46.9 per cent standard-process and 32.6 per cent mercerized.

In the medium-to-fine category (table 33) printed fabrics predominate, and of these 75.5 per cent are mercerized and 24.5 per cent undergo standard processing after printing. Of the dyed fabrics 6.7 per cent are unprocessed, 50 per cent are standard-dyed and 43.3 per cent are mercerized.

TABLE 34. PRODUCTION OF FINE COTTON FABRICS, BY TYPE OF PROCESSING, 1956-60
(*Percentage*)

| Type of fabric | 1956 | 1957 | 1958 | 1959 | 1960 |
|---|---|---|---|---|---|
| *Unprocessed* | *9.2* | *9.2* | *5.3* | *8.2* | *10.1* |
| *Standard process* | *3.1* | *3.4* | *2.4* | *2.8* | *2.6* |
| *Dyed* | *43.3* | *36.3* | *54.6* | *44.1* | *34.3* |
| Unprocessed | 13.2 | 10.3 | 9.8 | 14.5 | 11.8 |
| Standard process | 11.1 | 9.5 | 4.3 | 5.3 | 5.9 |
| Mercerized | 19.0 | 16.5 | 40.6 | 24.3 | 16.6 |
| *Printed* | *35.3* | *43.6* | *31.8* | *37.7* | *44.8* |
| Standard process | 7.4 | 6.0 | 5.7 | 5.4 | 5.5 |
| Mercerized | 27.9 | 37.6 | 26.1 | 32.3 | 39.3 |
| *Special fabrics* | *9.1* | *7.5* | *5.8* | *7.2* | *8.2* |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* ECLA survey.

This structure of production in the cotton sector, which is the largest sector in the Brazilian textile industry, appears to represent a sound balance, and the first conclusion suggested both by the course of its development and by the situation at the end of the period analysed is that the existing plants could, generally speaking, undertake re-equipment on the basis of approximately the present pattern of production which, as far as yarn counts are concerned, is very suitable to market conditions. The production stage where most changes are needed is undoubtedly the processing, since it is clear that the consumer trend is towards better looking fabrics, that are more highly processed. This conclusion is also reached by SUDENE,[7] whose report attributes the poor quality of processing it found to the unfavourable position of the Nordeste textile manufacturers in the domestic market. Thus a re-equipment programme would have the basic aim, not of establishing conditions for the production of finer fabrics, but of producing yarns and fabrics similar to those now produced, though of better quality, that is, more uniform and cleaner, and also, of course, of producing them more efficiently and at a higher level of productivity, and hence at less cost.

### (b) *Wool fabrics*

As noted earlier, the Brazilian wool industry expanded rapidly after the war, and at present the country's requirements for wool, as for other fibres, are almost entirely met by domestic production. The production of tropical fabrics predominates, followed by serges, gabardines, and a wide range of worsteds, fancy weaves, fabrics for women's wear, and bedspread and carpet weaves, etc., grouped together under the term "other fabrics". For 1956-60 the structure of wool fabric production was as shown in table 35.

TABLE 35. WOOL FABRIC PRODUCTION, BY FABRIC, 1956-60
(*Percentage*)

| Fabrics | 1956 | 1957 | 1958 | 1959 | 1960 |
|---|---|---|---|---|---|
| Gabardines | 23.6 | 21.6 | 21.2 | 19.8 | 18.1 |
| Tropical fabrics | 30.2 | 32.2 | 34.7 | 36.2 | 33.8 |
| Serges | 14.0 | 14.0 | 14.7 | 14.8 | 13.3 |
| Other fabrics | 32.2 | 32.2 | 29.4 | 29.2 | 34.8 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

The percentage of standard and special processing is shown in table 36. The distinction is between fabrics given the "English" treatment (which ensures satisfactory pre-shrinking), here termed "special", and those given only the standard processing. The table shows that over 40 per cent of all fabrics receive the special processing. In the tropical fabrics, the percentage of this processing increased from 32.2 in 1956 to 54.8 in 1960, when it represented a higher proportion of special processing than for any other group of fabrics. In gabardines and serges the proportion was lower but showed a tendency to increase. In other fabrics the proportion declined. Thus the position was most satisfactory as regards tropical wool fabrics, with respect both to volume and type of processing.

### (c) *Fabrics of man-made fibres*

For these products the breakdown is shown in table 37.

Blends of continuous filaments and staple predominate, although there is a declining trend. The proportion of fabrics made with continuous filaments remained relatively stable. There is a slightly declining trend in the two items staple fibre and other blends, and a marked rise for nylon.

[7] SUDENE, "O Reaparelhamento da Indústria do Nordeste", *Diário Oficial da União*, 27 July 1961.

TABLE 34. PRODUCTION OF FINE COTTON FABRICS, BY TYPE OF PROCESSING, 1956-60
(*Percentage*)

| *Type of fabric* | *1956* | *1957* | *1958* | *1959* | *1960* |
|---|---|---|---|---|---|
| *Unprocessed* | *9.2* | *9.2* | *5.3* | *8.2* | *10.1* |
| *Standard process* | *3.1* | *3.4* | *2.4* | *2.8* | *2.6* |
| *Dyed* | *43.3* | *36.3* | *54.6* | *44.1* | *34.3* |
| Unprocessed | 13.2 | 10.3 | 9.8 | 14.5 | 11.8 |
| Standard process | 11.1 | 9.5 | 4.3 | 5.3 | 5.9 |
| Mercerized | 19.0 | 16.5 | 40.6 | 24.3 | 16.6 |
| *Printed* | *35.3* | *43.6* | *31.8* | *37.7* | *44.8* |
| Standard process | 7.4 | 6.0 | 5.7 | 5.4 | 5.5 |
| Mercerized | 27.9 | 37.6 | 26.1 | 32.3 | 39.3 |
| *Special fabrics* | *9.1* | *7.5* | *5.8* | *7.2* | *8.2* |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* ECLA survey.

This structure of production in the cotton sector, which is the largest sector in the Brazilian textile industry, appears to represent a sound balance, and the first conclusion suggested both by the course of its development and by the situation at the end of the period analysed is that the existing plants could, generally speaking, undertake re-equipment on the basis of approximately the present pattern of production which, as far as yarn counts are concerned, is very suitable to market conditions. The production stage where most changes are needed is undoubtedly the processing, since it is clear that the consumer trend is towards better looking fabrics, that are more highly processed. This conclusion is also reached by SUDENE,[7] whose report attributes the poor quality of processing it found to the unfavourable position of the Nordeste textile manufacturers in the domestic market. Thus a re-equipment programme would have the basic aim, not of establishing conditions for the production of finer fabrics, but of producing yarns and fabrics similar to those now produced, though of better quality, that is, more uniform and cleaner, and also, of course, of producing them more efficiently and at a higher level of productivity, and hence at less cost.

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| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

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[7] SUDENE, "O Reaparelhamento da Indústria do Nordeste", *Diário Oficial da União*, 27 July 1961.

As to the various types of processing (see table 38), standard dyes predominate, representing 49.9 per cent, followed by unprocessed fabrics, at 30 per cent, special-process fabrics at 13.3 per cent and printed fabrics at 6.8 per cent.

### 5. Marketing of textile products

#### (a) *Cotton fabrics*

The bulk of the sales for each plant are made directly to clothing manufacturers, and part of the sales by the wholesalers are also to clothing manufacturers; thus the clothing industry has a marked influence on the distribution process in the textile industry.

The difference between the ex-factory price of fabrics and the consumer price is about 50 per cent, and is sometimes as high as 70 per cent, mainly for fancy weaves. Factory sales are against payment in 90 days, and the annual rate of turnover of working capital is estimated as from 1.5 to 2.

#### (b) *Wool fabrics*

Of the spinning mill output, 70 per cent goes for the production of woven fabrics (in the same mill or elsewhere); 20 to 25 per cent is for the production of knitted goods, and 5 to 10 per cent is sold as skeins for hand knitting. Of the fabrics, 30 to 40 per cent of the worsteds and about 90 per cent of woollens go to the clothing industry, the balance being sold to special stores that resell to retailers, or in rolls to tailors.

Sales are against payment in an average of 120 days to tailors and retailers, but up to six months for clothing manufacturers. The annual rate of turnover of working capital is estimated as 1.5. The differences between the factory and consumer prices are similar to those for cotton.

#### (c) *Textiles of artificial and synthetic fibres*

Approximately 50 per cent of these fabrics go to wholesalers, 20 per cent to retailers and 30 per cent to clothing manufacturers.

In this branch, too, the clothing industry is becoming increasingly important. The result is a decrease in the proportion of small manufacturers producing special fabrics in small quantities but in a wide range, since the clothing industry requires large quantities of fabric of the same type and pattern for cutting on an industrial scale, and needs cloth with a good finish available at low or medium price levels.

The rate of turnover of working capital in this sector is estimated to be two times a year. Most of the weaving mills do not have spinning sections, and buy their yarn from spinning mills; the relatively slow turnover is due to the fact that the average payment period for sales is 120 days, whereas yarn purchases are generally against immediate payment or, in exceptional cases, payment within not more than 60 days.

### 6. Evolution and structure of imports

#### (a) *Textile products*

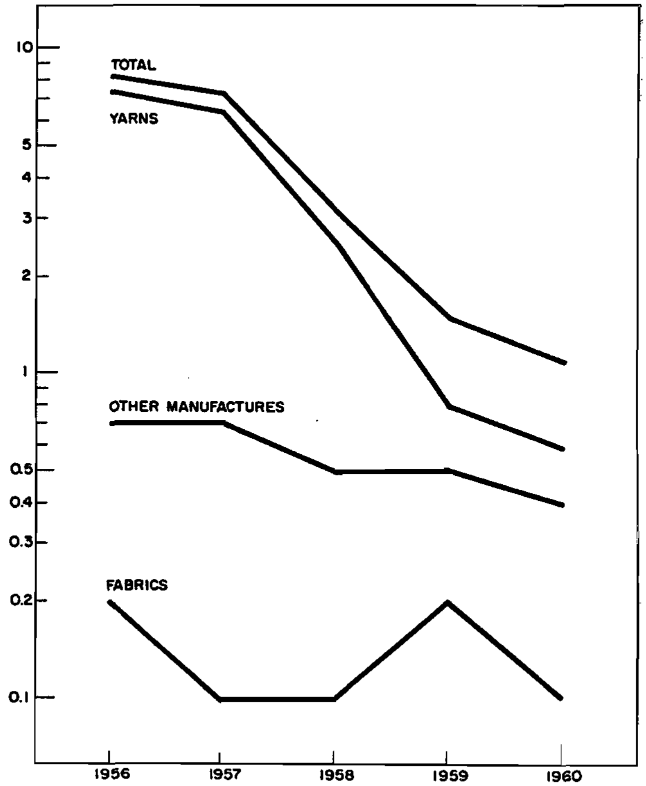
(i) *By type of product.* Table 39 and figure V show imports of yarns, fabrics and other textile manufactures by Brazil during 1956-60, and show that these imports as a whole declined between 1956 and 1960, from 8.2 to 1.1 million dollars. There was a decrease in the proportion of yarns and an increase in the proportion of fabrics and other manufactures. The fabrics consisted mainly of special process items for industrial use, such as fabrics treated with rubber or other materials. The other manufactures consist either of items for industrial use, such as rope and twine, or costly items such as linen towels, wool carpets, and even some knitted articles such as stockings.

Figure V

Imports of textile products, 1956-60

(*Millions of dollars*)

Semi-logarithmic scale




*Source:* I.B.G.E., *Anuários Estatísticos do Comércio Exterior do Brasil.*

(ii) *By fibre.* The composition of textile imports by fibre for the period is shown in table 40. Imports of flax products predominated, although to a decreasing extent. The artificial fibre group, which had been declining during the period, increased relatively sharply during the final year. Cotton imports increased, whereas wool imports decreased steadily.

The ratios between the volume and value percentages vary with the fibre. For flax, the value percentages are lower, a fact attributable to the predominance of yarns in imports of this fibre. Although the ratio fluctuates for the artificial fibre group, value percentages are always higher. For wool, there was a sharp decrease in the percentage of value represented; for cotton both percentages rose, but value percentages more markedly, indicating higher prices, as a result of the more elaborate processing given to the special products, whichar e those that are imported.

(iii) *By origin.* As previously noted, yarn imports predominate in Brazilian textile purchases abroad, and

As to the various types of processing (see table 38), standard dyes predominate, representing 49.9 per cent, followed by unprocessed fabrics, at 30 per cent, special-process fabrics at 13.3 per cent and printed fabrics at 6.8 per cent.

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#### (b) *Wool fabrics*

Of the spinning mill output, 70 per cent goes for the production of woven fabrics (in the same mill or elsewhere); 20 to 25 per cent is for the production of knitted goods, and 5 to 10 per cent is sold as skeins for hand knitting. Of the fabrics, 30 to 40 per cent of the worsteds and about 90 per cent of woollens go to the clothing industry, the balance being sold to special stores that resell to retailers, or in rolls to tailors.

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Approximately 50 per cent of these fabrics go to wholesalers, 20 per cent to retailers and 30 per cent to clothing manufacturers.

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The rate of turnover of working capital in this sector is estimated to be two times a year. Most of the weaving mills do not have spinning sections, and buy their yarn from spinning mills; the relatively slow turnover is due to the fact that the average payment period for sales is 120 days, whereas yarn purchases are generally against immediate payment or, in exceptional cases, payment within not more than 60 days.

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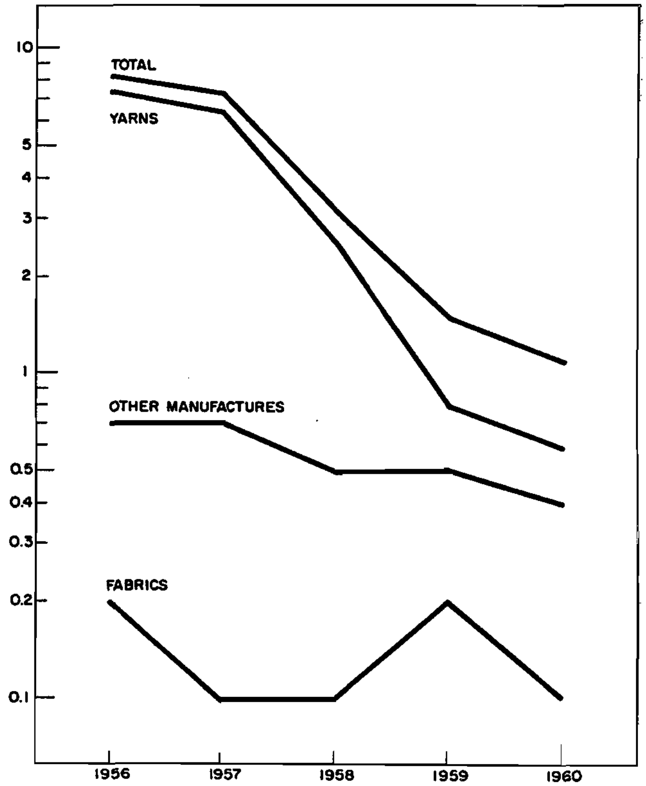
Figure V

Imports of textile products, 1956-60
(*Millions of dollars*)

Semi-logarithmic scale




*Source:* I.B.G.E., *Anuários Estatísticos do Comércio Exterior do Brasil.*

(ii) *By fibre.* The composition of textile imports by fibre for the period is shown in table 40. Imports of flax products predominated, although to a decreasing extent. The artificial fibre group, which had been declining during the period, increased relatively sharply during the final year. Cotton imports increased, whereas wool imports decreased steadily.

The ratios between the volume and value percentages vary with the fibre. For flax, the value percentages are lower, a fact attributable to the predominance of yarns in imports of this fibre. Although the ratio fluctuates for the artificial fibre group, value percentages are always higher. For wool, there was a sharp decrease in the percentage of value represented; for cotton both percentages rose, but value percentages more markedly, indicating higher prices, as a result of the more elaborate processing given to the special products, whichar e those that are imported.

(iii) *By origin.* As previously noted, yarn imports predominate in Brazilian textile purchases abroad, and

TABLE 42. BRAZILIAN IMPORTS OF TEXTILE RAW MATERIALS, BY TYPE OF FIBRE, 1956-60

| *Type of fibre* | *1956* | *1957* | *1958* | *1959* | *1960* |
|---|---|---|---|---|---|
| | *Thousands of dollars* | | | | |
| Wool (clean scoured) | 2,943.9 | 1,097.4 | 855.4 | 11.3 | 589.9 |
| Cotton | 14.3 | 11.0 | 8.6 | 5.0 | 2.9 |
| Artificial fibres | 1,379.2 | 467.0 | 97.3 | 32.9 | 284.0 |
| Flax | 1,695.8 | 633.8 | 827.5 | 1,218.5 | 1,884.2 |
| Other fibres | 213.9 | 103.3 | 76.0 | 40.5 | 37.1 |
| TOTAL | 6,247.1 | 2,312.5 | 1,864.8 | 1,308.2 | 2,798.1 |
| | *Percentage of total value* | | | | |
| Wool (clean scoured) | 47.2 | 47.4 | 45.9 | 0.9 | 21.1 |
| Cotton | 0.2 | 0.5 | 0.5 | 0.4 | 0.1 |
| Artificial fibres | 22.0 | 20.2 | 5.2 | 2.5 | 10.2 |
| Flax | 27.2 | 27.4 | 44.4 | 93.1 | 67.3 |
| Other fibres | 3.4 | 4.5 | 4.0 | 3.1 | 1.3 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* I.B.G.E., *Anuários Estatísticos do Comércio Exterior do Brasil.*

The relative importance of the various fibres showed marked changes during the period, with decreased percentages for wool, cotton, artificial fibres, and "other fibres". The only raw material of which imports remained relatively stable was flax, and even when the volume of imports fell far below the 1956 level, the percentage rose steadily. Nevertheless, as imports of yarns and fabrics of this fibre practically ceased, and the increase in the raw material imports were not sufficient to offset this decrease there was an over-all drop in the final consumption of flax products, largely compensated for by the use of ramie and also artificial and synthetic fibres. The reductions for all fibres were due to import substitutions, or to increases and improvements in domestic production and the use of alternative fibres (especially as regards wool, since there was both an improvement in the types produced domestically, and an increase in its replacement by artificial and synthetic fibres, particularly the latter). Cotton imports were negligible, and were attributable solely to occasional special imports of extra long-staple fibre (38 or 39 millimetres) not produced in the country, which are used for very fine yarns (100's and above) needed for the production of high grade fabrics.

(ii) *By source.* Most Brazilian imports of textile raw materials are from Europe; between 1956 and 1960 they represented an annual average of 56 per cent of the total, the ALALC countries following with 30 per cent, the United States with 7 per cent and other countries with the remaining 7 per cent.

Europe sells Brazil artificial and synthetic fibres, and fibres of flax, wool and other materials, whereas the ALALC countries supply only certain types of wool; the percentages of total wool imports represented by these types are given in table 43.

TABLE 43. PERCENTAGE OF TOTAL BRAZILIAN WOOL IMPORTS REPRESENTED BY IMPORTS FROM THE ALALC COUNTRIES, 1956-60

| | *Volume* | | | | *Value* | | | |
|---|---|---|---|---|---|---|---|---|
| *Year* | *Greasy wool* | *Clean scoured* | *Tops* | *Total* | *Greasy wool* | *Clean scoured* | *Tops* | *Total* |
| 1956 | 90.6 | 100.0 | 88.6 | 91.2 | 74.7 | 100.0 | 92.1 | 91.0 |
| 1957 | 34.0 | — | 90.4 | 87.1 | 20.0 | — | 93.1 | 89.2 |
| 1958 | 0 | — | 0 | 0 | 0 | — | 0 | 0 |
| 1959 | — | 0 | — | 0 | — | 0 | — | 0 |
| 1960 | 88.4 | 49.0 | 0 | 77.8 | 85.3 | 48.6 | 0 | 78.7 |

*Source:* I.B.G.E., *Anuários Estatísticos do Comércio Exterior do Brasil.*

## 7. EVOLUTION AND COMPOSITION OF EXPORTS

### (a) *Textile products*

Textile exports, unlike imports, increased considerably between 1956 and 1960. The average for the period was 1,255.2 tons and 2,575,400 dollars. The breakdown is given in table 44.

As 1956 was an exceptional year, 1957 should be used as the standard of comparison in considering the fluctuations shown in the table. On this basis, the value of exports in 1960 was three times as high as that for 1957. Average unit values declined during 1957-60, from 2,100 dollars per ton to 1,800 dollars.

(i) *Composition of exports.* The percentages of the total volume of exports represented by yarns, fabrics and other manufactures are shown in table 44. In terms of the average for the period fabrics predominated, with a share of 51.9 per cent, followed by yarns (43.0 per cent)

TABLE 42. BRAZILIAN IMPORTS OF TEXTILE RAW MATERIALS, BY TYPE OF FIBRE, 1956-60

| *Type of fibre* | *1956* | *1957* | *1958* | *1959* | *1960* |
|---|---|---|---|---|---|
| | *Thousands of dollars* | | | | |
| Wool (clean scoured) | 2,943.9 | 1,097.4 | 855.4 | 11.3 | 589.9 |
| Cotton | 14.3 | 11.0 | 8.6 | 5.0 | 2.9 |
| Artificial fibres | 1,379.2 | 467.0 | 97.3 | 32.9 | 284.0 |
| Flax | 1,695.8 | 633.8 | 827.5 | 1,218.5 | 1,884.2 |
| Other fibres | 213.9 | 103.3 | 76.0 | 40.5 | 37.1 |
| TOTAL | 6,247.1 | 2,312.5 | 1,864.8 | 1,308.2 | 2,798.1 |
| | *Percentage of total value* | | | | |
| Wool (clean scoured) | 47.2 | 47.4 | 45.9 | 0.9 | 21.1 |
| Cotton | 0.2 | 0.5 | 0.5 | 0.4 | 0.1 |
| Artificial fibres | 22.0 | 20.2 | 5.2 | 2.5 | 10.2 |
| Flax | 27.2 | 27.4 | 44.4 | 93.1 | 67.3 |
| Other fibres | 3.4 | 4.5 | 4.0 | 3.1 | 1.3 |
| TOTAL | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

*Source:* I.B.G.E., *Anuários Estatísticos do Comércio Exterior do Brasil.*

The relative importance of the various fibres showed marked changes during the period, with decreased percentages for wool, cotton, artificial fibres, and "other fibres". The only raw material of which imports remained relatively stable was flax, and even when the volume of imports fell far below the 1956 level, the percentage rose steadily. Nevertheless, as imports of yarns and fabrics of this fibre practically ceased, and the increase in the raw material imports were not sufficient to offset this decrease there was an over-all drop in the final consumption of flax products, largely compensated for by the use of ramie and also artificial and synthetic fibres. The reductions for all fibres were due to import substitutions, or to increases and improvements in domestic production and the use of alternative fibres (especially as regards wool, since there was both an improvement in the types produced domestically, and an increase in its replacement by artificial and synthetic fibres, particularly the latter). Cotton imports were negligible, and were attributable solely to occasional special imports of extra long-staple fibre (38 or 39 millimetres) not produced in the country, which are used for very fine yarns (100's and above) needed for the production of high grade fabrics.

(ii) *By source.* Most Brazilian imports of textile raw materials are from Europe; between 1956 and 1960 they represented an annual average of 56 per cent of the total, the ALALC countries following with 30 per cent, the United States with 7 per cent and other countries with the remaining 7 per cent.

Europe sells Brazil artificial and synthetic fibres, and fibres of flax, wool and other materials, whereas the ALALC countries supply only certain types of wool; the percentages of total wool imports represented by these types are given in table 43.

TABLE 43. PERCENTAGE OF TOTAL BRAZILIAN WOOL IMPORTS REPRESENTED BY IMPORTS FROM THE ALALC COUNTRIES, 1956-60

| *Year* | *Volume* | | | | *Value* | | | |
|---|---|---|---|---|---|---|---|---|
| | *Greasy wool* | *Clean scoured* | *Tops* | *Total* | *Greasy wool* | *Clean scoured* | *Tops* | *Total* |
| 1956 | 90.6 | 100.0 | 88.6 | 91.2 | 74.7 | 100.0 | 92.1 | 91.0 |
| 1957 | 34.0 | — | 90.4 | 87.1 | 20.0 | — | 93.1 | 89.2 |
| 1958 | 0 | — | 0 | 0 | 0 | — | 0 | 0 |
| 1959 | — | 0 | — | 0 | — | 0 | — | 0 |
| 1960 | 88.4 | 49.0 | 0 | 77.8 | 85.3 | 48.6 | 0 | 78.7 |

*Source:* I.B.G.E., *Anuários Estatísticos do Comércio Exterior do Brasil.*

## 7. EVOLUTION AND COMPOSITION OF EXPORTS

### (a) *Textile products*

Textile exports, unlike imports, increased considerably between 1956 and 1960. The average for the period was 1,255.2 tons and 2,575,400 dollars. The breakdown is given in table 44.

As 1956 was an exceptional year, 1957 should be used as the standard of comparison in considering the fluctuations shown in the table. On this basis, the value of exports in 1960 was three times as high as that for 1957. Average unit values declined during 1957-60, from 2,100 dollars per ton to 1,800 dollars.

(i) *Composition of exports.* The percentages of the total volume of exports represented by yarns, fabrics and other manufactures are shown in table 44. In terms of the average for the period fabrics predominated, with a share of 51.9 per cent, followed by yarns (43.0 per cent)

TABLE 46. BRAZILIAN TEXTILE EXPORTS AND IMPORTS, 1957-60

| Year | Imports | Exports | Foreign trade balance | Domestic consumption | Ratio of imports to domestic consumption |
|---|---|---|---|---|---|
| | (Thousands of tons) | | | | (Percentage) |
| 1957 . . . | 3.30 | 0.68 | −2.62 | 275.9 | 1.2 |
| 1958 . . . | 1.89 | 2.38 | +0.49 | 294.3 | 0.6 |
| 1959 . . . | 1.10 | 0.79 | −0.31 | 304.3 | 0.3 |
| 1960 . . . | 0.90 | 2.35 | +1.45 | 313.9 | 0.2 |

However, this situation is by no means an inherent feature of an advanced stage of industrial development, as shown in table 47, which gives data for a number of other countries all of which (except Chile) are more industrially developed than Brazil. A comparison of the percentages represented by the contribution of imports to apparent consumption of textiles in the various countries shows that Brazil imports relatively less than France, which has a well equipped textile industry; than Chile, which like Brazil has a highly protected industry; than the United Kingdom, which is a traditional producer of textiles and which has recently carried out an extensive re-equipment programme, and than Switzerland, a highly industrialized country. The United Kingdom and Switzerland, the two countries that import most in relation to apparent consumption, are also among the largest exporters. France, too, which is also a large exporter and whose tariffs are recognized as high (by European standards), effects imports which are higher than those of Brazil on a percentage basis, and are also substantial in absolute terms.

TABLE 47. FOREIGN TRADE AND APPARENT CONSUMPTION OF TEXTILE PRODUCTS IN SELECTED COUNTRIES, 1957

| Country | Imports | Exports | Foreign trade balance | Apparent consumption | Ratio of imports to apparent consumption (Percentage) |
|---|---|---|---|---|---|
| | (Thousands of tons) | | | | |
| | (Thousands of tons) | | | | |
| France . . . . . . . . . . | 21.54 | 137.13 | +115.59 | 468.17 | 4.6 |
| United Kingdom . . . . . . | 108.77 | 251.93 | +143.16 | 639.31 | 17.0 |
| Switzerland . . . . . . . . | 28.20 | 36.97 | + 8.77 | 63.85 | 44.2 |
| Brazil . . . . . . . . . . . | 3.30 | 0.68 | − 2.62 | 275.90 | 1.2 |
| Chile . . . . . . . . . . . | 2.50 | 0.64 | − 1.7 | 27.60 | 9.1 |

*Source:* ECLA, on the basis of FAO *Commodity Bulletin,* No. 31.

These data reveal, not an inability of the industry in these countries to meet national requirements completely, but a systematic economic policy of keeping the tariff protection granted to the domestic industry within reasonable limits than can preserve a certain degree of competition between imports and domestic production. This competition, since it is limited, has the effect of extending the markets open to the domestic industry, rather than restricting them. The competition brings new life to the industry, by ensuring continuing concern with efficiency and productivity and by encouraging a form of specialization that makes possible the optimum use of the productive resources of the country, on the basis of its particular advantages, and thus extends the markets available to the domestic industry. As the above table shows, the elimination of both imports and exports of textiles would represent, for France, the United Kingdom and Switzerland, a reduction in the markets available to their industries.

The high level of self-sufficiency in textile products attained in both Brazil and Chile is largely a reflection of the high tariffs in those countries, substantially higher than those prevailing in Europe. However, the situation of these two countries is somewhat different. Their early stage of industrial development requires at the outset a higher level of tariff protection, and also requires that the gradual reduction of this level should be effected mainly as between countries with similar levels of economic development and industrial experience. A detailed consideration of this aspect is beyond the scope of the present study, and belongs in the comparative study of the textile industries of the ALALC countries that is to conclude the present series of textile studies by ECLA. For the moment, suffice it to draw attention to the important role that can be played by a policy of reciprocal tariff concessions within Latin America in a programme for the reorganization and modernization of the region's textile industries.

TABLE 46. BRAZILIAN TEXTILE EXPORTS AND IMPORTS, 1957-60

| Year | Imports | Exports | Foreign trade balance | Domestic consumption | Ratio of imports to domestic consumption |
|---|---|---|---|---|---|
| | (Thousands of tons) | | | | (Percentage) |
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| 1958 . . . | 1.89 | 2.38 | +0.49 | 294.3 | 0.6 |
| 1959 . . . | 1.10 | 0.79 | −0.31 | 304.3 | 0.3 |
| 1960 . . . | 0.90 | 2.35 | +1.45 | 313.9 | 0.2 |

However, this situation is by no means an inherent feature of an advanced stage of industrial development, as shown in table 47, which gives data for a number of other countries all of which (except Chile) are more industrially developed than Brazil. A comparison of the percentages represented by the contribution of imports to apparent consumption of textiles in the various countries shows that Brazil imports relatively less than France, which has a well equipped textile industry; than Chile, which like Brazil has a highly protected industry; than the United Kingdom, which is a traditional producer of textiles and which has recently carried out an extensive re-equipment programme, and than Switzerland, a highly industrialized country. The United Kingdom and Switzerland, the two countries that import most in relation to apparent consumption, are also among the largest exporters. France, too, which is also a large exporter and whose tariffs are recognized as high (by European standards), effects imports which are higher than those of Brazil on a percentage basis, and are also substantial in absolute terms.

TABLE 47. FOREIGN TRADE AND APPARENT CONSUMPTION OF TEXTILE PRODUCTS IN SELECTED COUNTRIES, 1957

| Country | Imports | Exports | Foreign trade balance | Apparent consumption | Ratio of imports to apparent consumption (Percentage) |
|---|---|---|---|---|---|
| | (Thousands of tons) | | | | |
| | (Thousands of tons) | | | | |
| France . . . . . . . . . . | 21.54 | 137.13 | +115.59 | 468.17 | 4.6 |
| United Kingdom . . . . . . | 108.77 | 251.93 | +143.16 | 639.31 | 17.0 |
| Switzerland . . . . . . . . | 28.20 | 36.97 | + 8.77 | 63.85 | 44.2 |
| Brazil . . . . . . . . . . . | 3.30 | 0.68 | − 2.62 | 275.90 | 1.2 |
| Chile . . . . . . . . . . . | 2.50 | 0.64 | − 1.7 | 27.60 | 9.1 |

*Source:* ECLA, on the basis of FAO *Commodity Bulletin*, No. 31.

These data reveal, not an inability of the industry in these countries to meet national requirements completely, but a systematic economic policy of keeping the tariff protection granted to the domestic industry within reasonable limits than can preserve a certain degree of competition between imports and domestic production. This competition, since it is limited, has the effect of extending the markets open to the domestic industry, rather than restricting them. The competition brings new life to the industry, by ensuring continuing concern with efficiency and productivity and by encouraging a form of specialization that makes possible the optimum use of the productive resources of the country, on the basis of its particular advantages, and thus extends the markets available to the domestic industry. As the above table shows, the elimination of both imports and exports of textiles would represent, for France, the United Kingdom and Switzerland, a reduction in the markets available to their industries.

The high level of self-sufficiency in textile products attained in both Brazil and Chile is largely a reflection of the high tariffs in those countries, substantially higher than those prevailing in Europe. However, the situation of these two countries is somewhat different. Their early stage of industrial development requires at the outset a higher level of tariff protection, and also requires that the gradual reduction of this level should be effected mainly as between countries with similar levels of economic development and industrial experience. A detailed consideration of this aspect is beyond the scope of the present study, and belongs in the comparative study of the textile industries of the ALALC countries that is to conclude the present series of textile studies by ECLA. For the moment, suffice it to draw attention to the important role that can be played by a policy of reciprocal tariff concessions within Latin America in a programme for the reorganization and modernization of the region's textile industries.

TABLE 48. COVERAGE OF THE TEXTILE INDUSTRY BY THE ECLA AND SUDENE SURVEYS

| Distribution | Thousand spindles[a] Installed | Thousand spindles[a] Surveyed | Looms[a] Installed | Looms[a] Surveyed |
|---|---|---|---|---|
| TOTAL | | | | |
| *By state* | *4,294.9* | *4,025.3* | *131,860* | *121,149* |
| São Paulo | 1,888.1 | 1,723.7 | 60,384 | 53,609 |
| Rio-Guanabara | 964.9 | 931.4 | 25,962 | 23,358 |
| Minas Gerais | 594.0 | 557.5 | 17,450 | 17,260 |
| Santa Catarina | 105.1 | 101.8 | 2,500 | 2,445 |
| Rio Grande do Sul | 87.5 | 68.6 | 2,230 | 2,001 |
| Nordeste[b] | 642.3 | 642.3 | 22,476 | 22,476 |
| Others[c] | 13.0 | — | 858 | — |
| *By fibre* | | | | |
| Cotton | 3,840.0 | 3,656.3 | 102,760 | 95,427 |
| Wool | 301.9 | 245.8 | 5,500 | 4,534 |
| Man-made fibres | 60.0[d] | 53.0[d] | 17,500 | 16,278 |
| Jute and similar fibres | 60.0 | 43.2 | 4,500 | 3,538 |
| Flax and ramie | 33.0 | 27.0 | 1,600 | 1,372 |

*Source:* ECLA and SUDENE surveys.
[a] This covers all spindles or looms in each mill that are in working condition, whether or not they are being used.
[b] Because of the lack of other data, the machinery covered by the survey was regarded as representing 100 per cent of the machinery installed in the region surveyed.
[c] Estimates.
[d] This covers the spinning of staple fibre whose processing is similar to that for cotton and wool.

TABLE 49. SPINNING AND WEAVING MACHINERY IN SELECTED COUNTRIES

| Country | Cotton | Wool | Total | Percentage of the total represented by cotton |
|---|---|---|---|---|
| | | *Spindles (thousands)* | | |
| Brazil | 3,840[a] | 301[a] | 4,141 | 92.7 |
| Argentina | 989 | 380 | 1,369 | 72.2 |
| Mexico | 1,188 | ... | ... | ... |
| United States | 20,000 | 1,339[b] | 21,339 | 93.7 |
| Japan | 12,895 | 1,920 | 14,815 | 87.0 |
| India | 13,149 | 191 | 13,340 | 98.6 |
| France | 6,280 | 1,427 | 7,707 | 81.5 |
| Federal Republic of Germany | 6,020 | 1,191 | 7,211 | 83.5 |
| United Kingdom | 19,889 | 4,663 | 24,552 | 81.0 |
| Italy | 5,211 | 1,555 | 6,766 | 77.0 |
| | | *Looms* | | |
| Brazil | 102,760[a] | 5,500[a] | 108,260 | 94.9 |
| Argentina | 19,444 | 9,000 | 28,444 | 68.4 |
| Mexico | 38,604 | ... | ... | ... |
| United States | 326,387 | 14,234[b] | 340,621 | 95.8 |
| Japan | 367,349 | 32,994 | 400,343 | 91.7 |
| India | 204,306 | 3,865[b] | 208,171 | 98.1 |
| France | 124,517 | 19,085 | 143,602 | 86.7 |
| Federal Republic of Germany | 125,771 | 16,600 | 142,371 | 88.3 |
| United Kingdom | 250,000 | 51,734 | 301,734 | 82.9 |
| Italy | 109,299 | 24,500 | 133,799 | 81.7 |

*Source:* Instituto Cotoniero Italiano, *Anuario Statistiche Tessili* 1960.
[a] 1960 data.
[b] 1957 data.

and 78.0 per cent of all looms; the corresponding percentages for the other sectors are: wool, 7.0 and 4.2, man-made fibres 1.4 and 13.3,[4] jute 1.4 and 3.4,[5] and flax, 0.8 and 1.8. The distribution of production capacity between the various fibres and states is shown in tables 51 and 52.

[4] It should be recalled that the weaving mills consume a large volume of continuous filament yarn produced by the chemical industry.

[5] It should be pointed out that there are a large number of jute processing mills in the Nordeste and Norte, and others again in Espirito Santo, which were not covered by the ECLA or the SUDENE survey. Total installed capacity for this sector in Brazil is probably about twice that in the region surveyed by ECLA.

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*Source:* ECLA and SUDENE surveys.
[a] This covers all spindles or looms in each mill that are in working condition, whether or not they are being used.
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| India | 13,149 | 191 | 13,340 | 98.6 |
| France | 6,280 | 1,427 | 7,707 | 81.5 |
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| Italy | 5,211 | 1,555 | 6,766 | 77.0 |
| | | *Looms* | | |
| Brazil | 102,760[a] | 5,500[a] | 108,260 | 94.9 |
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| Mexico | 38,604 | ... | ... | ... |
| United States | 326,387 | 14,234[b] | 340,621 | 95.8 |
| Japan | 367,349 | 32,994 | 400,343 | 91.7 |
| India | 204,306 | 3,865[b] | 208,171 | 98.1 |
| France | 124,517 | 19,085 | 143,602 | 86.7 |
| Federal Republic of Germany | 125,771 | 16,600 | 142,371 | 88.3 |
| United Kingdom | 250,000 | 51,734 | 301,734 | 82.9 |
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*Source:* Instituto Cotoniero Italiano, *Anuario Statistiche Tessili* 1960.
[a] 1960 data.
[b] 1957 data.

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[4] It should be recalled that the weaving mills consume a large volume of continuous filament yarn produced by the chemical industry.

[5] It should be pointed out that there are a large number of jute processing mills in the Nordeste and Norte, and others again in in Espirito Santo, which were not covered by the ECLA or the SUDENE survey. Total installed capacity for this sector in Brazil is probably about twice that in the region surveyed by ECLA.

TABLE 52. TECHNOLOGICAL CHARACTERISTICS OF WEAVING MACHINERY IN BRAZIL, BY STATE AND BY FIBRE

| | Cotton | Wool | Man-made fibres | Jute | Flax | Total |
|---|---|---|---|---|---|---|
| 1. *Power Looms* . . . . . . . . | *69,656* | *3,848* | *13,333* | *2,582* | *871* | *90,290* |
| São Paulo . . . . . . . . | 18,719 | 2,809 | 12,079 | 1,552 | 735 | 35,894 |
| Rio-Guanabara . . . . . . | 14,953 | 547 | 913 | 651 | 122 | 17,186 |
| Minas Gerais . . . . . . . | 13,089 | 14 | 106 | — | — | 13,209 |
| Santa Catarina . . . . . . | 1,996 | — | — | — | — | 1,996 |
| Rio Grande do Sul . . . . | 760 | 478 | 235 | 379 | 14 | 1,866 |
| Nordeste . . . . . . . . . | 20,139 | — | — | — | — | 20,139 |
| 2. *Automatic looms* . . . . . . | *23,833* | *448* | *1,160* | *760* | *464* | *26,665* |
| São Paulo . . . . . . . . | 12,289 | 247 | 1,118 | 760 | 360 | 14,774 |
| Rio-Guanabara . . . . . . | 5,206 | 128 | 34 | — | 92 | 5,460 |
| Minas Gerais . . . . . . . | 3,541 | 61 | — | — | — | 3,602 |
| Santa Catarina . . . . . . | 449 | — | — | — | — | 449 |
| Rio Grande do Sul . . . . | 11 | 12 | 8 | — | 12 | 43 |
| Nordeste . . . . . . . . . | 2,337 | — | — | — | — | 2,337 |
| 3. *Circular looms* . . . . . . . | — | — | — | *142* | — | *142* |
| São Paulo . . . . . . . . | — | — | — | 102 | — | 102 |
| Rio-Guanabara . . . . . . | — | — | — | 40 | — | 40 |
| 4. TOTAL . . . . . . . . . . . | *93,489* | *4,296* | *14,493* | *3,484* | *1,335* | *117,097* |

*Source:* ECLA and SUDENE surveys.

TABLE 53. CHANGES IN INSTALLED CAPACITY IN THE COTTON AND WOOL WEAVING SECTORS, BY STATE, 1946-60

| | Thousand spindles | | Percentage increase | Percentage share in national capacity | |
|---|---|---|---|---|---|
| | 1946 | 1960 | | 1946 | 1960 |
| *Cotton* | | | | | |
| São Paulo. . . . . . . . . . . | 1,083.6 | 1,544.5 | 42 | 35 | 40 |
| Rio-Guanabara . . . . . . . . | 876.6 | 935.1 | 7 | 28 | 24 |
| Nordeste . . . . . . . . . . . | 704.6 | 642.3 | −9 | 22.8 | 16.7 |
| Minas Gerais . . . . . . . . . | 349.4 | 594.0 | 70 | 11.3 | 15.5 |
| Santa Catarina . . . . . . . . | 45.9 | 105.1 | 129 | 1.5 | 2.7 |
| Rio Grande do Sul . . . . . . | 24.2 | 19.0 | −22 | 1 | 1 |
| TOTAL | 3,084.3 | 3,840.0 | 25 | 100 | 100 |
| *Wool* . . . . . . . . . . . . . | | | | | |
| São Paulo . . . . . . . . . . | 61.1 | 223.3 | 265 | 69 | 74 |
| Rio-Guanabara . . . . . . . . | 5.7 | 16.3 | 186 | 6 | 5 |
| Rio Grande do Sul . . . . . . | 22.5 | 62.3 | 177 | 25 | 21 |
| TOTAL | 98.3 | 301.9 | 238 | 100 | 100 |

In cotton spinning, capacity increased by 25 per cent during the period (the increase in cotton yarn production was 43 per cent). The 9 per cent decrease in the number of cotton spindles in the Nordeste region was due to the shutting-down of several mills there, whose severe shortage of technical facilities and lack of administrative organization resulted in high production costs that made it impossible for them to compete on the market with manufacturers in other regions. The increase in production capacity and output in the cotton sector in Minas Gerais, and its success in the domestic market, was probably due to its efficient administrative organization and the consequent relatively high productivity of its labour, the highest in Brazil. The fact that all this has been achieved despite scarcity of up-to-date machines clearly proves the importance of organizational factors and labour training.[7] The significant increase in Santa Catarina can be attributed to the specialization of production there,[8] to the proximity of the major textile consumer centres and cotton growers (São Paulo and Parana) and to labour costs lower than in any other Centro-Sul state. There is no apparent connexion in this instance between the growth of the industry and labour productivity, since productivity in Santa Catarina is lower than in any other part of the area surveyed (see chapter V). The development of the industry in São Paulo is undoubtedly due to the proximity of a large market, the existence of facilities for the purchase of raw materials, and substantial external economies.

[7] This question is dealt with in some detail in chapter VIII.
[8] Towels, coverlets, etc.

TABLE 52. TECHNOLOGICAL CHARACTERISTICS OF WEAVING MACHINERY IN BRAZIL, BY STATE AND BY FIBRE

| | Cotton | Wool | Man-made fibres | Jute | Flax | Total |
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| 1. *Power Looms* . . . . . . . . | *69,656* | *3,848* | *13,333* | *2,582* | *871* | *90,290* |
| São Paulo . . . . . . . . | 18,719 | 2,809 | 12,079 | 1,552 | 735 | 35,894 |
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| Minas Gerais . . . . . . . | 13,089 | 14 | 106 | — | — | 13,209 |
| Santa Catarina . . . . . . | 1,996 | — | — | — | — | 1,996 |
| Rio Grande do Sul . . . . | 760 | 478 | 235 | 379 | 14 | 1,866 |
| Nordeste . . . . . . . . . | 20,139 | — | — | — | — | 20,139 |
| 2. *Automatic looms* . . . . . . | *23,833* | *448* | *1,160* | *760* | *464* | *26,665* |
| São Paulo . . . . . . . . | 12,289 | 247 | 1,118 | 760 | 360 | 14,774 |
| Rio-Guanabara . . . . . . | 5,206 | 128 | 34 | — | 92 | 5,460 |
| Minas Gerais . . . . . . . | 3,541 | 61 | — | — | — | 3,602 |
| Santa Catarina . . . . . . | 449 | — | — | — | — | 449 |
| Rio Grande do Sul . . . . | 11 | 12 | 8 | — | 12 | 43 |
| Nordeste . . . . . . . . . | 2,337 | — | — | — | — | 2,337 |
| 3. *Circular looms* . . . . . . . | — | — | — | *142* | — | *142* |
| São Paulo . . . . . . . . | — | — | — | 102 | — | 102 |
| Rio-Guanabara . . . . . . | — | — | — | 40 | — | 40 |
| 4. TOTAL . . . . . . . . . . . | *93,489* | *4,296* | *14,493* | *3,484* | *1,335* | *117,097* |

*Source:* ECLA and SUDENE surveys.

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| | Thousand spindles | | Percentage increase | Percentage share in national capacity | |
|---|---|---|---|---|---|
| | 1946 | 1960 | | 1946 | 1960 |
| *Cotton* | | | | | |
| São Paulo. . . . . . . . . . . | 1,083.6 | 1,544.5 | 42 | 35 | 40 |
| Rio-Guanabara . . . . . . . . | 876.6 | 935.1 | 7 | 28 | 24 |
| Nordeste . . . . . . . . . . . | 704.6 | 642.3 | −9 | 22.8 | 16.7 |
| Minas Gerais . . . . . . . . . | 349.4 | 594.0 | 70 | 11.3 | 15.5 |
| Santa Catarina . . . . . . . . | 45.9 | 105.1 | 129 | 1.5 | 2.7 |
| Rio Grande do Sul . . . . . . | 24.2 | 19.0 | −22 | 1 | 1 |
| TOTAL | 3,084.3 | 3,840.0 | 25 | 100 | 100 |
| *Wool* . . . . . . . . . . . . . | | | | | |
| São Paulo . . . . . . . . . . | 61.1 | 223.3 | 265 | 69 | 74 |
| Rio-Guanabara . . . . . . . . | 5.7 | 16.3 | 186 | 6 | 5 |
| Rio Grande do Sul . . . . . . | 22.5 | 62.3 | 177 | 25 | 21 |
| TOTAL | 98.3 | 301.9 | 238 | 100 | 100 |

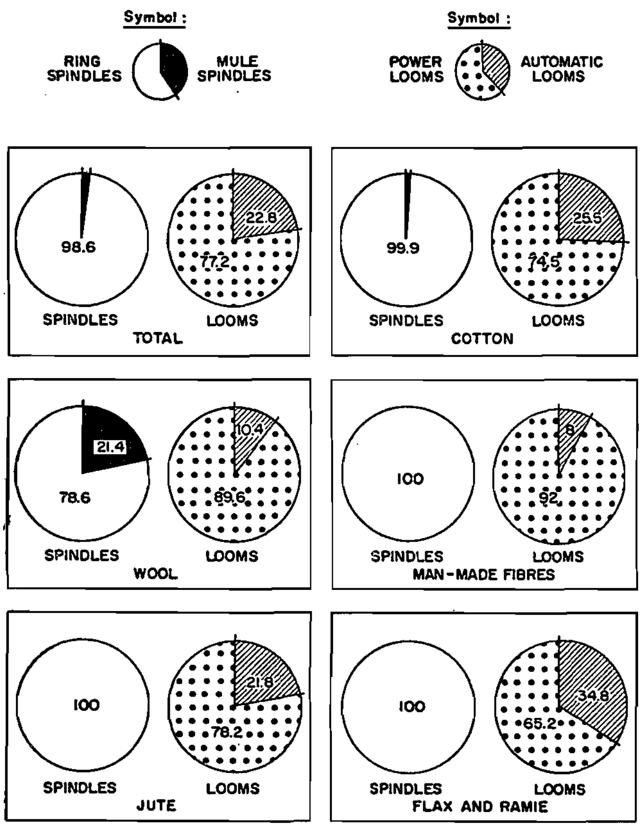
In cotton spinning, capacity increased by 25 per cent during the period (the increase in cotton yarn production was 43 per cent). The 9 per cent decrease in the number of cotton spindles in the Nordeste region was due to the shutting-down of several mills there, whose severe shortage of technical facilities and lack of administrative organization resulted in high production costs that made it impossible for them to compete on the market with manufacturers in other regions. The increase in production capacity and output in the cotton sector in Minas Gerais, and its success in the domestic market, was probably due to its efficient administrative organization and the consequent relatively high productivity of its labour, the highest in Brazil. The fact that all this has been achieved despite scarcity of up-to-date machines clearly proves the importance of organizational factors and labour training.[7] The significant increase in Santa Catarina can be attributed to the specialization of production there,[8] to the proximity of the major textile consumer centres and cotton growers (São Paulo and Parana) and to labour costs lower than in any other Centro-Sul state. There is no apparent connexion in this instance between the growth of the industry and labour productivity, since productivity in Santa Catarina is lower than in any other part of the area surveyed (see chapter V). The development of the industry in São Paulo is undoubtedly due to the proximity of a large market, the existence of facilities for the purchase of raw materials, and substantial external economies.

[7] This question is dealt with in some detail in chapter VIII.
[8] Towels, coverlets, etc.

Table 51 (above) and figure VI show the proportion of ring spindles used for the various fibres. In the jute and man-made fibre sectors only ring spindles are used, and in the cotton sector most of the spindles are ring spindles; in the wool sector, however, mule spindles predominate (78 per cent of the total). Only ring spindles are used for cotton in all states, except São Paulo, where there are also a small number of mule spindles. In the wool sector São Paulo has the highest proportion of ring spindles in its inventory (84 per cent) and Rio Grande do Sul the lowest (nearly 60 per cent). Only ring spindles are used in the man-made fibre sector (all in São Paulo), and in the jute sector; the flax sector uses mainly ring spindles, most of which are in São Paulo.

FIGURE VI

TECHNICAL CHARACTERISTICS OF SPINNING AND WEAVING EQUIPMENT, BY FIBRE, 1960




*Source:* ECLA survey.

The proportion of automatic looms used for the various fibres is shown in table 52 above and figure VI. The highest proportion (35 per cent) is in the linen sector, and the lowest (8 per cent) in the man-made fibre sector. In cotton weaving the State of São Paulo has the highest percentage of automatic looms (40 per cent) and the Nordeste States the lowest (9 per cent). In the wool sector Rio-Guanabara has the highest proportion of automatic looms (nearly 20 per cent) and Rio Grande do Sul, where nearly all the looms are non-automatic, the lowest. In the man-made fibre sector most of the automatic looms are in São Paulo, but they represent only about 8 per cent of the total in the State, in Rio Grande do Sul, almost all the looms are non-automatic.

In the jute sector, only São Paulo has automaticlo oms.[10] In the linen sector Rio Grande do Sul has the highest proportion of automatic looms (nearly 50 per cent) and São Paulo the lowest (about 33 per cent).

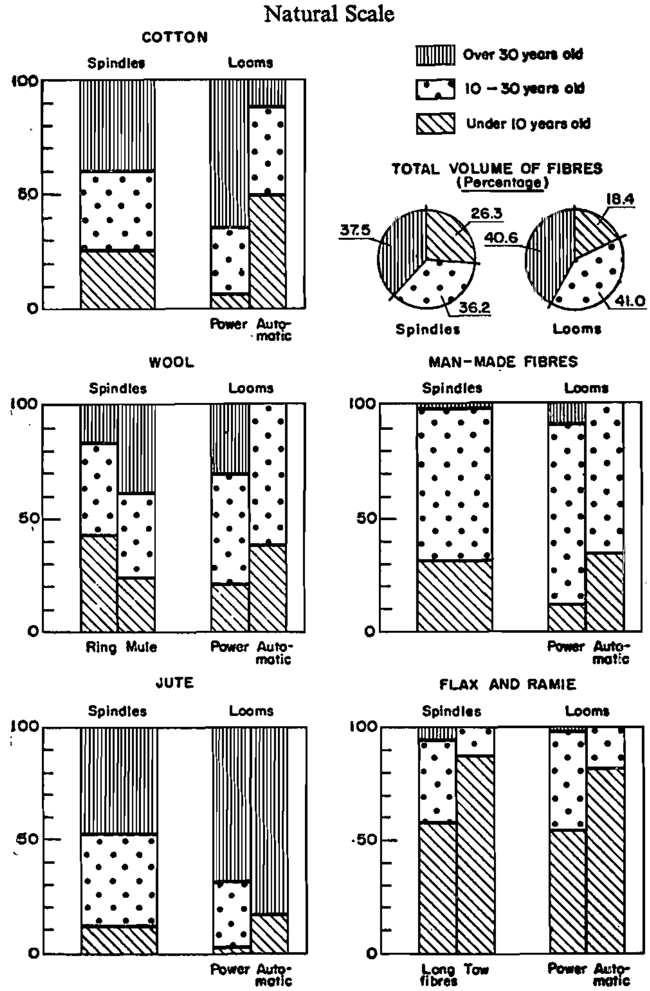
## 4. AGE OF THE MACHINERY

The machinery covered by the ECLA survey (equipment in use in 1960) was classified by its age[11] into three groups: machinery under ten years old, that had been acquired in the post-war period; machinery ten to thirty years old, that had not yet reached the end of the useful life calculated for machinery used intensively during the war, when there was virtually no replacement of equipment; and machinery over thirty years old, which had generally exceeded the term of its useful life. This classification was used for all the equipment included in the survey questionnaire for the different fibre sectors (see also figure VII). The equipment was also grouped under the headings of preparation for spinning, spinning, preparation for weaving, weaving, and yarn and fabric processing.

FIGURE VII.

PERCENTAGE DISTRIBUTION OF EQUIPMENT BY AGE AND BY FIBRE, 1960

Natural Scale




*Source:* ECLA survey.

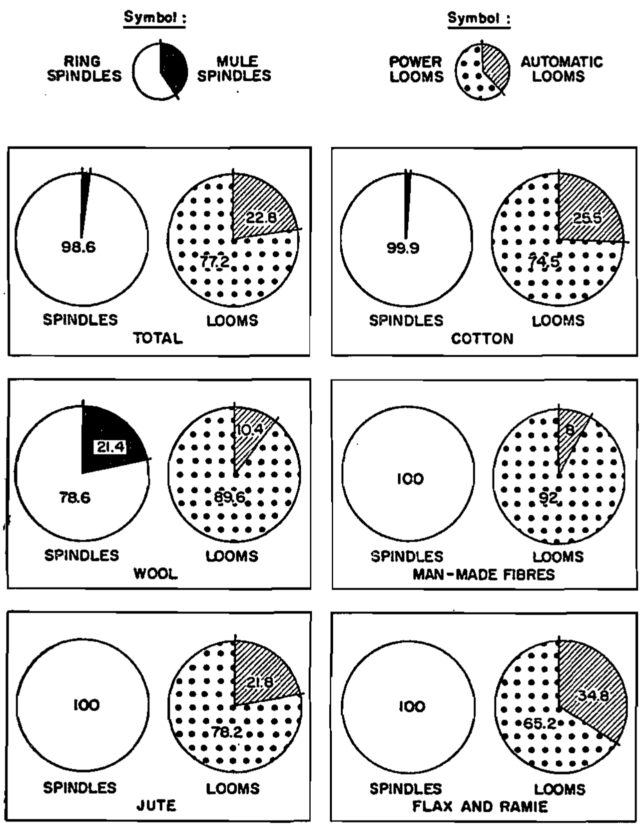
[10] São Paulo and Rio-Guanabara also have circular looms.

[11] On 31 December 1960, as indicated by the date of manufacture by the mill-owner in his reply to the survey questionnaire.

Table 51 (above) and figure VI show the proportion of ring spindles used for the various fibres. In the jute and man-made fibre sectors only ring spindles are used, and in the cotton sector most of the spindles are ring spindles; in the wool sector, however, mule spindles predominate (78 per cent of the total). Only ring spindles are used for cotton in all states, except São Paulo, where there are also a small number of mule spindles. In the wool sector São Paulo has the highest proportion of ring spindles in its inventory (84 per cent) and Rio Grande do Sul the lowest (nearly 60 per cent). Only ring spindles are used in the man-made fibre sector (all in São Paulo), and in the jute sector; the flax sector uses mainly ring spindles, most of which are in São Paulo.

FIGURE VI

TECHNICAL CHARACTERISTICS OF SPINNING AND WEAVING EQUIPMENT, BY FIBRE, 1960




*Source:* ECLA survey.

The proportion of automatic looms used for the various fibres is shown in table 52 above and figure VI. The highest proportion (35 per cent) is in the linen sector, and the lowest (8 per cent) in the man-made fibre sector. In cotton weaving the State of São Paulo has the highest percentage of automatic looms (40 per cent) and the Nordeste States the lowest (9 per cent). In the wool sector Rio-Guanabara has the highest proportion of automatic looms (nearly 20 per cent) and Rio Grande do Sul, where nearly all the looms are non-automatic, the lowest. In the man-made fibre sector most of the automatic looms are in São Paulo, but they represent only about 8 per cent of the total in the State, in Rio Grande do Sul, almost all the looms are non-automatic.

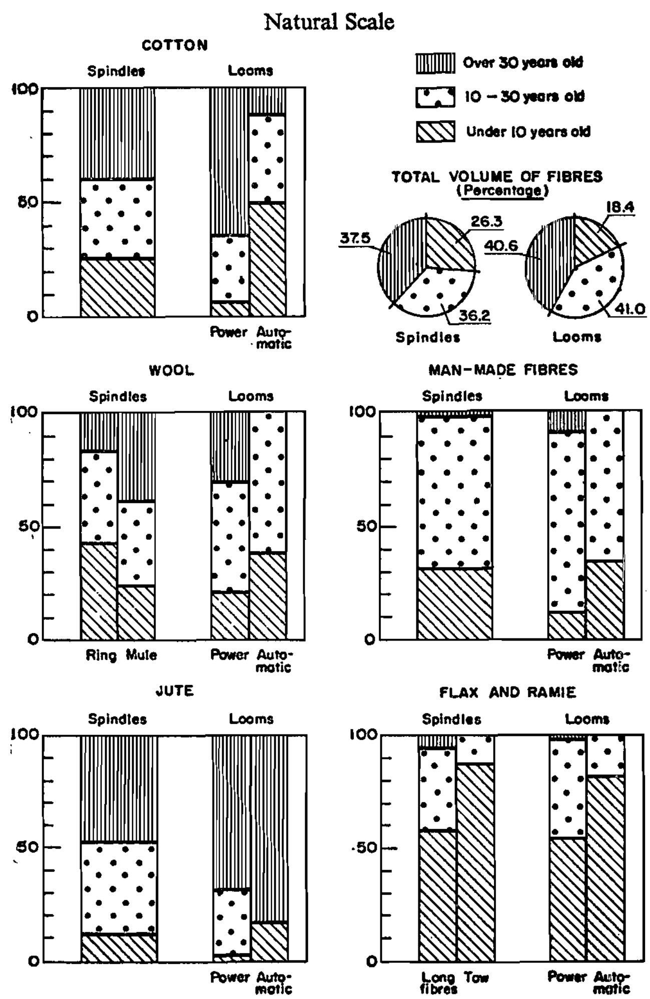
In the jute sector, only São Paulo has automaticlo oms.[10] In the linen sector Rio Grande do Sul has the highest proportion of automatic looms (nearly 50 per cent) and São Paulo the lowest (about 33 per cent).

## 4. AGE OF THE MACHINERY

The machinery covered by the ECLA survey (equipment in use in 1960) was classified by its age[11] into three groups: machinery under ten years old, that had been acquired in the post-war period; machinery ten to thirty years old, that had not yet reached the end of the useful life calculated for machinery used intensively during the war, when there was virtually no replacement of equipment; and machinery over thirty years old, which had generally exceeded the term of its useful life. This classification was used for all the equipment included in the survey questionnaire for the different fibre sectors (see also figure VII). The equipment was also grouped under the headings of preparation for spinning, spinning, preparation for weaving, weaving, and yarn and fabric processing.

FIGURE VII.

PERCENTAGE DISTRIBUTION OF EQUIPMENT BY AGE AND BY FIBRE, 1960




*Source:* ECLA survey.

[10] São Paulo and Rio-Guanabara also have circular looms.
[11] On 31 December 1960, as indicated by the date of manufacture by the mill-owner in his reply to the survey questionnaire.

TABLE 56. DISTRIBUTION OF MACHINERY BY AGE IN THE COTTON SECTOR

| Machinery | Less than ten years old | 10-30 years old | Over 30 years old | Total | Total number of machines |
|---|---|---|---|---|---|
| | (Percentage of total) | | | | |
| *Preparation for spinning* | | | | | |
| Scutchers | 24.5 | 37.4 | 38.1 | 100.0 | 420 |
| Cards | 19.2 | 34.0 | 46.8 | 100.0 | 9,956 |
| Waste cards | 28.0 | 25.6 | 46.4 | 100.0 | 164 |
| Drawing frames | 27.0 | 32.0 | 41.0 | 100.0 | 11,233 |
| Sliver lap machines | 23.8 | 52.7 | 23.5 | 100.0 | 315 |
| Ribbon lap machines | 23.0 | 44.0 | 33.0 | 100.0 | 209 |
| Combers | 25.8 | 45.0 | 29.2 | 100.0 | 2,157 |
| Roving frames | 15.5 | 29.6 | 54.9 | 100.0 | 338,324 |
| *Spinning* | | | | | |
| Ring spindles | 25.1 | 35.3 | 39.6 | 100.0 | 2,892,292 |
| Mule spindles | — | — | 100.0 | 100.0 | 2,490 |
| *Preparation for weaving* | | | | | |
| Cheese winders (cone winders) | 32.4 | 51.5 | 16.1 | 100.0 | 107,639 |
| Twisting frames | 22.0 | 48.0 | 30.0 | 100.0 | 461,815 |
| Reeling machines | 11.9 | 51.9 | 36.2 | 100.0 | 32.521 |
| Warp winders | 33.7 | 40.8 | 25.5 | 100.0 | 1,277 |
| Pirn winders | 42.1 | 36.5 | 21.4 | 100.0 | 44,844 |
| Slasher sizers | 20.0 | 27.0 | 53.0 | 100.0 | 426 |
| *Weaving* | | | | | |
| *Power looms* | 5.4 | 31.3 | 63.3 | 100.0 | 49,517 |
| Plain looms | 3.6 | 28.5 | 67.9 | 100.0 | 25,967 |
| Check looms | 7.4 | 37.0 | 55.6 | 100.0 | 10,245 |
| Dobby looms | 6.0 | 30.9 | 63.1 | 100.0 | 10,581 |
| Jacquard looms | 12.3 | 37.8 | 49.9 | 100.0 | 2,724 |
| *Automatic looms* | 49.6 | 39.7 | 10.7 | 100.0 | 21,496 |
| Plain looms | 49.8 | 39.0 | 11.2 | 100.0 | 15,442 |
| Check looms | 80.4 | 15.7 | 3.9 | 100.0 | 775 |
| Dobby looms | 44.4 | 45.3 | 10.3 | 100.0 | 5,173 |
| Jacquard looms | 35.9 | 64.1 | — | 100.0 | 106 |
| *Yarn and fabric processing* | | | | | |
| Bleaching plant | 29.6 | 42.4 | 28.0 | 100.0 | 602 |
| Fibre and yarn dyeing plant | 37.8 | 49.2 | 13.0 | 100.0 | 262 |
| Fabric dyeing plant | 47.1 | 44.2 | 8.7 | 100.0 | 1,151 |
| Printing machines | 27.6 | 43.7 | 28.7 | 100.0 | 174 |
| Finishing machines | 23.6 | 40.5 | 35.9 | 100.0 | 704 |

*Source:* ECLA survey.

types (double cards, pre-comber intersecting gill boxes, combers, post-comber intersecting gill boxes, backwashers, melange gill boxes and preparation systems) over a third of the equipment was in the under-10 age group, in proportions ranging from 36.8 per cent for melange gill boxes to 47.5 for the post-comber intersecting gill boxes. For the leviathan washers, cheese winders and waste cards the proportions were lower, and lowest of all for the single cards (4.5 per cent). The drying machines had the highest proportion in the 10-30 age group (57.1 per cent) and the backwashers the lowest (36.2 per cent). In the over-30 age group the pre-comber intersecting gill boxes had the lowest proportion (7.1 per cent) and the single cards the highest (59.1 per cent); for most of the other types of machine an average of 20 per cent was in this group.

Most of the equipment used in the preparation for weaving was in the 10-30 age group, the highest proportion (73 per cent) being for reeling machines. Over half the slasher sizers were over thirty years old. On the other hand, over a third of the doubling and twisting frames and cheese winders were in the up-to-date group.

For yarn and fabric processing the age composition of the machinery is much the same in the wool sector as in the cotton sector. The percentages in the up-to-date group are very similar, and there is some similarity in the proportions in the other age groups as well, the over-30 group being the smallest in both cases.

### (c) *Man-made fibre sector*

In this sector, the production machines proper consist of spindles for staple fibre, and power and automatic looms to weave staple fibre produced by the spindles and the continuous filament yarn manufactured by the chemical industry. The age composition of the machinery is as shown in table 58. The spinning equipment in this sector was found to be much more up to date than in the cotton sector, where only 25 per cent of the spindles were less than ten years old. However,

TABLE 56. DISTRIBUTION OF MACHINERY BY AGE IN THE COTTON SECTOR

| Machinery | Less than ten years old | 10-30 years old | Over 30 years old | Total | Total number of machines |
|---|---|---|---|---|---|
| | (Percentage of total) | | | | |
| *Preparation for spinning* | | | | | |
| Scutchers | 24.5 | 37.4 | 38.1 | 100.0 | 420 |
| Cards | 19.2 | 34.0 | 46.8 | 100.0 | 9,956 |
| Waste cards | 28.0 | 25.6 | 46.4 | 100.0 | 164 |
| Drawing frames | 27.0 | 32.0 | 41.0 | 100.0 | 11,233 |
| Sliver lap machines | 23.8 | 52.7 | 23.5 | 100.0 | 315 |
| Ribbon lap machines | 23.0 | 44.0 | 33.0 | 100.0 | 209 |
| Combers | 25.8 | 45.0 | 29.2 | 100.0 | 2,157 |
| Roving frames | 15.5 | 29.6 | 54.9 | 100.0 | 338,324 |
| *Spinning* | | | | | |
| Ring spindles | 25.1 | 35.3 | 39.6 | 100.0 | 2,892,292 |
| Mule spindles | — | — | 100.0 | 100.0 | 2,490 |
| *Preparation for weaving* | | | | | |
| Cheese winders (cone winders) | 32.4 | 51.5 | 16.1 | 100.0 | 107,639 |
| Twisting frames | 22.0 | 48.0 | 30.0 | 100.0 | 461,815 |
| Reeling machines | 11.9 | 51.9 | 36.2 | 100.0 | 32.521 |
| Warp winders | 33.7 | 40.8 | 25.5 | 100.0 | 1,277 |
| Pirn winders | 42.1 | 36.5 | 21.4 | 100.0 | 44,844 |
| Slasher sizers | 20.0 | 27.0 | 53.0 | 100.0 | 426 |
| *Weaving* | | | | | |
| *Power looms* | 5.4 | 31.3 | 63.3 | 100.0 | 49,517 |
| Plain looms | 3.6 | 28.5 | 67.9 | 100.0 | 25,967 |
| Check looms | 7.4 | 37.0 | 55.6 | 100.0 | 10,245 |
| Dobby looms | 6.0 | 30.9 | 63.1 | 100.0 | 10,581 |
| Jacquard looms | 12.3 | 37.8 | 49.9 | 100.0 | 2,724 |
| *Automatic looms* | 49.6 | 39.7 | 10.7 | 100.0 | 21,496 |
| Plain looms | 49.8 | 39.0 | 11.2 | 100.0 | 15,442 |
| Check looms | 80.4 | 15.7 | 3.9 | 100.0 | 775 |
| Dobby looms | 44.4 | 45.3 | 10.3 | 100.0 | 5,173 |
| Jacquard looms | 35.9 | 64.1 | — | 100.0 | 106 |
| *Yarn and fabric processing* | | | | | |
| Bleaching plant | 29.6 | 42.4 | 28.0 | 100.0 | 602 |
| Fibre and yarn dyeing plant | 37.8 | 49.2 | 13.0 | 100.0 | 262 |
| Fabric dyeing plant | 47.1 | 44.2 | 8.7 | 100.0 | 1,151 |
| Printing machines | 27.6 | 43.7 | 28.7 | 100.0 | 174 |
| Finishing machines | 23.6 | 40.5 | 35.9 | 100.0 | 704 |

*Source:* ECLA survey.

types (double cards, pre-comber intersecting gill boxes, combers, post-comber intersecting gill boxes, backwashers, melange gill boxes and preparation systems) over a third of the equipment was in the under-10 age group, in proportions ranging from 36.8 per cent for melange gill boxes to 47.5 for the post-comber intersecting gill boxes. For the leviathan washers, cheese winders and waste cards the proportions were lower, and lowest of all for the single cards (4.5 per cent). The drying machines had the highest proportion in the 10-30 age group (57.1 per cent) and the backwashers the lowest (36.2 per cent). In the over-30 age group the pre-comber intersecting gill boxes had the lowest proportion (7.1 per cent) and the single cards the highest (59.1 per cent); for most of the other types of machine an average of 20 per cent was in this group.

Most of the equipment used in the preparation for weaving was in the 10-30 age group, the highest proportion (73 per cent) being for reeling machines. Over half the slasher sizers were over thirty years old. On the other hand, over a third of the doubling and twisting frames and cheese winders were in the up-to-date group.

For yarn and fabric processing the age composition of the machinery is much the same in the wool sector as in the cotton sector. The percentages in the up-to-date group are very similar, and there is some similarity in the proportions in the other age groups as well, the over-30 group being the smallest in both cases.

### (c) *Man-made fibre sector*

In this sector, the production machines proper consist of spindles for staple fibre, and power and automatic looms to weave staple fibre produced by the spindles and the continuous filament yarn manufactured by the chemical industry. The age composition of the machinery is as shown in table 58. The spinning equipment in this sector was found to be much more up to date than in the cotton sector, where only 25 per cent of the spindles were less than ten years old. However,

TABLE 58. DISTRIBUTION OF MACHINERY BY AGE IN THE MAN-MADE FIBRE SECTOR

| *Machinery* | *Less than 10 years old* | *10-30 years old* | *Over 30 years old* | *Total* | *Total number of machines* |
|---|---|---|---|---|---|
| | *(Percentage of total)* | | | | |
| *Preparation for spinning* | | | | | |
| Scutchers | 28.6 | 71.4 | — | 100.0 | 7 |
| Cards | 30.2 | 69.8 | — | 100.0 | 139 |
| Drawing frames | 20.7 | 79.3 | — | 100.0 | 184 |
| Roving frames | 17.4 | 79.7 | 2.9 | 100.0 | 4,206 |
| *Spinning* | | | | | |
| Spindles | 30.2 | 67.7 | 2.1 | 100.0 | 52,908 |
| *Preparation for weaving* | | | | | |
| Cheese or cone winders | 48.7 | 50.2 | 1.1 | 100.0 | 14,059 |
| Doubling frames | 40.6 | 57.5 | 1.9 | 100.0 | 184,704 |
| Reeling machines | 15.0 | 71.0 | 14.0 | 100.0 | 2,620 |
| Warping machines | 16.8 | 77.0 | 6.2 | 100.0 | 814 |
| Pirn winders | 40.5 | 58.7 | 0.8 | 100.0 | 18,674 |
| Slasher sizers | 23.1 | 76.9 | — | 100.0 | 52 |
| *Weaving* | | | | | |
| *Power looms* | 11.7 | 79.1 | 9.2 | 100.0 | 13,333 |
| Plain looms | 1.3 | 81.6 | 17.1 | 100.0 | 792 |
| Check looms | 9.7 | 87.3 | 3.0 | 100.0 | 2,742 |
| Dobby looms | 12.6 | 76.8 | 10.6 | 100.0 | 9,081 |
| Jacquard looms | 20.3 | 73.5 | 6.2 | 100.0 | 718 |
| *Automatic looms* | 33.7 | 66.3 | — | 100.0 | 1,160 |
| Plain looms | 55.8 | 44.2 | — | 100.0 | 242 |
| Check looms | 2.5 | 97.5 | — | 100.0 | 284 |
| Dobby looms | 32.0 | 68.0 | — | 100.0 | 537 |
| Jacquard looms | 79.4 | 20.6 | — | 100.0 | 97 |
| *Yarn and fabric processing* | | | | | |
| Fibre and yarn dyeing plant | 54.3 | 45.7 | — | 100.0 | 35 |
| Fabric dyeing plant | 34.2 | 64.1 | 1.7 | 100.0 | 576 |
| Printing | 8.3 | 91.7 | — | 100.0 | 48 |
| Finishing | 42.6 | 57.4 | — | 100.0 | 108 |
| Other | 20.1 | 70.0 | 9.9 | 100.0 | 219 |

*Source:* ECLA survey.

machinery. The age composition of the machinery is shown in table 60.

In flax spinning, there were 22,660 long fibre spindles, of which 58 per cent were less than ten years old, and 3,954 tow spindles, of which 87 per cent were in the same group.

The relatively up-to-date state of this sector is shown by the ratio of non-automatic to automatic looms, which is less than 2 to 1. Nearly 55 per cent of the non-automatic looms and 80 per cent of the automatic looms were less than ten years old.

In the preparation for spinning and weaving too, most of the machinery is new. Although a high proportion of some machines are in the 10-30 age group, only the twisting frames are present in significant proportion in the over-thirty group. In the processing sector there were virtually no old machines found, and a substantial proportion was of recent manufacture (75 per cent of the dyeing equipment) or between ten and thirty years old (all the printing equipment).

### 5. DEGREE OF OBSOLESCENCE OF THE MACHINERY

Analysis of Brazil's textile machinery on the basis of the technical criteria of up-to-dateness adopted for the purposes of the present study, which are set forth in the Methodological Annex, indicates a high degree of machinery obsolescence in nearly all sectors of the industry.

According to these criteria, the machinery is classified as up-to-date, suitable for reconditioning, or obsolete. In the first group are the machines that meet certain minimum technical and output capacity standards; in the second, those that after reconditioning will meet the output standards laid down for an up-to-date machine, and in the third, machines that cannot meet the requirements for the first two categories. Of the two main forms of production machinery, spindles and looms, 37 and 51 per cent respectively, are obsolete in the cotton sector, and 38 and 34 per cent in the wool sector. The situation is somewhat better in the man-made fibre sector, where only 13 per cent of spindles and 23 per cent of looms are obsolete. In the flax sector only 6 per cent of the looms are obsolete, and although 47 per cent of the spindles are obsolete, the remaining 53 per cent are all modern. The highest level of obsolescence is in the jute sector, where 82 per cent of the spindles and 88 per cent of the looms are obsolete. In general, obsolescence tends to be higher in the weaving mills than in the spinning mills.

TABLE 58. DISTRIBUTION OF MACHINERY BY AGE IN THE MAN-MADE FIBRE SECTOR

| Machinery | Less than 10 years old | 10-30 years old | Over 30 years old | Total | Total number of machines |
|---|---|---|---|---|---|
| | (Percentage of total) | | | | |
| *Preparation for spinning* | | | | | |
| Scutchers | 28.6 | 71.4 | — | 100.0 | 7 |
| Cards | 30.2 | 69.8 | — | 100.0 | 139 |
| Drawing frames | 20.7 | 79.3 | — | 100.0 | 184 |
| Roving frames | 17.4 | 79.7 | 2.9 | 100.0 | 4,206 |
| *Spinning* | | | | | |
| Spindles | 30.2 | 67.7 | 2.1 | 100.0 | 52,908 |
| *Preparation for weaving* | | | | | |
| Cheese or cone winders | 48.7 | 50.2 | 1.1 | 100.0 | 14,059 |
| Doubling frames | 40.6 | 57.5 | 1.9 | 100.0 | 184,704 |
| Reeling machines | 15.0 | 71.0 | 14.0 | 100.0 | 2,620 |
| Warping machines | 16.8 | 77.0 | 6.2 | 100.0 | 814 |
| Pirn winders | 40.5 | 58.7 | 0.8 | 100.0 | 18,674 |
| Slasher sizers | 23.1 | 76.9 | — | 100.0 | 52 |
| *Weaving* | | | | | |
| *Power looms* | 11.7 | 79.1 | 9.2 | 100.0 | 13,333 |
| Plain looms | 1.3 | 81.6 | 17.1 | 100.0 | 792 |
| Check looms | 9.7 | 87.3 | 3.0 | 100.0 | 2,742 |
| Dobby looms | 12.6 | 76.8 | 10.6 | 100.0 | 9,081 |
| Jacquard looms | 20.3 | 73.5 | 6.2 | 100.0 | 718 |
| *Automatic looms* | 33.7 | 66.3 | — | 100.0 | 1,160 |
| Plain looms | 55.8 | 44.2 | — | 100.0 | 242 |
| Check looms | 2.5 | 97.5 | — | 100.0 | 284 |
| Dobby looms | 32.0 | 68.0 | — | 100.0 | 537 |
| Jacquard looms | 79.4 | 20.6 | — | 100.0 | 97 |
| *Yarn and fabric processing* | | | | | |
| Fibre and yarn dyeing plant | 54.3 | 45.7 | — | 100.0 | 35 |
| Fabric dyeing plant | 34.2 | 64.1 | 1.7 | 100.0 | 576 |
| Printing | 8.3 | 91.7 | — | 100.0 | 48 |
| Finishing | 42.6 | 57.4 | — | 100.0 | 108 |
| Other | 20.1 | 70.0 | 9.9 | 100.0 | 219 |

*Source:* ECLA survey.

machinery. The age composition of the machinery is shown in table 60.

In flax spinning, there were 22,660 long fibre spindles, of which 58 per cent were less than ten years old, and 3,954 tow spindles, of which 87 per cent were in the same group.

The relatively up-to-date state of this sector is shown by the ratio of non-automatic to automatic looms, which is less than 2 to 1. Nearly 55 per cent of the non-automatic looms and 80 per cent of the automatic looms were less than ten years old.

In the preparation for spinning and weaving too, most of the machinery is new. Although a high proportion of some machines are in the 10-30 age group, only the twisting frames are present in significant proportion in the over-thirty group. In the processing sector there were virtually no old machines found, and a substantial proportion was of recent manufacture (75 per cent of the dyeing equipment) or between ten and thirty years old (all the printing equipment).

### 5. DEGREE OF OBSOLESCENCE OF THE MACHINERY

Analysis of Brazil's textile machinery on the basis of the technical criteria of up-to-dateness adopted for the purposes of the present study, which are set forth in the Methodological Annex, indicates a high degree of machinery obsolescence in nearly all sectors of the industry.

According to these criteria, the machinery is classified as up-to-date, suitable for reconditioning, or obsolete. In the first group are the machines that meet certain minimum technical and output capacity standards; in the second, those that after reconditioning will meet the output standards laid down for an up-to-date machine, and in the third, machines that cannot meet the requirements for the first two categories. Of the two main forms of production machinery, spindles and looms, 37 and 51 per cent respectively, are obsolete in the cotton sector, and 38 and 34 per cent in the wool sector. The situation is somewhat better in the man-made fibre sector, where only 13 per cent of spindles and 23 per cent of looms are obsolete. In the flax sector only 6 per cent of the looms are obsolete, and although 47 per cent of the spindles are obsolete, the remaining 53 per cent are all modern. The highest level of obsolescence is in the jute sector, where 82 per cent of the spindles and 88 per cent of the looms are obsolete. In general, obsolescence tends to be higher in the weaving mills than in the spinning mills.

As table 61 shows, the degree of obsolescence varies somewhat between the different states surveyed. In the cotton sector the obsolescence is greater in the States of Guanabara and Rio de Janeiro, where over half the spindles and nearly three-quarters of the looms are obsolete. In Minas Gerais, and in Santa Catarina and Rio Grande do Sul taken together, over half the looms are obsolete, but only 39 and 27 per cent, respectively, of the spindles. In the wool sector also the level of obsolescence is less in São Paulo than in the other states, with 36 per cent of the spindles and 28 per cent of the looms classified as obsolete. In the Rio-Guanabara grouping the corresponding figures are 44 and 43 per cent, respectively, and in Santa Catarina-Rio Grande do Sul they are 44 and 66 per cent. The State of Minas Gerais is favourably placed, since its whole inventory (all weaving machinery) is either up-to-date or suitable for reconditioning. In the man-made fibre sector on the other hand, the highest level of obsolete looms (57 per cent) is in Minas Gerais, and the lowest (21 per cent), in São Paulo; the level in the other states lies between these two extremes. In the jute industry, all the spindles in Rio-Guanabara and Santa Catarina-Rio Grande do Sul are obsolete, and 77 per cent of those in São Paulo; the percentages for these states are much the same for the jute weaving mills. In the flax sector, 40 and 52 per cent of the spindles in São Paulo and Rio-Guanabara, respectively, are obsolete, but only 6 and 3 per cent, respectively, of the looms.

TABLE 61. PERCENTAGE DISTRIBUTION OF EXISTING PRODUCTION MACHINERY, BY DEGREE OF OBSOLESCENCE AND BY STATE

| *Machinery* | *Guanabara and Rio de Janeiro* | *Minas Gerais* | *Santa Catarina and Rio Grande do Sul* | *São Paulo* | *Total* |
|---|---|---|---|---|---|
| ***Cotton*** | | | | | |
| Spinning frame spindles | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Up-to-date | 20.1 | 14.8 | 33.2 | 22.5 | 20.8 |
| Suitable for reconditioning | 28.8 | 46.1 | 39.5 | 47.9 | 41.8 |
| Obsolete | 51.1 | 39.1 | 27.3 | 29.6 | 37.4 |
| Looms | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Up-to-date | 24.0 | 25.1 | 24.6 | 40.6 | 31.5 |
| Suitable for reconditioning | 5.0 | 18.6 | 20.8 | 24.7 | 17.5 |
| Obsolete | 71.0 | 56.3 | 54.6 | 34.7 | 51.0 |
| ***Wool*** | | | | | |
| Spinning frame spindles | 100.0 | — | 100.0 | 100.0 | 100.0 |
| Up-to-date | 55.5 | — | 55.6 | 50.7 | 51.9 |
| Suitable for reconditioning | — | — | — | 13.2 | 10.0 |
| Obsolete | 44.5 | — | 44.4 | 36.1 | 38.1 |
| Looms | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Up-to-date | 31.3 | 81.3 | 11.4 | 42.4 | 37.8 |
| Suitable for reconditioning | 25.5 | 18.7 | 22.1 | 29.6 | 27.9 |
| Obsolete | 43.2 | — | 66.5 | 28.0 | 34.3 |
| ***Man-made fibres*** | | | | | |
| Spinning frame spindles | — | — | — | 100.0 | 100.0 |
| Up-to-date | — | — | — | 81.2 | 81.2 |
| Suitable for reconditioning | — | — | — | 5.8 | 5.8 |
| Obsolete | — | — | — | 13.0 | 13.0 |
| Looms | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Up-to-date | 23.9 | 41.5 | 28.4 | 21.2 | 21.6 |
| Suitable for reconditioning | 40.1 | 1.9 | 31.3 | 57.3 | 55.3 |
| Obsolete | 36.0 | 56.6 | 40.3 | 21.5 | 23.1 |
| ***Jute*** | | | | | |
| Spinning frame spindles | 100.0 | — | 100.0 | 100.0 | 100.0 |
| Up-to-date | — | — | — | 22.5 | 17.6 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 100.0 | — | 100.0 | 77.5 | 82.4 |
| Looms | 100.0 | — | 100.0 | 100.0 | 100.0 |
| Up-to-date | 5.8 | — | — | 15.9 | 12.2 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 94.2 | — | 100.0 | 84.1 | 87.8 |
| ***Flax*** | | | | | |
| Spinning frame spindles | 100.0 | — | 100.0 | 100.0 | 100.0 |
| Up-to-date | 48.3 | — | — | 60.1 | 53.8 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 51.7 | — | 100.0 | 39.9 | 46.2 |
| Looms | 100.0 | | 100.0 | 100.0 | 100.0 |
| Up-to-date | 50.5 | — | 46.2 | 33.8 | 36.7 |
| Suitable for reconditioning | 46.7 | — | — | 60.5 | 57.2 |
| Obsolete | 2.8 | — | 53.8 | 5.7 | 6.1 |

*Source:* ECLA survey.

As table 61 shows, the degree of obsolescence varies somewhat between the different states surveyed. In the cotton sector the obsolescence is greater in the States of Guanabara and Rio de Janeiro, where over half the spindles and nearly three-quarters of the looms are obsolete. In Minas Gerais, and in Santa Catarina and Rio Grande do Sul taken together, over half the looms are obsolete, but only 39 and 27 per cent, respectively, of the spindles. In the wool sector also the level of obsolescence is less in São Paulo than in the other states, with 36 per cent of the spindles and 28 per cent of the looms classified as obsolete. In the Rio-Guanabara grouping the corresponding figures are 44 and 43 per cent, respectively, and in Santa Catarina-Rio Grande do Sul they are 44 and 66 per cent. The State of Minas Gerais is favourably placed, since its whole inventory (all weaving machinery) is either up-to-date or suitable for reconditioning. In the man-made fibre sector on the other hand, the highest level of obsolete looms (57 per cent) is in Minas Gerais, and the lowest (21 per cent), in São Paulo; the level in the other states lies between these two extremes. In the jute industry, all the spindles in Rio-Guanabara and Santa Catarina-Rio Grande do Sul are obsolete, and 77 per cent of those in São Paulo; the percentages for these states are much the same for the jute weaving mills. In the flax sector, 40 and 52 per cent of the spindles in São Paulo and Rio-Guanabara, respectively, are obsolete, but only 6 and 3 per cent, respectively, of the looms.

TABLE 61. PERCENTAGE DISTRIBUTION OF EXISTING PRODUCTION MACHINERY, BY DEGREE OF OBSOLESCENCE AND BY STATE

| *Machinery* | *Guanabara and Rio de Janeiro* | *Minas Gerais* | *Santa Catarina and Rio Grande do Sul* | *São Paulo* | *Total* |
|---|---|---|---|---|---|
| *Cotton* | | | | | |
| Spinning frame spindles | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Up-to-date | 20.1 | 14.8 | 33.2 | 22.5 | 20.8 |
| Suitable for reconditioning | 28.8 | 46.1 | 39.5 | 47.9 | 41.8 |
| Obsolete | 51.1 | 39.1 | 27.3 | 29.6 | 37.4 |
| Looms | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Up-to-date | 24.0 | 25.1 | 24.6 | 40.6 | 31.5 |
| Suitable for reconditioning | 5.0 | 18.6 | 20.8 | 24.7 | 17.5 |
| Obsolete | 71.0 | 56.3 | 54.6 | 34.7 | 51.0 |
| *Wool* | | | | | |
| Spinning frame spindles | 100.0 | — | 100.0 | 100.0 | 100.0 |
| Up-to-date | 55.5 | — | 55.6 | 50.7 | 51.9 |
| Suitable for reconditioning | — | — | — | 13.2 | 10.0 |
| Obsolete | 44.5 | — | 44.4 | 36.1 | 38.1 |
| Looms | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Up-to-date | 31.3 | 81.3 | 11.4 | 42.4 | 37.8 |
| Suitable for reconditioning | 25.5 | 18.7 | 22.1 | 29.6 | 27.9 |
| Obsolete | 43.2 | — | 66.5 | 28.0 | 34.3 |
| *Man-made fibres* | | | | | |
| Spinning frame spindles | — | — | — | 100.0 | 100.0 |
| Up-to-date | — | — | — | 81.2 | 81.2 |
| Suitable for reconditioning | — | — | — | 5.8 | 5.8 |
| Obsolete | — | — | — | 13.0 | 13.0 |
| Looms | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Up-to-date | 23.9 | 41.5 | 28.4 | 21.2 | 21.6 |
| Suitable for reconditioning | 40.1 | 1.9 | 31.3 | 57.3 | 55.3 |
| Obsolete | 36.0 | 56.6 | 40.3 | 21.5 | 23.1 |
| *Jute* | | | | | |
| Spinning frame spindles | 100.0 | — | 100.0 | 100.0 | 100.0 |
| Up-to-date | — | — | — | 22.5 | 17.6 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 100.0 | — | 100.0 | 77.5 | 82.4 |
| Looms | 100.0 | — | 100.0 | 100.0 | 100.0 |
| Up-to-date | 5.8 | — | — | 15.9 | 12.2 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 94.2 | — | 100.0 | 84.1 | 87.8 |
| *Flax* | | | | | |
| Spinning frame spindles | 100.0 | — | 100.0 | 100.0 | 100.0 |
| Up-to-date | 48.3 | — | — | 60.1 | 53.8 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 51.7 | — | 100.0 | 39.9 | 46.2 |
| Looms | 100.0 | | 100.0 | 100.0 | 100.0 |
| Up-to-date | 50.5 | — | 46.2 | 33.8 | 36.7 |
| Suitable for reconditioning | 46.7 | — | — | 60.5 | 57.2 |
| Obsolete | 2.8 | — | 53.8 | 5.7 | 6.1 |

*Source:* ECLA survey.

TABLE 63. DEGREE OF OBSOLESCENCE OF THE EXISTING MACHINERY IN THE COTTON SECTOR

(*As a percentage of the total*)

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Scutchers | 43.6 | 2,1 | 54.3 | 100.0 |
| Cards | 17.4 | 28.3 | 54.3 | 100.0 |
| Waste cards | 25.0 | 22.6 | 52.4 | 100.0 |
| Drawing frames | 1.8 | 0.3 | 97.9 | 100.0 |
| Sliver lap machines | 41.3 | 1.3 | 57.4 | 100.0 |
| Ribbon lap machines | 47.8 | 1.9 | 50.3 | 100.0 |
| Combers | 9.9 | 3.6 | 86.5 | 100.0 |
| Roving frames | 7.7 | 11.4 | 80.9 | 100.0 |
| *Spinning* | | | | |
| Ring spindles | 20.8 | 41.8 | 37.4 | 100.0 |
| Mule spindles | — | 33.7 | 66.3 | 100.0 |
| *Preparation for weaving* | | | | |
| Cheese or cone winders | 42.3 | — | 57.7 | 100.0 |
| Doubling frames | 39.2 | 29.8 | 31.0 | 100.0 |
| Reeling machines | 21.1 | 12.4 | 66.5 | 100.0 |
| Warping machines | 32.9 | 6.4 | 60.7 | 100.0 |
| Pirn winders | 52.9 | 0.1 | 47.0 | 100.0 |
| Slasher sizers | 21.1 | 3.5 | 75.4 | 100.0 |
| *Weaving* | | | | |
| *Power looms* | 6.6 | 24.9 | 68.5 | 100.0 |
| Plain looms | 1.6 | 28.8 | 69.6 | 100.0 |
| Check looms | 24.9 | 1.8 | 73.3 | 100.0 |
| Dobby looms | 0.5 | 34.9 | 64.6 | 100.0 |
| Jacquard looms | 8.9 | 36.2 | 54.9 | 100.0 |
| *Automatic looms* | 88.9 | 0.5 | 10.6 | 100.0 |
| Plain looms | 88.7 | 0.1 | 11.2 | 100.0 |
| Check looms | 96.1 | — | 3.9 | 100.0 |
| Dobby looms | 88.2 | 1.5 | 10.3 | 100.0 |
| Jacquard looms | 100.0 | — | — | 100.0 |
| *Yarn and fabric processing* | | | | |
| Boiling and bleaching plant | 44.7 | 15.3 | 40.0 | 100.0 |
| Fibre and yarn dyeing plant | 60.3 | 13.4 | 26.3 | 100.0 |
| Fabric dyeing plant | 69.0 | 10.6 | 20.4 | 100.0 |
| Printing | 52.9 | 21.8 | 25.3 | 100.0 |
| Finishing | 45.5 | 20.6 | 33.9 | 100.0 |

*Source:* ECLA survey.

### (*b*) *Wool sector*

Of the 190,000 ring spindles in the wool sector, 58 per cent were up-to-date (see tables 64 and 65) but of the 52,000 mule spindles over 71 per cent were obsolete. Of the 3,848 non-automatic looms, the majority were obsolete, the remainder being about equally divided between up-to-date looms and those suitable for reconditioning. In addition there were 448 automatic looms, practically all up-to-date. In the preparatory spinning processes the obsolescence varies widely with the type of machine; for example, a high proportion of the double cards (76 per cent) and the pre-comber intersecting gill boxes (68 per cent) were up-to-date, but only 5 per cent of the combers, all the remainder being obsolete. In the preparatory weaving processes, too, there is a similar variation in the level of obsolescence but the proportion of up-to-date machines is higher (except for the warpers) than the 30 per cent found in the non-automatic looms. As in the cotton sector, there is a high proportion (about 60 per cent) of up-to-date machines in yarn and fabric processing.

TABLE 63. DEGREE OF OBSOLESCENCE OF THE EXISTING MACHINERY IN THE COTTON SECTOR
(*As a percentage of the total*)

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Scutchers | 43.6 | 2,1 | 54.3 | 100.0 |
| Cards | 17.4 | 28.3 | 54.3 | 100.0 |
| Waste cards | 25.0 | 22.6 | 52.4 | 100.0 |
| Drawing frames | 1.8 | 0.3 | 97.9 | 100.0 |
| Sliver lap machines | 41.3 | 1.3 | 57.4 | 100.0 |
| Ribbon lap machines | 47.8 | 1.9 | 50.3 | 100.0 |
| Combers | 9.9 | 3.6 | 86.5 | 100.0 |
| Roving frames | 7.7 | 11.4 | 80.9 | 100.0 |
| *Spinning* | | | | |
| Ring spindles | 20.8 | 41.8 | 37.4 | 100.0 |
| Mule spindles | — | 33.7 | 66.3 | 100.0 |
| *Preparation for weaving* | | | | |
| Cheese or cone winders | 42.3 | — | 57.7 | 100.0 |
| Doubling frames | 39.2 | 29.8 | 31.0 | 100.0 |
| Reeling machines | 21.1 | 12.4 | 66.5 | 100.0 |
| Warping machines | 32.9 | 6.4 | 60.7 | 100.0 |
| Pirn winders | 52.9 | 0.1 | 47.0 | 100.0 |
| Slasher sizers | 21.1 | 3.5 | 75.4 | 100.0 |
| *Weaving* | | | | |
| *Power looms* | 6.6 | 24.9 | 68.5 | 100.0 |
| Plain looms | 1.6 | 28.8 | 69.6 | 100.0 |
| Check looms | 24.9 | 1.8 | 73.3 | 100.0 |
| Dobby looms | 0.5 | 34.9 | 64.6 | 100.0 |
| Jacquard looms | 8.9 | 36.2 | 54.9 | 100.0 |
| *Automatic looms* | 88.9 | 0.5 | 10.6 | 100.0 |
| Plain looms | 88.7 | 0.1 | 11.2 | 100.0 |
| Check looms | 96.1 | — | 3.9 | 100.0 |
| Dobby looms | 88.2 | 1.5 | 10.3 | 100.0 |
| Jacquard looms | 100.0 | — | — | 100.0 |
| *Yarn and fabric processing* | | | | |
| Boiling and bleaching plant | 44.7 | 15.3 | 40.0 | 100.0 |
| Fibre and yarn dyeing plant | 60.3 | 13.4 | 26.3 | 100.0 |
| Fabric dyeing plant | 69.0 | 10.6 | 20.4 | 100.0 |
| Printing | 52.9 | 21.8 | 25.3 | 100.0 |
| Finishing | 45.5 | 20.6 | 33.9 | 100.0 |

*Source:* ECLA survey.

### (*b*) *Wool sector*

Of the 190,000 ring spindles in the wool sector, 58 per cent were up-to-date (see tables 64 and 65) but of the 52,000 mule spindles over 71 per cent were obsolete. Of the 3,848 non-automatic looms, the majority were obsolete, the remainder being about equally divided between up-to-date looms and those suitable for reconditioning. In addition there were 448 automatic looms, practically all up-to-date. In the preparatory spinning processes the obsolescence varies widely with the type of machine; for example, a high proportion of the double cards (76 per cent) and the pre-comber intersecting gill boxes (68 per cent) were up-to-date, but only 5 per cent of the combers, all the remainder being obsolete. In the preparatory weaving processes, too, there is a similar variation in the level of obsolescence but the proportion of up-to-date machines is higher (except for the warpers) than the 30 per cent found in the non-automatic looms. As in the cotton sector, there is a high proportion (about 60 per cent) of up-to-date machines in yarn and fabric processing.

TABLE 65. DEGREE OF OBSOLESCENCE OF EXISTING MACHINERY IN THE WOOL SECTOR

*(As a percentage of the total)*

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Leviathan washers | 32.2 | 27.1 | 40.7 | 100.0 |
| Dryers | 48.2 | 21.4 | 30.4 | 100.0 |
| Single cards | — | — | 100.0 | 100.0 |
| Double cards | 76.3 | — | 23.7 | 100.0 |
| Waste cards | 37.3 | 5.7 | 57.0 | 100.0 |
| Pre-comber intersecting gill boxes | 68.5 | — | 31.5 | 100.0 |
| Combers | 5.0 | — | 95.0 | 100.0 |
| Post-comber intersecting gill boxes | 64.7 | — | 35.3 | 100.0 |
| Backwashers | 46.6 | 3.4 | 50.0 | 100.0 |
| Melange gill boxes | 75.0 | — | 25.0 | 100.0 |
| Preparation systems | 16.4 | — | 83.6 | 100.0 |
| *Spinning* | | | | |
| Ring spindles | 58.4 | 12.7 | 28.9 | 100.0 |
| Mule spindles | 28.1 | — | 71.9 | 100.0 |
| *Preparation for weaving* | | | | |
| Doubling frames | 48.5 | 5.5 | 46.0 | 100.0 |
| Twisting frames | 50.0 | 34.9 | 15.1 | 100.0 |
| Cheese winders | 43.3 | 0.3 | 56.4 | 100.0 |
| Reeling machines | 40.2 | 6.4 | 53.4 | 100.0 |
| Warping machines | 19.5 | 41.9 | 38.6 | 100.0 |
| Pirn winders | 37.9 | — | 62.1 | 100.0 |
| Slasher sizers | 36.8 | 7.9 | 55.3 | 100.0 |
| *Weaving* | | | | |
| *Power looms* | 30.7 | 31.1 | 38.2 | 100.0 |
| Plain looms | — | 47.0 | 53.0 | 100.0 |
| Check looms | 56.1 | 2.6 | 41.3 | 100.0 |
| Dobby looms | 3.8 | 66.1 | 30.1 | 100.0 |
| Jacquard looms | 59.4 | 5.8 | 34.8 | 100.0 |
| *Automatic looms* | 99.3 | — | 0.7 | 100.0 |
| Plain looms | 100.0 | — | — | 100.0 |
| Check looms | 100.0 | — | — | 100.0 |
| Dobby looms | 98.9 | — | 1.1 | 100.0 |
| Jacquard looms | 100.0 | — | — | 100.0 |
| *Yarn and fabric processing* | | | | |
| Fibre and yarn dyeing | 57.1 | 19.0 | 23.9 | 100.0 |
| Fabric dyeing | 66.4 | 15.9 | 17.7 | 100.0 |
| Finishing | 57.1 | 18.1 | 24.8 | 100.0 |

*Source:* ECLA survey.

TABLE 65. DEGREE OF OBSOLESCENCE OF EXISTING MACHINERY IN THE WOOL SECTOR

*(As a percentage of the total)*

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Leviathan washers | 32.2 | 27.1 | 40.7 | 100.0 |
| Dryers | 48.2 | 21.4 | 30.4 | 100.0 |
| Single cards | — | — | 100.0 | 100.0 |
| Double cards | 76.3 | — | 23.7 | 100.0 |
| Waste cards | 37.3 | 5.7 | 57.0 | 100.0 |
| Pre-comber intersecting gill boxes | 68.5 | — | 31.5 | 100.0 |
| Combers | 5.0 | — | 95.0 | 100.0 |
| Post-comber intersecting gill boxes | 64.7 | — | 35.3 | 100.0 |
| Backwashers | 46.6 | 3.4 | 50.0 | 100.0 |
| Melange gill boxes | 75.0 | — | 25.0 | 100.0 |
| Preparation systems | 16.4 | — | 83.6 | 100.0 |
| *Spinning* | | | | |
| Ring spindles | 58.4 | 12.7 | 28.9 | 100.0 |
| Mule spindles | 28.1 | — | 71.9 | 100.0 |
| *Preparation for weaving* | | | | |
| Doubling frames | 48.5 | 5.5 | 46.0 | 100.0 |
| Twisting frames | 50.0 | 34.9 | 15.1 | 100.0 |
| Cheese winders | 43.3 | 0.3 | 56.4 | 100.0 |
| Reeling machines | 40.2 | 6.4 | 53.4 | 100.0 |
| Warping machines | 19.5 | 41.9 | 38.6 | 100.0 |
| Pirn winders | 37.9 | — | 62.1 | 100.0 |
| Slasher sizers | 36.8 | 7.9 | 55.3 | 100.0 |
| *Weaving* | | | | |
| *Power looms* | 30.7 | 31.1 | 38.2 | 100.0 |
| Plain looms | — | 47.0 | 53.0 | 100.0 |
| Check looms | 56.1 | 2.6 | 41.3 | 100.0 |
| Dobby looms | 3.8 | 66.1 | 30.1 | 100.0 |
| Jacquard looms | 59.4 | 5.8 | 34.8 | 100.0 |
| *Automatic looms* | 99.3 | — | 0.7 | 100.0 |
| Plain looms | 100.0 | — | — | 100.0 |
| Check looms | 100.0 | — | — | 100.0 |
| Dobby looms | 98.9 | — | 1.1 | 100.0 |
| Jacquard looms | 100.0 | — | — | 100.0 |
| *Yarn and fabric processing* | | | | |
| Fibre and yarn dyeing | 57.1 | 19.0 | 23.9 | 100.0 |
| Fabric dyeing | 66.4 | 15.9 | 17.7 | 100.0 |
| Finishing | 57.1 | 18.1 | 24.8 | 100.0 |

*Source:* ECLA survey.

TABLE 67. DEGREE OF OBSOLESCENCE OF THE EXISTING MACHINERY IN THE MAN-MADE FIBRE SECTOR
(*As a percentage of the total*)

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Scutchers | 100.0 | — | — | 100.0 |
| Cards | 62.6 | 23.0 | 14.4 | 100.0 |
| Drawing frames | 4.3 | — | 95.7 | 100.0 |
| Roving frames | 70.9 | 1.3 | 27.8 | 100.0 |
| *Spinning* | | | | |
| Spindles | 81.2 | 5.8 | 13.0 | 100.0 |
| *Preparation for weaving* | | | | |
| Cheese or cone winders | 69.1 | 1.7 | 29.2 | 100.0 |
| Doubling frames | 84.2 | 14.8 | 1.0 | 100.0 |
| Reeling machines | 45.6 | 20.3 | 34.1 | 100.0 |
| Warping machines | 35.0 | 45.3 | 19.7 | 100.0 |
| Pirn winders | 39.6 | — | 60.4 | 100.0 |
| Slasher sizers | 42.3 | 27.0 | 30.7 | 100.0 |
| *Weaving* | | | | |
| *Power looms* | 14.8 | 60.2 | 25.0 | 100.0 |
| Plain looms | 4.0 | 71.7 | 24.3 | 100.0 |
| Check looms | 58.7 | 10.1 | 31.2 | 100.0 |
| Dobby looms | — | 75.5 | 24.5 | 100.0 |
| Jacquard looms | 46.2 | 44.0 | 9.8 | 100.0 |
| *Automatic looms* | 100.0 | — | — | 100.0 |
| Plain looms | 100.0 | — | — | 100.0 |
| Check looms | 100.0 | — | — | 100.0 |
| Dobby looms | 100.0 | — | — | 100.0 |
| Jacquard looms | 100.0 | — | — | 100.0 |
| *Yarn and fabric processing* | | | | |
| Fibre and yarn dyeing plant | 85.7 | 11.4 | 2.9 | 100.0 |
| Fabric dyeing plant | 61.1 | 24.3 | 14.6 | 100.0 |
| Printing | 14.6 | 83.3 | 2.1 | 100.0 |
| Finishing | 76.8 | 13.0 | 10.2 | 100.0 |
| Other | 27.4 | 63.5 | 9.1 | 100.0 |

*Source:* ECLA survey.

### (*d*) *Jute sector*

This sector has the highest proportion of obsolete machines, and there is a close correlation between technical obsolescence and the actual age of the machinery (as defined in section 3). The degree of obsolescence of the various types of machinery is shown in tables 68 and 69. Of the 43,000 spindles surveyed over 82 per cent were obsolete and only 17.6 per cent were up-to-date. The situation is even worse in the weaving mills, where the 2,582 non-automatic looms in use were all obsolete, as well as 63 per cent of the 760 automatic looms.

The degree of obsolescence is less in spinning preparation equipment, but it varies enormously, from 100 per cent up-to-dateness for double cards to 100 per cent obsoleteness for roving frames. In the weaving preparation equipment, the proportion of obsolete machines ranges from a minimum of 70 per cent to a maximum of 100 per cent. In the processing section no clear-cut trend can be discerned in the pattern of obsolescence.

TABLE 67. DEGREE OF OBSOLESCENCE OF THE EXISTING MACHINERY IN THE MAN-MADE FIBRE SECTOR
(*As a percentage of the total*)

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Scutchers | 100.0 | — | — | 100.0 |
| Cards | 62.6 | 23.0 | 14.4 | 100.0 |
| Drawing frames | 4.3 | — | 95.7 | 100.0 |
| Roving frames | 70.9 | 1.3 | 27.8 | 100.0 |
| *Spinning* | | | | |
| Spindles | 81.2 | 5.8 | 13.0 | 100.0 |
| *Preparation for weaving* | | | | |
| Cheese or cone winders | 69.1 | 1.7 | 29.2 | 100.0 |
| Doubling frames | 84.2 | 14.8 | 1.0 | 100.0 |
| Reeling machines | 45.6 | 20.3 | 34.1 | 100.0 |
| Warping machines | 35.0 | 45.3 | 19.7 | 100.0 |
| Pirn winders | 39.6 | — | 60.4 | 100.0 |
| Slasher sizers | 42.3 | 27.0 | 30.7 | 100.0 |
| *Weaving* | | | | |
| *Power looms* | 14.8 | 60.2 | 25.0 | 100.0 |
| Plain looms | 4.0 | 71.7 | 24.3 | 100.0 |
| Check looms | 58.7 | 10.1 | 31.2 | 100.0 |
| Dobby looms | — | 75.5 | 24.5 | 100.0 |
| Jacquard looms | 46.2 | 44.0 | 9.8 | 100.0 |
| *Automatic looms* | 100.0 | — | — | 100.0 |
| Plain looms | 100.0 | — | — | 100.0 |
| Check looms | 100.0 | — | — | 100.0 |
| Dobby looms | 100.0 | — | — | 100.0 |
| Jacquard looms | 100.0 | — | — | 100.0 |
| *Yarn and fabric processing* | | | | |
| Fibre and yarn dyeing plant | 85.7 | 11.4 | 2.9 | 100.0 |
| Fabric dyeing plant | 61.1 | 24.3 | 14.6 | 100.0 |
| Printing | 14.6 | 83.3 | 2.1 | 100.0 |
| Finishing | 76.8 | 13.0 | 10.2 | 100.0 |
| Other | 27.4 | 63.5 | 9.1 | 100.0 |

*Source:* ECLA survey.

### (*d*) *Jute sector*

This sector has the highest proportion of obsolete machines, and there is a close correlation between technical obsolescence and the actual age of the machinery (as defined in section 3). The degree of obsolescence of the various types of machinery is shown in tables 68 and 69. Of the 43,000 spindles surveyed over 82 per cent were obsolete and only 17.6 per cent were up-to-date. The situation is even worse in the weaving mills, where the 2,582 non-automatic looms in use were all obsolete, as well as 63 per cent of the 760 automatic looms.

The degree of obsolescence is less in spinning preparation equipment, but it varies enormously, from 100 per cent up-to-dateness for double cards to 100 per cent obsoleteness for roving frames. In the weaving preparation equipment, the proportion of obsolete machines ranges from a minimum of 70 per cent to a maximum of 100 per cent. In the processing section no clear-cut trend can be discerned in the pattern of obsolescence.

TABLE 69. DEGREE OF OBSOLESCENCE OF THE EXISTING MACHINERY IN THE JUTE SECTOR

*(As a percentage of the total)*

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Softeners | 25.0 | 35.7 | 39.3 | 100.0 |
| Breaker cards | 17.9 | 14.3 | 67.8 | 100.0 |
| Finisher cards | 16.0 | 13.6 | 70.4 | 100.0 |
| Combined cards | 100.0 | — | — | 100.0 |
| Waste cards | 25.0 | — | 75.0 | 100.0 |
| Drawing gill frames | 33.1 | 1.8 | 65.1 | 100.0 |
| Roving frames | — | — | 100.0 | 100.0 |
| *Spinning* | | | | |
| Spindles | 17.6 | — | 82.4 | 100.0 |
| *Preparation for weaving* | | | | |
| Spoolers | — | — | 100.0 | 100.0 |
| Cheese winders | 4.7 | — | 95.3 | 100.0 |
| Doubling frames | 4.1 | 3.6 | 92.3 | 100.0 |
| Reeling machines | — | — | 100.0 | 100.0 |
| Warping machines | 28.6 | — | 71.4 | 100.0 |
| Pirn winders | 4.2 | — | 95.8 | 100.0 |
| Slasher sizers | 5.7 | 7.2 | 87.1 | 100.0 |
| *Weaving* | | | | |
| Power looms | — | — | 100.0 | 100.0 |
| Circular looms | 100.0 | — | — | 100.0 |
| Automatic looms | 37.1 | — | 62.9 | 100.0 |
| *Fabric processing* | | | | |
| Calenders | 28.1 | 28.1 | 43.8 | 100.0 |
| Folding machines | 13.6 | 22.7 | 63.7 | 100.0 |
| Cutters | 47.1 | 17.6 | 35.3 | 100.0 |
| Sewing machines | 26.9 | 13.8 | 59.3 | 100.0 |
| Stamping machines | 42.3 | 11.5 | 46.2 | 100.0 |
| Other | 20.0 | 50.0 | 30.0 | 100.0 |

*Source:* ECLA survey.

The degree of obsolescence in spinning preparation machinery ranges from 20 per cent for cards to 83 per cent for drawing frames. In weaving preparation equipment, the cheese winders and reeling machines are largely obsolete, while 75 per cent of the pirn winders are up-to-date, and nearly 60 per cent of the warp winders and twisting frames have been reconditioned. Of the dyeing and finishing machines, 80 per cent and 50 per cent, respectively, are up-to-date, but only 33 per cent of the printing machines.

TABLE 69. DEGREE OF OBSOLESCENCE OF THE EXISTING MACHINERY IN THE JUTE SECTOR

*(As a percentage of the total)*

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Softeners | 25.0 | 35.7 | 39.3 | 100.0 |
| Breaker cards | 17.9 | 14.3 | 67.8 | 100.0 |
| Finisher cards | 16.0 | 13.6 | 70.4 | 100.0 |
| Combined cards | 100.0 | — | — | 100.0 |
| Waste cards | 25.0 | — | 75.0 | 100.0 |
| Drawing gill frames | 33.1 | 1.8 | 65.1 | 100.0 |
| Roving frames | — | — | 100.0 | 100.0 |
| *Spinning* | | | | |
| Spindles | 17.6 | — | 82.4 | 100.0 |
| *Preparation for weaving* | | | | |
| Spoolers | — | — | 100.0 | 100.0 |
| Cheese winders | 4.7 | — | 95.3 | 100.0 |
| Doubling frames | 4.1 | 3.6 | 92.3 | 100.0 |
| Reeling machines | — | — | 100.0 | 100.0 |
| Warping machines | 28.6 | — | 71.4 | 100.0 |
| Pirn winders | 4.2 | — | 95.8 | 100.0 |
| Slasher sizers | 5.7 | 7.2 | 87.1 | 100.0 |
| *Weaving* | | | | |
| Power looms | — | — | 100.0 | 100.0 |
| Circular looms | 100.0 | — | — | 100.0 |
| Automatic looms | 37.1 | — | 62.9 | 100.0 |
| *Fabric processing* | | | | |
| Calenders | 28.1 | 28.1 | 43.8 | 100.0 |
| Folding machines | 13.6 | 22.7 | 63.7 | 100.0 |
| Cutters | 47.1 | 17.6 | 35.3 | 100.0 |
| Sewing machines | 26.9 | 13.8 | 59.3 | 100.0 |
| Stamping machines | 42.3 | 11.5 | 46.2 | 100.0 |
| Other | 20.0 | 50.0 | 30.0 | 100.0 |

*Source:* ECLA survey.

The degree of obsolescence in spinning preparation machinery ranges from 20 per cent for cards to 83 per cent for drawing frames. In weaving preparation equipment, the cheese winders and reeling machines are largely obsolete, while 75 per cent of the pirn winders are up-to-date, and nearly 60 per cent of the warp winders and twisting frames have been reconditioned. Of the dyeing and finishing machines, 80 per cent and 50 per cent, respectively, are up-to-date, but only 33 per cent of the printing machines.

TABLE 71. DEGREE OF OBSOLESCENCE OF THE EXISTING MACHINERY IN THE FLAX SECTOR

(*As a percentage of the total*)

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Hackling machines | 78.6 | — | 21.4 | 100.0 |
| Drawing frames | 17.4 | — | 82.6 | 100.0 |
| Cards | 80.0 | — | 20.0 | 100.0 |
| Rectilinear combers | 4.2 | — | 95.8 | 100.0 |
| Roving frames | 74.3 | — | 25.7 | 100.0 |
| *Spinning* | | | | |
| Long fibre spindles | 54.2 | — | 45.8 | 100.0 |
| Tow spindles | 52.0 | — | 48.0 | 100.0 |
| *Preparation for weaving* | | | | |
| Doubling frames | 11.4 | 66.0 | 22.6 | 100.0 |
| Cheese or cone winders | 27.6 | — | 72.4 | 100.0 |
| Reeling machines | — | — | 100.0 | 100.0 |
| Warping machines | 1.5 | 59.1 | 39.4 | 100.0 |
| Ball winders | 75.1 | — | 24.9 | 100.0 |
| Slasher sizers | 27.3 | 27.3 | 45.4 | 100.0 |
| *Weaving* | | | | |
| *Power looms* | 3.0 | 87.6 | 9.4 | 100.0 |
| Plain looms | — | 94.9 | 5.1 | 100.0 |
| Check looms | 55.3 | — | 44.7 | 100.0 |
| Dobby looms | — | 100.0 | — | 100.0 |
| Jacquard looms | — | — | 100.0 | 100.0 |
| *Automatic looms* | 100.0 | — | — | 100.0 |
| Plain looms | 100.0 | — | — | 100.0 |
| Dobby looms | 100.0 | — | — | 100.0 |
| *Yarn and fabric processing* | | | | |
| Dyeing | 80.3 | 13.5 | 6.2 | 100.0 |
| Printing | 32.6 | 67.4 | — | 100.0 |
| Finishing | 50.0 | 31.8 | 18.2 | 100.0 |

*Source:* ECLA survey.

machinery resulted in a high proportion of stoppage time for repairs and upkeep.

Table 72 analyses utilization of available production capacity from three different standpoints: the proportion of machines in operation at the time of the ECLA survey, the ratio of machine hours actually worked per year to those available,[13] and the number of operatives on each of the three working shifts.

During 1960, 90.3 per cent of the total spindle inventory was in operation, a fairly satisfactory figure. The machinery was used for an average of 5,485 hours during the year, that is, 83 per cent of the hours available in the conditions prevailing in Brazil. Table 72 shows that on the second shift the number of workers was 72 per cent of the number on the first shift, dropping to only 20 per cent for the third shift. Despite the high proportion of obsolete machinery, which inevitably led to a certain amount of idle capacity, good use was made of the available spinning capacity in 1960, at least as far as the first shift was concerned. The number of units used during each of the three shifts is shown in table 73. (See also figure VIII.) Of the total number of spindles in the industry 41.6 per cent are used for two shifts, 29 per cent for three complete shifts and 19 per cent for two shifts and part of a third shift. Less than 10 per cent operate during one shift only. The most intensive utilization is in the flax sector. In the cotton sector only 9.6 per cent of the spindles are used for one shift, about 90 per cent for at least two shifts and 30 per cent for all three. In the man-made fibre sector all the equipment is in use during two shifts at least, and 45 per cent during three shifts.

The ratio of hours worked to the total number available in 1960 is shown in table 74. The utilization coefficient was highest (89.4) in the man-made fibre sector and lowest (70.9) in the jute sector; in the cotton sector, the coefficient was 85.3 per cent; in the weaving mills, the average coefficient was only 59.6. Hence, out of the three full shifts theoretically available per day, the number really worked was 1.8. Table 72 shows

[13] The number of hours available with one shift is eight hours on 300 days a year, or 2,400 hours. This was the criterion used previously by ECLA for its study of the textile industry in Chile, and will also be the basis for future studies in other Latin American countries. In practice, of course, the legal holidays and the 40-hour week are liable to lower the total number of available hours in a year. The hours worked daily in a three-shift factory would theoretically be 24, which gives a total of 7,200 hours a year to be taken into account in estimating the hours available. But as the third shift is usually shorter than the others, because of the time needed to clean the machines and the compulsory rest period halfway through the shift which is required by social legislation in certain countries, production estimates are based on a third shift of only six hours, which reduces the daily working hours to 22, and gives an annual total of 6,600.

TABLE 71. DEGREE OF OBSOLESCENCE OF THE EXISTING MACHINERY IN THE FLAX SECTOR
(*As a percentage of the total*)

| *Machinery* | *Up-to-date* | *Suitable for reconditioning* | *Obsolete* | *Total* |
|---|---|---|---|---|
| *Preparation for spinning* | | | | |
| Hackling machines | 78.6 | — | 21.4 | 100.0 |
| Drawing frames | 17.4 | — | 82.6 | 100.0 |
| Cards | 80.0 | — | 20.0 | 100.0 |
| Rectilinear combers | 4.2 | — | 95.8 | 100.0 |
| Roving frames | 74.3 | — | 25.7 | 100.0 |
| *Spinning* | | | | |
| Long fibre spindles | 54.2 | — | 45.8 | 100.0 |
| Tow spindles | 52.0 | — | 48.0 | 100.0 |
| *Preparation for weaving* | | | | |
| Doubling frames | 11.4 | 66.0 | 22.6 | 100.0 |
| Cheese or cone winders | 27.6 | — | 72.4 | 100.0 |
| Reeling machines | — | — | 100.0 | 100.0 |
| Warping machines | 1.5 | 59.1 | 39.4 | 100.0 |
| Ball winders | 75.1 | — | 24.9 | 100.0 |
| Slasher sizers | 27.3 | 27.3 | 45.4 | 100.0 |
| *Weaving* | | | | |
| *Power looms* | 3.0 | 87.6 | 9.4 | 100.0 |
| Plain looms | — | 94.9 | 5.1 | 100.0 |
| Check looms | 55.3 | — | 44.7 | 100.0 |
| Dobby looms | — | 100.0 | — | 100.0 |
| Jacquard looms | — | — | 100.0 | 100.0 |
| *Automatic looms* | 100.0 | — | — | 100.0 |
| Plain looms | 100.0 | — | — | 100.0 |
| Dobby looms | 100.0 | — | — | 100.0 |
| *Yarn and fabric processing* | | | | |
| Dyeing | 80.3 | 13.5 | 6.2 | 100.0 |
| Printing | 32.6 | 67.4 | — | 100.0 |
| Finishing | 50.0 | 31.8 | 18.2 | 100.0 |

*Source:* ECLA survey.

machinery resulted in a high proportion of stoppage time for repairs and upkeep.

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The ratio of hours worked to the total number available in 1960 is shown in table 74. The utilization coefficient was highest (89.4) in the man-made fibre sector and lowest (70.9) in the jute sector; in the cotton sector, the coefficient was 85.3 per cent; in the weaving mills, the average coefficient was only 59.6. Hence, out of the three full shifts theoretically available per day, the number really worked was 1.8. Table 72 shows

[13] The number of hours available with one shift is eight hours on 300 days a year, or 2,400 hours. This was the criterion used previously by ECLA for its study of the textile industry in Chile, and will also be the basis for future studies in other Latin American countries. In practice, of course, the legal holidays and the 40-hour week are liable to lower the total number of available hours in a year. The hours worked daily in a three-shift factory would theoretically be 24, which gives a total of 7,200 hours a year to be taken into account in estimating the hours available. But as the third shift is usually shorter than the others, because of the time needed to clean the machines and the compulsory rest period halfway through the shift which is required by social legislation in certain countries, production estimates are based on a third shift of only six hours, which reduces the daily working hours to 22, and gives an annual total of 6,600.

mills with 20,000 spindles, but drops to 1.74 in the bigger mills. Similarly, the average number of shifts in the weaving mills increases as with mill size at first, from 1.21 in the small mills with less than 50 looms to 1.66 in those with 500 to 999 looms, but then falls to 1.43 in the mills with 1,000 or more looms.

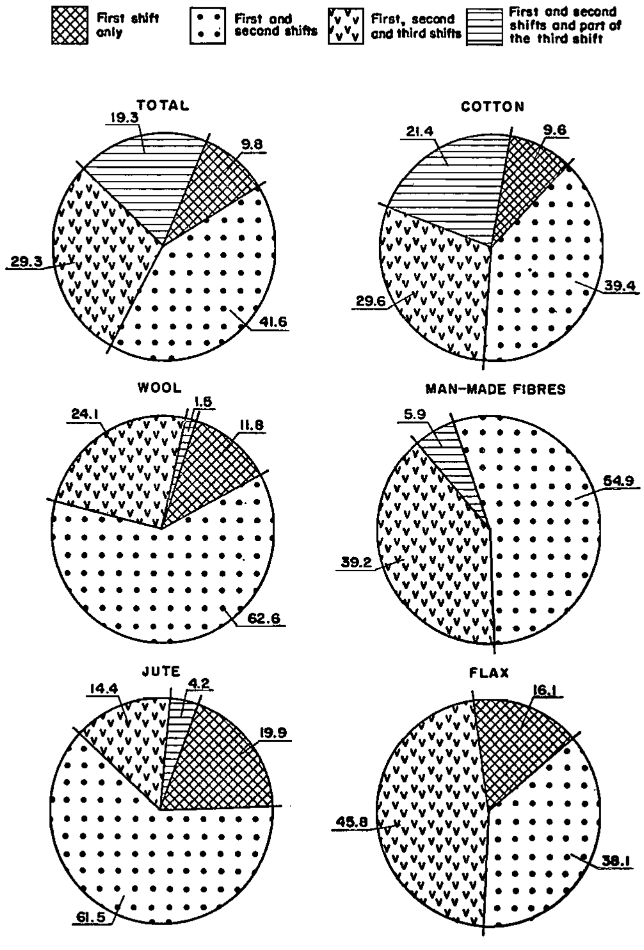
TABLE 75. RELATION OF MILL SIZE TO THE NUMBER OF SHIFTS WORKED IN SPINNING AND WEAVING

| *Size of establishment (Number of spindles)* | *Number of shifts worked* Spinning mills | Weaving mills | *Size of establishment (Number of looms)* |
|---|---|---|---|
| Less than 1,000 . . . | 1.52 | 1.21 | Less than 50 |
| 1,000-4,999 . . . . . | 1.91 | 1.21 | 50-99 |
| 5,000-9,999 . . . . . | 2.01 | 1.50 | 100-199 |
| 10,000-19,999 . . . . | 2.05 | 1.53 | 200-499 |
| 20,000-49,999 . . . . | 1.77 | 1.66 | 500-999 |
| 50,000 and over . . . | 1.74 | 1.43 | 1,000 and over |

Table 76 shows the differences between the use of spinning capacity in some Brazilian states, and in selected countries. In terms of the proportion of hours available worked in the cotton spinning industry, Brazil is virtually on a level with the United States, and achieves better results than Argentina, Chile and some European countries, the low rate of utilization in the latter being largely due to a lack of manpower or the existence of surplus capacity. The highest level of utilization in Brazil was in the State of Santa Catarina where 21.8 hours were recorded daily in spinning and 6,560 annually, i.e., 16 per cent more than the average for the industry surveyed. Assuming that the spinning industry's institutional difficulties could be solved, and that it could operate during the entire number of hours available, the present level of utilization would probably increase by about 17 per cent, with a corresponding increase in production capacity.

FIGURE VIII

PERCENTAGE DISTRIBUTION OF SPINDLES, BY SHIFT AND BY FIBRE, 1960




*Source:* ECLA survey.

TABLE 76. SPINDLE AND LOOM HOURS WORKED IN THE COTTON SECTOR IN BRAZIL AND SELECTED COUNTRIES, 1958-60

| *Country* | *Year* | *Annual hours per spindle* Units | Index | *Annual hours per loom* Units | Index |
|---|---|---|---|---|---|
| Brazil . . . . . . . . . . . | 1960 | 5,632 | 100.0 | 5,062 | 100.0 |
| São Paulo . . . . . . . . | 1960 | 5,732 | 101.8 | 4,277 | 84.4 |
| Santa Catarina . . . . . . | 1960 | 6,560 | 116.5 | 4,620 | 91.3 |
| Minas Gerais . . . . . . | 1960 | 5,920 | 105.1 | 5,890 | 116.3 |
| Guanabara . . . . . . . | 1960 | 5,232 | 92.9 | 5,113 | 101.0 |
| Argentina . . . . . . . . . | 1958 | 4,916 | 87.2 | 4,186 | 82.7 |
| Chile . . . . . . . . . . . | 1959 | 4,974 | 80.3 | 4,630 | 91.5 |
| France . . . . . . . . . . | 1958 | 3,249 | 57.7 | 2,759 | 54.5 |
| Italy . . . . . . . . . . . | 1958 | 2,852 | 50.6 | 2,491 | 49.2 |
| Spain . . . . . . . . . . . | 1958 | 3,858 | 68.5 | 2,450 | 48.4 |
| United Kingdom . . . . . . | 1958 | 1,545 | 27.4 | 2,022 | 39.9 |
| United States . . . . . . . | 1958 | 5,450 | 96.7 | 5,657 | 111.8 |

In the weaving mills the highest level of utilization was in Minas Gerais with 5,890 annual hours, nearly 16 per cent higher than the sample average. Next came Rio-Guanabara, while the lowest coefficient was found in Santa Catarina. This under-utilization of the hours available is also due to institutional factors. If all the available hours were fully used, production capacity for all fibres would in theory expand by about 30 per cent.

mills with 20,000 spindles, but drops to 1.74 in the bigger mills. Similarly, the average number of shifts in the weaving mills increases as with mill size at first, from 1.21 in the small mills with less than 50 looms to 1.66 in those with 500 to 999 looms, but then falls to 1.43 in the mills with 1,000 or more looms.

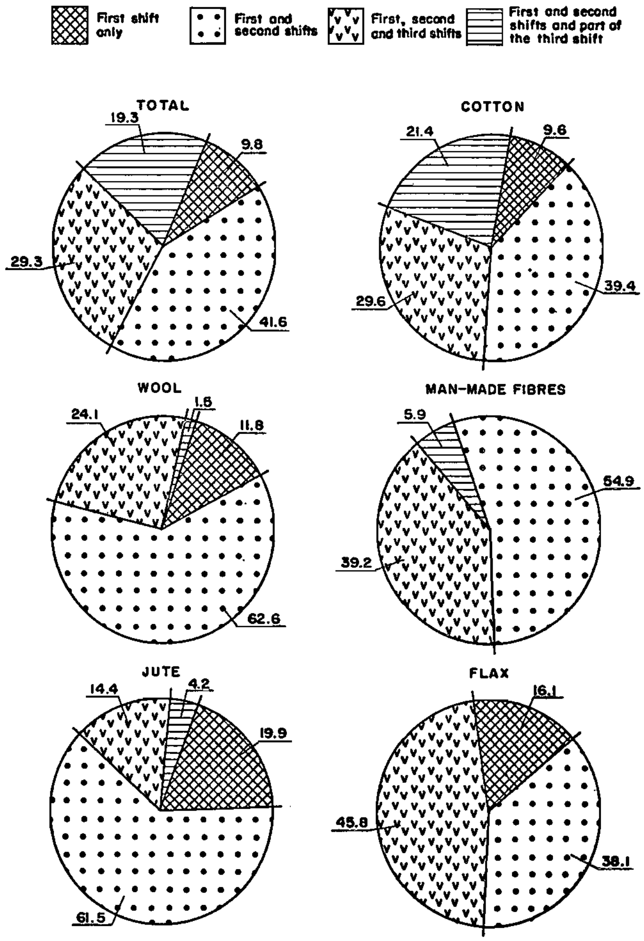
TABLE 75. RELATION OF MILL SIZE TO THE NUMBER OF SHIFTS WORKED IN SPINNING AND WEAVING

| Size of establishment (Number of spindles) | Number of shifts worked: Spinning mills | Weaving mills | Size of establishment (Number of looms) |
|---|---|---|---|
| Less than 1,000 . . . | 1.52 | 1.21 | Less than 50 |
| 1,000-4,999 . . . . . | 1.91 | 1.21 | 50-99 |
| 5,000-9,999 . . . . . | 2.01 | 1.50 | 100-199 |
| 10,000-19,999 . . . . | 2.05 | 1.53 | 200-499 |
| 20,000-49,999 . . . . | 1.77 | 1.66 | 500-999 |
| 50,000 and over . . . | 1.74 | 1.43 | 1,000 and over |

Table 76 shows the differences between the use of spinning capacity in some Brazilian states, and in selected countries. In terms of the proportion of hours available worked in the cotton spinning industry, Brazil is virtually on a level with the United States, and achieves better results than Argentina, Chile and some European countries, the low rate of utilization in the latter being largely due to a lack of manpower or the existence of surplus capacity. The highest level of utilization in Brazil was in the State of Santa Catarina where 21.8 hours were recorded daily in spinning and 6,560 annually, i.e., 16 per cent more than the average for the industry surveyed. Assuming that the spinning industry's institutional difficulties could be solved, and that it could operate during the entire number of hours available, the present level of utilization would probably increase by about 17 per cent, with a corresponding increase in production capacity.

FIGURE VIII

PERCENTAGE DISTRIBUTION OF SPINDLES, BY SHIFT AND BY FIBRE, 1960




*Source:* ECLA survey.

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| Country | Year | Annual hours per spindle: Units | Index | Annual hours per loom: Units | Index |
|---|---|---|---|---|---|
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| São Paulo . . . . . . . . | 1960 | 5,732 | 101.8 | 4,277 | 84.4 |
| Santa Catarina . . . . . . | 1960 | 6,560 | 116.5 | 4,620 | 91.3 |
| Minas Gerais . . . . . . | 1960 | 5,920 | 105.1 | 5,890 | 116.3 |
| Guanabara . . . . . . . | 1960 | 5,232 | 92.9 | 5,113 | 101.0 |
| Argentina . . . . . . . . . | 1958 | 4,916 | 87.2 | 4,186 | 82.7 |
| Chile . . . . . . . . . . . | 1959 | 4,974 | 80.3 | 4,630 | 91.5 |
| France . . . . . . . . . . | 1958 | 3,249 | 57.7 | 2,759 | 54.5 |
| Italy . . . . . . . . . . . | 1958 | 2,852 | 50.6 | 2,491 | 49.2 |
| Spain . . . . . . . . . . . | 1958 | 3,858 | 68.5 | 2,450 | 48.4 |
| United Kingdom . . . . . . | 1958 | 1,545 | 27.4 | 2,022 | 39.9 |
| United States . . . . . . . | 1958 | 5,450 | 96.7 | 5,657 | 111.8 |

In the weaving mills the highest level of utilization was in Minas Gerais with 5,890 annual hours, nearly 16 per cent higher than the sample average. Next came Rio-Guanabara, while the lowest coefficient was found in Santa Catarina. This under-utilization of the hours available is also due to institutional factors. If all the available hours were fully used, production capacity for all fibres would in theory expand by about 30 per cent.

## 2. Methodological considerations

For the purposes of the analyses and comparisons presented in this chapter, three basic concepts are adopted: unit output of machinery, operational efficiency of machinery and labour productivity. It should be noted that whereas unit output can be determined for groups of machines of the same kind, but of widely differing ages, states of repair, etc., and is therefore an aggregative concept reflecting only an average level of performance, the concept of efficiency relates specifically to a particular machine.

*Unit output* is the physical output obtained by one unit of equipment in one working hour. In the present study this coefficient was determined by dividing the physical output of a group of machines of a given type by the total number of hours during which these machines would actually be in operation. For spindles and looms, for example, unit output is expressed in terms of grammes per spindle/hour and metres per loom/hour. The comparisons made between unit output in Brazil and in other countries are based on output and efficiency standards established in accordance with the criteria set forth in the Methodological Annex. The unit output standards were so calculated as to represent rates that would be practicable in modernized production units operating at 90 per cent efficiency.

The *operational efficiency* of a machine is the ratio between the maximum output that could be achieved in theoretical operating conditions and the output obtained in other specified conditions. The most important of the factors affecting the output of a machine are the speed of operation, the level of manpower training and the mill's organizational efficiency. In practice no machine can operate uninterruptedly, that is, at 100 per cent efficiency, since some stoppages are unavoidable. For example, non-automatic looms have to be stopped for manual changing of bobbins and shuttles, and automatic looms for changing of the warp beams. Spinning frames must be stopped for spindle changing (more frequently if they are out-of-date than if they are modern). In addition there are accidental stoppages caused by yarn breaks, mechanical breakdowns, etc. Furthermore, the output of a machine may be reduced by factors other than stoppages, such as low operating speed, deriving either from machinery obsolescence or defective organization of production. Machine efficiency increases as the number and duration of necessary or accidental stoppages decreases.[3]

*Labour productivity* is the physical output of one man in one working hour. It is calculated on the basis of the total output obtained over a given period (one day, week, month or year) and the total number of man/hours taken to produce this output. Thus, in calculating productivity in a spinning mill, account is taken of the hours worked by all the operatives directly and indirectly employed in the production process, and by the foreman and assistant foremen, in all sections of the mill, from the opening of the bales to the cone winding of the yarn.[4] The same method is applied to weaving, for which the man/hours are computed from the time the cones are received to the time the grey fabric comes off the loom. This criterion was adopted because some spinning mills sell yarn, which must therefore be wound, since the weaving mills do not buy yarn in any other form.[5] Productivity is a function of several factors (see Methodological Annex), which can be summed up under the three main heads of machine utilization efficiency, workload (number of production units per operative) and quality of the raw materials.

To permit comparison of the data on unit output of machinery and labour productivity in the textile industry in Brazil with the figures for other countries, and to give an idea of how these values are distributed among the different size-categories of mills and the various states, actual output (expressed in terms of the average yarn count for the mill concerned—see footnote 8 below) was weighted by a coefficient representing the ratio between the actual output and the corresponding output for the base count of Ne 18.[6] Division of the weighted output thus obtained by the number of spindle/hours or man/hours used to obtain the actual output gives the weighted unit output and weighted productivity, respectively.[7]

This weighting involves some degree of distortion, since it is applied to a yarn count average which is already a function of several other counts. The higher the number of average counts incorporated in the total average, the greater will be the distortion. The ideal method would be to apply the weighting to actual output separately for each yarn count produced in each of the mills; but such a calculation would be extremely toilsome, and would not be justified by the margin of error otherwise introduced. To reduce the distortion to a minimum, the weighting was computed at the level of the yarn count average for each mill, so that the results analysed in the present chapter can be regarded as reasonably accurate.[8]

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[3] For example, if a loom has a theoretical production capacity of 200 picks a minute when working uninterruptedly, but in practice its performance in optimum operating conditions is not more than 180 picks a minute, because of unavoidable stoppages, it is said to be working at 90 per cent efficiency. If a spindle can in theory produce 25 grammes of yarn in an hour, but in practice its output is only 20 grammes, it is wasting 20 per cent of its production capacity, that is, operating at 80 per cent efficiency.

[4] In making comparisons between countries it should be noted that spinning mill productivity data do not always cover winders (on cones for weaving), and this exclusion means that the productivity figure is higher than if winders are included.

[5] Dyeing man/hours were not taken into account even where the mills produced dyed yarn.

[6] This count is used as the base count for the cotton sector in the various studies on the textile industries in Latin America that are being carried out by ECLA.

[7] For example, given a daily output of 1,000 kilogrammes of 22-count yarn requiring N spindle/hours and $n$ man/hours, and a standard output of 18 grammes per spindle/hour for yarn count 22 and of 22 grammes for yarn/count 18, the coefficient to be applied to the actual output will be $\frac{22}{18} = 1.22$ and the weighted output will be $1,000 \times 1.22 = 1,220$ kilogrammes. The weighted unit output will be $\frac{1,220}{N}$, and weighted productivity $\frac{1,220}{n}$.

[8] At first glance it may seem paradoxical that in some cases a group of mills with a yarn count average which is lower than—or the same as—the base count of 18 should have a weighted output higher than its actual output. It should be explained that in calculating the yarn count average for the group, the coefficient (ratio of actual output for the average count to output for count 18) is applied to the actual output figures for each mill. The effect is that where the actual output is for an average count lower than the base count the weighted output will be lower than actual output, and where the

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To permit comparison of the data on unit output of machinery and labour productivity in the textile industry in Brazil with the figures for other countries, and to give an idea of how these values are distributed among the different size-categories of mills and the various states, actual output (expressed in terms of the average yarn count for the mill concerned—see footnote 8 below) was weighted by a coefficient representing the ratio between the actual output and the corresponding output for the base count of Ne 18.[6] Division of the weighted output thus obtained by the number of spindle/hours or man/hours used to obtain the actual output gives the weighted unit output and weighted productivity, respectively.[7]

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[8] At first glance it may seem paradoxical that in some cases a group of mills with a yarn count average which is lower than—or the same as—the base count of 18 should have a weighted output higher than its actual output. It should be explained that in calculating the yarn count average for the group, the coefficient (ratio of actual output for the average count to output for count 18) is applied to the actual output figures for each mill. The effect is that where the actual output is for an average count lower than the base count the weighted output will be lower than actual output, and where the

TABLE 77. UNIT OUTPUT AND PRODUCTIVITY IN COTTON SPINNING MILLS, BY MILL SIZE

| Mill size (spindles) | Spindles in use (as a percentage of total) | Average yarn count[a] | Unit output (grammes per spindle/hour) Actual | Unit output (grammes per spindle/hour) Weighted | Weighted unit output index | Productivity (grammes per man/hour) Actual | Productivity (grammes per man/hour) Weighted | Weighted productivity index |
|---|---|---|---|---|---|---|---|---|
| Under 1,000 | 0.2 | 7.8 | 27 | 17 | 121 | 1,149 | 748 | 37 |
| 1,000 to 4,999 | 5.7 | 13.5 | 16 | 14 | 100 | 1,558 | 1,349 | 68 |
| 5,000 to 9,999 | 15.6 | 18.1 | 15 | 15 | 107 | 1,574 | 1,605 | 80 |
| 10,000 to 19,999 | 27.7 | 22.4 | 12 | 16 | 114 | 1,505 | 2,048 | 102 |
| 20,000 to 49,999 | 32.4 | 22.9 | 10 | 14 | 100 | 1,590 | 2,169 | 109 |
| 50,000 and over | 18.4 | 24.6 | 9 | 13 | 93 | 1,689 | 2,440 | 122 |
| TOTAL | 100.0 | 21.1 | 11 | 14 | 100 | 1,575 | 1,996 | 100 |

*Source:* ECLA, on the basis of the survey data.
[a] English count.

TABLE 78. PRODUCTIVITY IN COTTON SPINNING MILLS IN SELECTED COUNTRIES, 1960

| | Brazil[a] | Chile[a] | Peru[b] | Latin American standard[c] | European average[d] | United States[d] |
|---|---|---|---|---|---|---|
| Grammes per man/hour | 1,996 | 1,940 | 1,975 | 4,300 | 5,500 | 12,400 |
| Indices | 46 | 45 | 46 | 100 | 128 | 290 |

*Source:* ECLA.
[a] Weighting base count 18 (English count).
[b] 1959.
[c] 20,000 spindles.
[d] Estimate.

### (b) *Comparison by mill size*

Table 77 above indicates that mill size exerts considerable influence on machinery output and labour productivity. Actual unit output decreases steadily as mill size increases; however, this is largely accounted for by the fact that the average yarn counts produced increase progressively with mill size, since such yarns take longer to process. Weighted unit output, on the other hand, increases with size through the three groups covering the range between 1,000 and 20,000 spindles, and then declines to a level at or a little below that of the over-all average of 14 grammes per spindle/hour. Since the standard unit output for yarn count Ne 18, at 90 per cent efficiency, is 22 grammes per spindle/hour,[10] this over-all average represents only 64 per cent of the standard. The lowest figure (13 grammes per spindle/hour) was for the over-50,000-spindle group, and represents about 54 per cent of the standard level, while the highest (17 grammes), for the under-1,000-spindle group, represents 77 per cent of the standard. The first four size categories all achieve between 63 and 77 per cent of the standard (see the detailed analysis of a sample of twenty-five mills in chapter VI). This finding suggests that, broadly speaking, the unit output level is somewhat higher in the small and medium-size mills than in the larger mills; the overall average unit output could be increased by 58 per cent in the first two and by 70 per cent in the last-named, once the machinery was brought up to date and production organization improved. As for productivity, it should be noted that the very high average level in the larger mills is attributable to a few up-to-date mills whose labour productivity is much above the average and at times actually higher than the standard adopted; if only four mills (less than 2 per cent of the total number covered by the survey) in the over-20,000-spindle range are excluded, the average productivity drops by about 10 per cent.

[10] See the Methodological Annex for production and up-to-dateness criteria.

### (c) *Comparison by state*

The levels for the various states are shown in table 79 and figure X. The best performance is in the State of São Paulo, which has the highest index for productivity (112) and the second highest for unit output (107). In Rio Grande do Sul and Santa Catarina taken together, the unit output index is the highest (129), but the productivity index is the lowest (81). In Minas Gerais, although unit output reaches the average level, productivity falls below it, because of the low indices of the smaller mills; the performance of the cotton spinning industry in this State is relatively good, despite the fact that the proportion of up-to-date spindles is the lowest, only 15 per cent of its total spindle capacity.

Of all the size categories in the various states, the highest unit output figure is for the under-1,000-spindle group in the State of São Paulo (26 grammes per spindle/hour), and the next highest (21 grammes) for the same size-group in the State of Minas Gerais. The lowest figure (6 grammes) is for the same size group in Santa Catarina and Rio Grande do Sul. However, another low figure (10 grammes) is for the over-50,000-spindle group, in Rio-Guanabara. The effect of mill size on unit output varies from state to state, but in all states the level for the mills with over 20,000 spindles is close to the average for the state concerned.

The correlation between mill size and productivity is more marked, especially in the States of São Paulo and

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|---|---|---|---|---|---|---|---|---|
| Under 1,000 | 0.2 | 7.8 | 27 | 17 | 121 | 1,149 | 748 | 37 |
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|---|---|---|---|---|---|---|
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| Indices | 46 | 45 | 46 | 100 | 128 | 290 |

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[a] Weighting base count 18 (English count).
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[10] See the Methodological Annex for production and up-to-dateness criteria.

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The levels for the various states are shown in table 79 and figure X. The best performance is in the State of São Paulo, which has the highest index for productivity (112) and the second highest for unit output (107). In Rio Grande do Sul and Santa Catarina taken together, the unit output index is the highest (129), but the productivity index is the lowest (81). In Minas Gerais, although unit output reaches the average level, productivity falls below it, because of the low indices of the smaller mills; the performance of the cotton spinning industry in this State is relatively good, despite the fact that the proportion of up-to-date spindles is the lowest, only 15 per cent of its total spindle capacity.

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The correlation between mill size and productivity is more marked, especially in the States of São Paulo and

TABLE 79. WEIGHTED INDICES FOR UNIT OUTPUT AND PRODUCTIVITY IN COTTON SPINNING, BY MILL SIZE AND BY STATE

| Mill size (spindles) | Total area | | Rio-Guanabara | | | | Minas Gerais | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unit output | | Productivity | | Unit output | | Productivity | |
| | Unit output | Productivity | State index | Over-all index | State index | Over-all index | State index | Over-all index | State index | Over-all index |
| Under 1,000 | 121 | 41 | — | — | — | — | 150 | 124 | 41 | 99 |
| 1,000 to 4,999 | 100 | 74 | 150 | 129 | 58 | 77 | 93 | 71 | 72 | 97 |
| 5,000 to 9,999 | 107 | 88 | 100 | 80 | 76 | 84 | 107 | 100 | 91 | 103 |
| 10,000 to 19,999 | 114 | 112 | 125 | 94 | 135 | 117 | 107 | 94 | 107 | 95 |
| 20,000 to 49,999 | 100 | 109 | 100 | 86 | 104 | 85 | 93 | 93 | 137 | 114 |
| 50.000 and over | 93 | 122 | 83 | 77 | 87 | 63 | — | — | — | — |
| | 100 | 100 | 100 | 86 | 100 | 89 | 100 | 100 | 100 | 91 |

| Mill size (spindles) | São Paulo | | | | Rio Grande do Sul and Santa Catarina | | | |
|---|---|---|---|---|---|---|---|---|
| | Unit output | | Productivity | | Unit output | | Productivity | |
| | State index | Over-all index | State index | Over-all index | State index | Over-all index | State index | Over-all index |
| Under 1,000 | 186 | 153 | 40 | 105 | 33 | 35 | 40 | 86 |
| 1,000 to 4,999 | 107 | 107 | 74 | 105 | 100 | 129 | 145 | 175 |
| 5,000 to 9,999 | 107 | 100 | 88 | 104 | 111 | 133 | 92 | 93 |
| 10,000 to 19,999 | 114 | 100 | 108 | 101 | 94 | 106 | 106 | 83 |
| 20,000 to 49,999 | 93 | 100 | 103 | 106 | — | — | — | — |
| 50,000 and over | 107 | 123 | 164 | 150 | — | — | — | — |
| | 100 | 107 | 100 | 112 | 100 | 129 | 100 | 81 |

*Source:* ECLA.

in Rio-Guanabara and 2 per cent in Santa Catarina and Rio Grande do Sul. The highest percentage of mills with a productivity that equals or exceeds the standard of 4,300 grammes per man/hour is in São Paulo (5.2 per cent), and the lowest in Santa Caterina and Rio Grande do Sul (nil). Of the total number of mills, 4.3 per cent equal or exceed the standard: 2.6 per cent in São Paulo, 1.4 per cent in Minas Gerais, and 0.3 per cent in Rio-Guanabara. The mills with the highest productivity (over 6,000 grammes per man/hour) are in Minas Gerais; the highest individual figure is 6,155 grammes, which is 44 per cent above the standard.

Of the mills whose productivity is above the standard, four belong to the 10,000-20,000-spindle group, three to the 20,000-50,000-spindle group and two to the over-50,000-spindle group. The highest individual levels were in the medium-size mills (10,000 to 20,000 spindles), and the highest average for any size category in the mills with over 50,000 spindles, where the levels are all relatively high, and cover a narrower range than in the other groups.

The great differences between the levels in individual mills, and the fact that some exceed the standard adopted (of which the average for Brazil represents less than 50 per cent), testify to the feasibility of a reorganization programme designed to promote the widespread application of processes and methods of work that are already in full use in some mills.

### 4. UNIT OUTPUT AND LABOUR PRODUCTIVITY IN WOOL SPINNING MILLS

In the wool spinning mills comparable productivity data are difficult to obtain because of the sector's highly diversified structure. Some mills undertake the whole of the process, from the receiving, sorting, washing and drying of the raw wool to its preparation and spinning;

TABLE 79. WEIGHTED INDICES FOR UNIT OUTPUT AND PRODUCTIVITY IN COTTON SPINNING, BY MILL SIZE AND BY STATE

| Mill size (spindles) | Total area | | Rio-Guanabara | | | | Minas Gerais | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Unit output | | Productivity | | Unit output | | Productivity | |
| | Unit output | Productivity | State index | Over-all index | State index | Over-all index | State index | Over-all index | State index | Over-all index |
| Under 1,000 | 121 | 41 | — | — | — | — | 150 | 124 | 41 | 99 |
| 1,000 to 4,999 | 100 | 74 | 150 | 129 | 58 | 77 | 93 | 71 | 72 | 97 |
| 5,000 to 9,999 | 107 | 88 | 100 | 80 | 76 | 84 | 107 | 100 | 91 | 103 |
| 10,000 to 19,999 | 114 | 112 | 125 | 94 | 135 | 117 | 107 | 94 | 107 | 95 |
| 20,000 to 49,999 | 100 | 109 | 100 | 86 | 104 | 85 | 93 | 93 | 137 | 114 |
| 50.000 and over | 93 | 122 | 83 | 77 | 87 | 63 | — | — | — | — |
| | 100 | 100 | 100 | 86 | 100 | 89 | 100 | 100 | 100 | 91 |

| Mill size (spindles) | São Paulo | | | | Rio Grande do Sul and Santa Catarina | | | |
|---|---|---|---|---|---|---|---|---|
| | Unit output | | Productivity | | Unit output | | Productivity | |
| | State index | Over-all index | State index | Over-all index | State index | Over-all index | State index | Over-all index |
| Under 1,000 | 186 | 153 | 40 | 105 | 33 | 35 | 40 | 86 |
| 1,000 to 4,999 | 107 | 107 | 74 | 105 | 100 | 129 | 145 | 175 |
| 5,000 to 9,999 | 107 | 100 | 88 | 104 | 111 | 133 | 92 | 93 |
| 10,000 to 19,999 | 114 | 100 | 108 | 101 | 94 | 106 | 106 | 83 |
| 20,000 to 49,999 | 93 | 100 | 103 | 106 | — | — | — | — |
| 50,000 and over | 107 | 123 | 164 | 150 | — | — | — | — |
| | 100 | 107 | 100 | 112 | 100 | 129 | 100 | 81 |

*Source:* ECLA.

in Rio-Guanabara and 2 per cent in Santa Catarina and Rio Grande do Sul. The highest percentage of mills with a productivity that equals or exceeds the standard of 4,300 grammes per man/hour is in São Paulo (5.2 per cent), and the lowest in Santa Caterina and Rio Grande do Sul (nil). Of the total number of mills, 4.3 per cent equal or exceed the standard: 2.6 per cent in São Paulo, 1.4 per cent in Minas Gerais, and 0.3 per cent in Rio-Guanabara. The mills with the highest productivity (over 6,000 grammes per man/hour) are in Minas Gerais; the highest individual figure is 6,155 grammes, which is 44 per cent above the standard.

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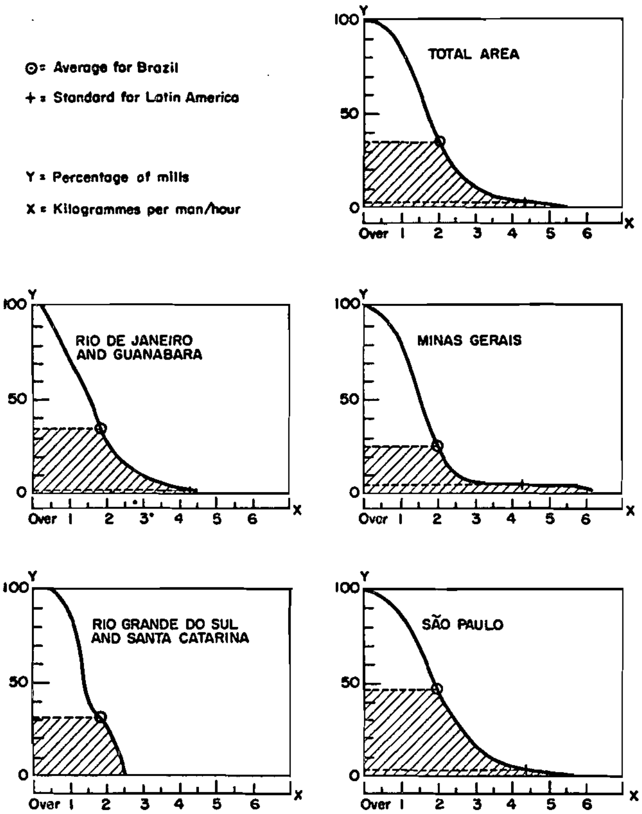
FIGURE XI

CUMULATIVE FREQUENCIES OF WEIGHTED PRODUCTIVITY FIGURES IN COTTON SPINNING MILLS, BY STATE

Natural scale




*Source:* ECLA survey.

others, usually the smaller mills, buy the wool already clean scoured, and thus employ no labour for sorting, washing and drying. Some mills produce only tops, others only carded yarn or combed yarn, and others both carded and combed yarn. The size of the labour force varies according to the process concerned. A productivity index by size groups or states would thus be meaningless, since these processes may differ completely from mill to mill, and in any case the number of mills in some states is too low to permit valid size-group comparisons. The analysis of productivity for the sector as a whole therefore relates only to the total number of mills, and the breakdown by size groups and states covers only spinning proper, and not preparation for spinning.

The same problem does not arise as regards unit output, which relates only to spindle performance. It should be noted that the figures given below apply to the whole of the Brazilian wool industry, all of which is in the area covered by the ECLA survey. The weighting system applied was the same as for cotton, except that the base yarn count adopted was metric count 17.

In wool spinning, labour productivity, in terms of grammes per man/hour, relates to the labour employed in all the operations from the reception of the greasy wool up to the production of the skeins or cones. The average weighted productivity for all the wool spinning mills in Brazil was 1,119 grammes for an output consisting of an average of 35 per cent carded and 65 per cent combed yarns (metric count 17). The productivity standards adopted for purposes of comparison were 1,700 grammes per man/hour for combed yarns and 3,600 grammes for carded yarns; for the proportions of combed and carded yarns found in Brazil, these figures give an average productivity of 2,400 grammes, which represents only 47 per cent of the standard.

### (a) *Comparison with other countries*

Table 82 and figure XII compare unit output and productivity in Brazil and in other Latin American countries with the standard levels. The levels are similar in Brazil and Peru, and somewhat higher than for Chile. Unit output in Brazil represents only 42 per cent of the standard, and productivity only 47 per cent. The latter figure is slightly higher than for cotton (46.4 per cent of the standard), perhaps because the wool industry was established much more recently and therefore uses relatively more up-to-date methods and equipment.

TABLE 82. UNIT OUTPUT AND PRODUCTIVITY IN WOOL SPINNING MILLS IN SELECTED COUNTRIES, 1960

(*Weighting: Metric count 17*)

| | *Unit output (grammes per spindle/hour)* | | *Weighted unit output index* | *Productivity (grammes per man/hour)* | | *Weighted productivity index* | *Composition of production (Percentage)* | |
|---|---|---|---|---|---|---|---|---|
| | *Actual* | *Weighted* | | *Actual* | *Weighted* | | *Combed* | *Carded* |
| Brazil | 15.0 | 22.0 | 42 | 770[a] | 1,119[a] | 47 | 65 | 35 |
| Chile | 17.0 | 17.0 | 32 | 989 | 989 | 41 | 67 | 33 |
| Peru | 33.0 | 29.7 | | 1,572 | 1,415 | | 36 | 64 |
| Peru (adjusted)[b] | | 25.5 | 43 | | 1,132 | 48 | 65 | 35 |
| Standard | | 52.5 | 100 | | 2,400 | 100 | 65 | 35 |

*Source:* ECLA survey.

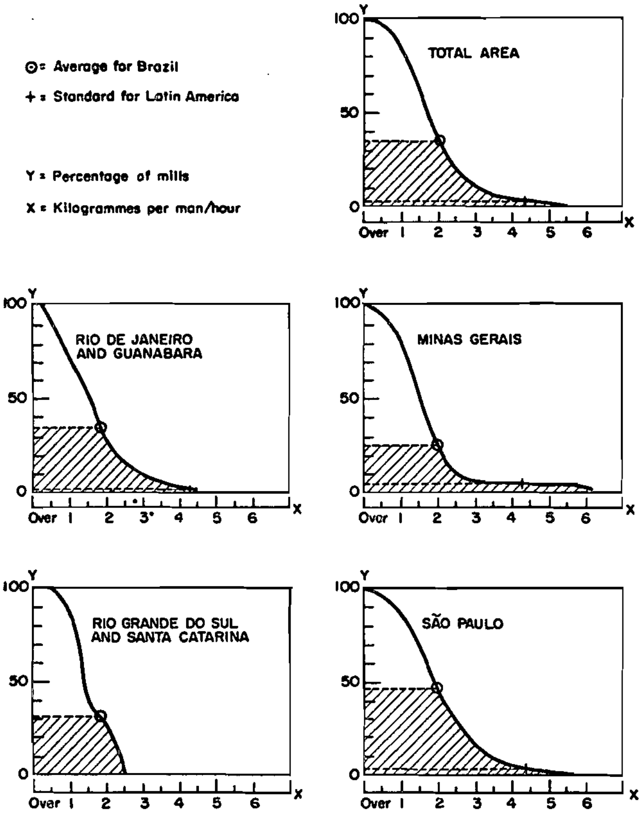
[a] These data relate to productivity per *worker/hour.* In table 83, showing productivity by mill size, productivity corresponds to output per *spinner/hour.*

[b] In Peru output consists of 36 per cent combed wool and 64 per cent carded wool; for purposes of comparison, the figures were adjusted so as to represent an output of 65 per cent combed and 35 per cent carded wool, since unit output varies considerably, and productivity even more, according to whether the wool is combed or carded.

FIGURE XI

CUMULATIVE FREQUENCIES OF WEIGHTED PRODUCTIVITY FIGURES IN COTTON SPINNING MILLS, BY STATE

Natural scale




*Source:* ECLA survey.

others, usually the smaller mills, buy the wool already clean scoured, and thus employ no labour for sorting, washing and drying. Some mills produce only tops, others only carded yarn or combed yarn, and others both carded and combed yarn. The size of the labour force varies according to the process concerned. A productivity index by size groups or states would thus be meaningless, since these processes may differ completely from mill to mill, and in any case the number of mills in some states is too low to permit valid size-group comparisons. The analysis of productivity for the sector as a whole therefore relates only to the total number of mills, and the breakdown by size groups and states covers only spinning proper, and not preparation for spinning.

The same problem does not arise as regards unit output, which relates only to spindle performance. It should be noted that the figures given below apply to the whole of the Brazilian wool industry, all of which is in the area covered by the ECLA survey. The weighting system applied was the same as for cotton, except that the base yarn count adopted was metric count 17.

In wool spinning, labour productivity, in terms of grammes per man/hour, relates to the labour employed in all the operations from the reception of the greasy wool up to the production of the skeins or cones. The average weighted productivity for all the wool spinning mills in Brazil was 1,119 grammes for an output consisting of an average of 35 per cent carded and 65 per cent combed yarns (metric count 17). The productivity standards adopted for purposes of comparison were 1,700 grammes per man/hour for combed yarns and 3,600 grammes for carded yarns; for the proportions of combed and carded yarns found in Brazil, these figures give an average productivity of 2,400 grammes, which represents only 47 per cent of the standard.

### (a) *Comparison with other countries*

Table 82 and figure XII compare unit output and productivity in Brazil and in other Latin American countries with the standard levels. The levels are similar in Brazil and Peru, and somewhat higher than for Chile. Unit output in Brazil represents only 42 per cent of the standard, and productivity only 47 per cent. The latter figure is slightly higher than for cotton (46.4 per cent of the standard), perhaps because the wool industry was established much more recently and therefore uses relatively more up-to-date methods and equipment.

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(*Weighting: Metric count 17*)

| | *Unit output (grammes per spindle/hour)* | | *Weighted unit output index* | *Productivity (grammes per man/hour)* | | *Weighted productivity index* | *Composition of production (Percentage)* | |
|---|---|---|---|---|---|---|---|---|
| | *Actual* | *Weighted* | | *Actual* | *Weighted* | | *Combed* | *Carded* |
| Brazil . . . . . . | 15.0 | 22.0 | 42 | 770[a] | 1,119[a] | 47 | 65 | 35 |
| Chile . . . . . . | 17.0 | 17.0 | 32 | 989 | 989 | 41 | 67 | 33 |
| Peru . . . . . . | 33.0 | 29.7 | | 1,572 | 1,415 | | 36 | 64 |
| Peru (adjusted)[b] . | | 25.5 | 43 | | 1,132 | 48 | 65 | 35 |
| Standard . . . . . | | 52.5 | 100 | | 2,400 | 100 | 65 | 35 |

*Source:* ECLA survey.

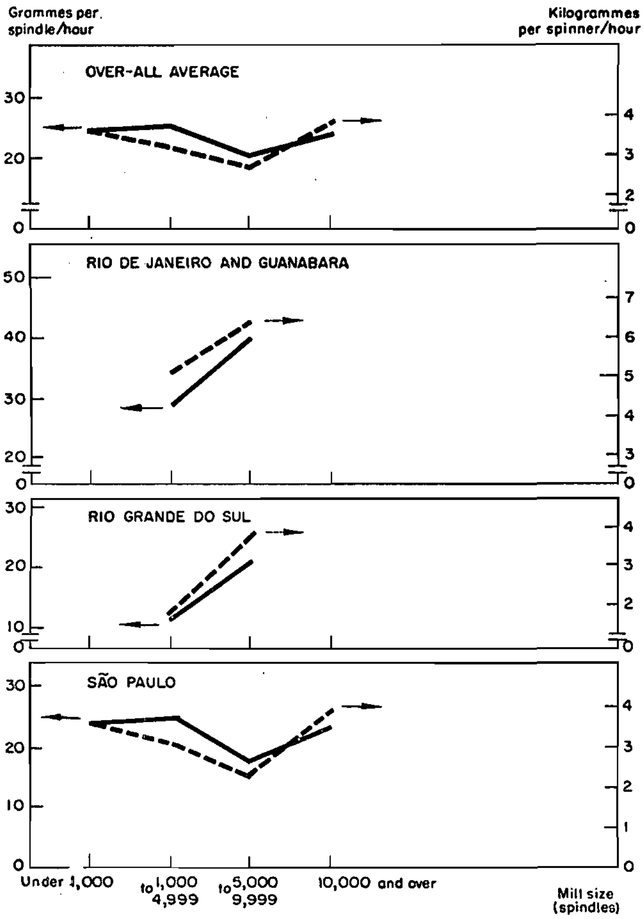
[a] These data relate to productivity per *worker/hour.* In table 83, showing productivity by mill size, productivity corresponds to output per *spinner/hour.*

[b] In Peru output consists of 36 per cent combed wool and 64 per cent carded wool; for purposes of comparison, the figures were adjusted so as to represent an output of 65 per cent combed and 35 per cent carded wool, since unit output varies considerably, and productivity even more, according to whether the wool is combed or carded.

FIGURE XIII

WEIGHTED UNIT OUTPUT AND WEIGHTED PRODUCTIVITY IN WOOL SPINNING MILLS, BY MILL SIZE AND BY STATE

Natural scale

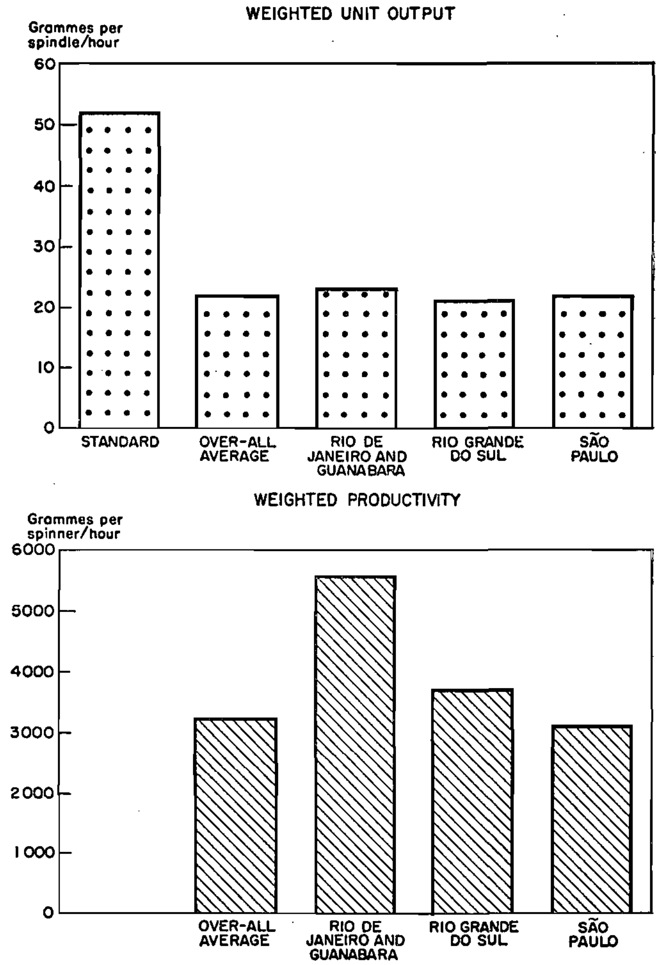



*Source:* ECLA survey.

FIGURE XIV

COMPARISON OF WEIGHTED UNIT OUTPUT AND WEIGHTED PRODUCTIVITY IN WOOL SPINNING MILLS IN THE STATES COVERED BY THE SURVEY WITH THE STANDARD FOR LATIN AMERICA

Natural scale




*Source:* ECLA survey.

### (c) *Comparison by state*

The data for the various states are shown in table 84 and figure XIV. The highest productivity figure is for Rio-Guanabara (index 173). The lowest is for São Paulo, whose productivity is below the average; this is because three-fourths of the Brazilian wool industry is concentrated in that state, which therefore provides a complex and highly representative sample, including mills of all sizes and degrees of obsolescence. Productivity naturally tends to be lower in such a group than in an area such as Rio-Guanabara, where there are few mills, all with a high level of productivity.

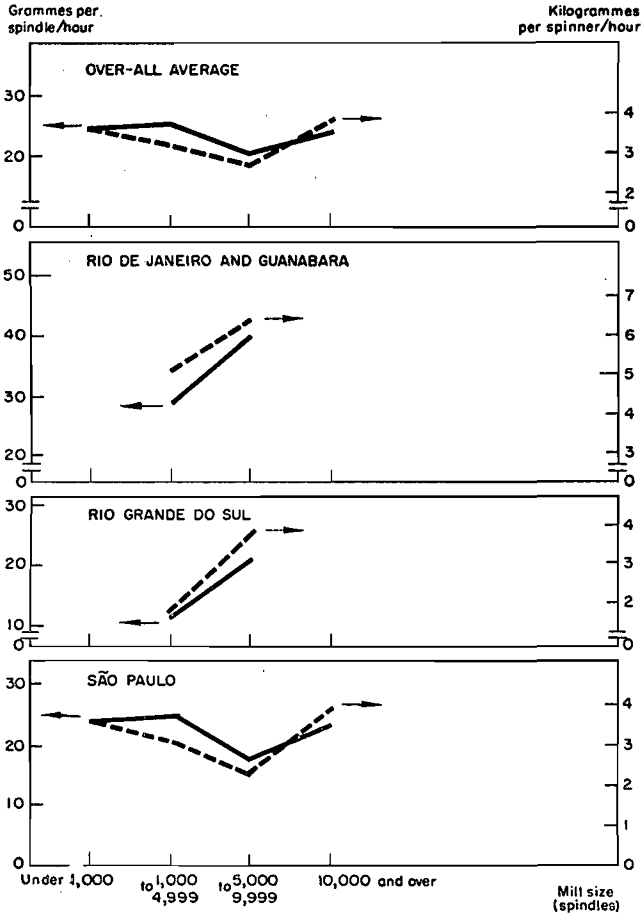
TABLE 84. PRODUCTIVITY AND OUTPUT IN WOOL SPINNING MILLS, BY STATE

| | *Mills* (as a percentage of total) | *Spindles in use* (as a percentage of total) | *Unit output (grammes per spindle/hour)* Actual | *Unit output (grammes per spindle/hour)* Weighted | *Weighted unit output index* | *Productivity (grammes per man/hour)* Actual | *Productivity (grammes per man/hour)* Weighted | *Weighted productivity index* |
|---|---|---|---|---|---|---|---|---|
| Rio de Janeiro and Guanabara . . | 12.5 | 6.8 | 20 | 23 | 105 | 2,455 | 5,621 | 173 |
| São Paulo . . . | 72.5 | 75.2 | 15 | 22 | 100 | 2,117 | 3,031 | 93 |
| Rio Grande do Sul | 15.0 | 18.0 | 14 | 21 | 95 | 2,506 | 3,681 | 113 |
| TOTAL | 100.0 | 100.0 | 15 | 22 | 100 | 2,239 | 3,252 | 100 |

Figure XIII

Weighted unit output and weighted productivity in wool spinning mills, by mill size and by state

Natural scale

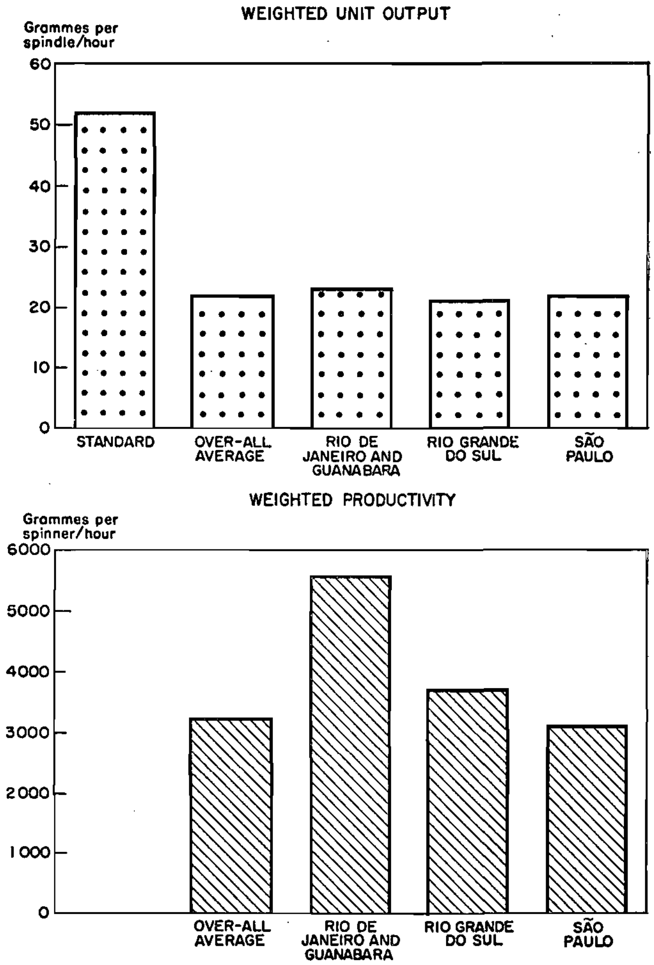



*Source:* ECLA survey.

Figure XIV

Comparison of weighted unit output and weighted productivity in wool spinning mills in the states covered by the survey with the standard for Latin America

Natural scale




*Source:* ECLA survey.

### (c) *Comparison by state*

The data for the various states are shown in table 84 and figure XIV. The highest productivity figure is for Rio-Guanabara (index 173). The lowest is for São Paulo, whose productivity is below the average; this is because three-fourths of the Brazilian wool industry is concentrated in that state, which therefore provides a complex and highly representative sample, including mills of all sizes and degrees of obsolescence. Productivity naturally tends to be lower in such a group than in an area such as Rio-Guanabara, where there are few mills, all with a high level of productivity.

Table 84. Productivity and output in wool spinning mills, by state

| | *Mills* (as a percentage of total) | *Spindles in use* (as a percentage of total) | *Unit output (grammes per spindle/hour)* Actual | *Unit output (grammes per spindle/hour)* Weighted | *Weighted unit output index* | *Productivity (grammes per man/hour)* Actual | *Productivity (grammes per man/hour)* Weighted | *Weighted productivity index* |
|---|---|---|---|---|---|---|---|---|
| Rio de Janeiro and Guanabara | 12.5 | 6.8 | 20 | 23 | 105 | 2,455 | 5,621 | 173 |
| São Paulo | 72.5 | 75.2 | 15 | 22 | 100 | 2,117 | 3,031 | 93 |
| Rio Grande do Sul | 15.0 | 18.0 | 14 | 21 | 95 | 2,506 | 3,681 | 113 |
| Total | 100.0 | 100.0 | 15 | 22 | 100 | 2,239 | 3,252 | 100 |

TABLE 86. UNIT OUTPUT AND PRODUCTIVITY IN THE JUTE SPINNING MILLS, BY STATE

| | *Mills* | *Spindles in use* | *Average count* | *Actual unit output (grammes per spindle/hour)* | *Actual productivity (grammes per man/hour)* |
|---|---|---|---|---|---|
| | *(as a percentage of total)* | | *(lea)* | | |
| Rio de Janeiro-Guanabara . . | 20 | 12 | 10.3 | 370 | 7,293 |
| Rio Grande do Sul . . . . . | 15 | 8 | 10.6 | 230 | 4,637 |
| São Paulo . . . . . . . . . | 65 | 80 | 10.2 | 220 | 4,877 |
| TOTAL | 100 | 100 | 10.2 | 240 | 5,270 |

## 6. UNIT OUTPUT AND PRODUCTIVITY IN COTTON WEAVING MILLS

The unit output standard adopted was an actual 180 picks per minute at 90 per cent efficiency (100 per cent efficiency is 200 picks per minute) on an automatic loom 110 centimetres wide, on the basis of a fabric with 2,000 picks per metre and an output of 5.40 metres per hour.[11] The average unit output for Brazil is 2.93 metres per loom/hour, which represents only 55 per cent of this standard. Since most of the existing looms are non-automatic or the less up-to-date automatic types, which cannot operate at a speed of more than 144 picks per minute at 80 per cent efficiency, with an output of some 4 metres per loom/hour, it can be concluded that the weaving mills surveyed produce an average of 70 per cent of the unit output possible with the type of equipment in use.

### (a) *Comparison with other countries*

Table 87 compares unit output and productivity in weaving mills in Brazil and in some other countries with the standard adopted for Latin America. The average Brazilian output of 8.18 metres per man/hour represents only 30 per cent of the 27 metres taken as a standard; the highest productivity in Brazil (9.15 metres) which is for Minas Gerais, represents about 33 per cent of the standard, and the lowest, which is for the State of Rio Grande do Sul, represents only 15 per cent of the standard. The productivity in Brazil in addition to falling far short of the standard, fails to match the levels attained in other Latin American countries, and is almost ten times less than in the United States.

TABLE 87. UNIT OUTPUT AND PRODUCTIVITY IN COTTON WEAVING MILLS IN BRAZIL AND SELECTED COUNTRIES

| | *Brazil* | *Chile* | *Peru* | *United States* | *Japan* | *Standard for Latin America* |
|---|---|---|---|---|---|---|
| Unit output (metres) . . . . . | 2.93 | 4.34 | 4.43 | — | — | 5.40[a] |
| Index . . . . . . . . . . . . | 54 | 80 | 82 | — | — | 100 |
| Productivity (metres) . . . . . | 8.18 | 11.60 | 14.33 | 78.10[b] | 30.40[b] | 43.0[a] |
| Index . . . . . . . . . . . . | 30 | 43 | 53 | 289 | 112 | 100 |

[a] Base: a loom operating at a speed of 180 picks per minute at 90 per cent efficiency (see Methodological Annex).

[b] Base: data from a study by the United States Department of Commerce (see chapter IX).

### (b) *Comparison by mill size*

Table 88 shows unit output and productivity levels by mill size. The over-all average of 1,972 picks to the square metre represents approximately 20 picks per centimetre for a fabric 100 centimetres wide. Actual unit output gradually declines as the size of the mills increases, since output is about 3.50 metres per loom/hour in the smaller mills and only 2.60 metres in the mills with over 2,000 looms. It should be noted, however, that the number of picks to the square metre rises from 1,500 in the smallest mills to 2,900 in the largest. If output is weighted on the basis of an average of 2,000 picks to the square metre, a different picture is obtained. Weighted unit output is very similar in the first six groups, and reaches a maximum in the mills with over 2,000 looms; the next highest figures are for the mills with between 200 and 1,000 looms.

Weighted productivity increases with size except for a slight falling off in the 1,000-2,000-loom group, and rises to the maximum level of 19 metres per man/hour in the over 2,000-loom-group.

### (c) *Comparison by states*

Table 89 and figure XV show the levels for the various states. Minas Gerais has the highest actual output (3 metres per loom/hour of a fabric with 2,080 picks per square metre), but its weighted output is about the same as that of São Paulo. Both states have above-average output indices. Their unit output represents about 55 per cent of the standard of 5.40 metres adopted (for new machinery working at 90 per cent efficiency), and the levels for Rio-Guanabara and for Santa Catarina and Rio Grande do Sul represent 48 and 44 per cent, respec-

[11] Standard used for defining an up-to-date loom (see Methodological Annex).

TABLE 86. UNIT OUTPUT AND PRODUCTIVITY IN THE JUTE SPINNING MILLS, BY STATE

| | *Mills* | *Spindles in use* | *Average count* | *Actual unit output (grammes per spindle/hour)* | *Actual productivity (grammes per man/hour)* |
|---|---|---|---|---|---|
| | *(as a percentage of total)* | | *(lea)* | | |
| Rio de Janeiro-Guanabara . . | 20 | 12 | 10.3 | 370 | 7,293 |
| Rio Grande do Sul . . . . . | 15 | 8 | 10.6 | 230 | 4,637 |
| São Paulo . . . . . . . . . | 65 | 80 | 10.2 | 220 | 4,877 |
| TOTAL | 100 | 100 | 10.2 | 240 | 5,270 |

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### (a) *Comparison with other countries*

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| | *Brazil* | *Chile* | *Peru* | *United States* | *Japan* | *Standard for Latin America* |
|---|---|---|---|---|---|---|
| Unit output (metres) . . . . . | 2.93 | 4.34 | 4.43 | — | — | 5.40[a] |
| Index . . . . . . . . . . . . | 54 | 80 | 82 | — | — | 100 |
| Productivity (metres) . . . . . | 8.18 | 11.60 | 14.33 | 78.10[b] | 30.40[b] | 43.0[a] |
| Index . . . . . . . . . . . . | 30 | 43 | 53 | 289 | 112 | 100 |

[a] Base: a loom operating at a speed of 180 picks per minute at 90 per cent efficiency (see Methodological Annex).

[b] Base: data from a study by the United States Department of Commerce (see chapter IX).

### (b) *Comparison by mill size*

Table 88 shows unit output and productivity levels by mill size. The over-all average of 1,972 picks to the square metre represents approximately 20 picks per centimetre for a fabric 100 centimetres wide. Actual unit output gradually declines as the size of the mills increases, since output is about 3.50 metres per loom/hour in the smaller mills and only 2.60 metres in the mills with over 2,000 looms. It should be noted, however, that the number of picks to the square metre rises from 1,500 in the smallest mills to 2,900 in the largest. If output is weighted on the basis of an average of 2,000 picks to the square metre, a different picture is obtained. Weighted unit output is very similar in the first six groups, and reaches a maximum in the mills with over 2,000 looms; the next highest figures are for the mills with between 200 and 1,000 looms.

Weighted productivity increases with size except for a slight falling off in the 1,000-2,000-loom group, and rises to the maximum level of 19 metres per man/hour in the over 2,000-loom-group.

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[11] Standard used for defining an up-to-date loom (see Methodological Annex).

TABLE 89. UNIT OUTPUT AND PRODUCTIVITY IN COTTON WEAVING MILLS, BY STATE

| | Mills (as a percentage of total) | Picks per square metre | Unit output (metres per loom/hour) Actual | Unit output (metres per loom/hour) Weighted | Weighted unit output index | Productivity (metres per man/hour) Actual | Productivity (metres per man/hour) Weighted | Weighted productivity index |
|---|---|---|---|---|---|---|---|---|
| Minas Gerais . . . . . . | 17.9 | 2,080 | 3.00 | 3.00 | 102 | 9.15 | 9.15 | 112 |
| Rio de Janeiro and Guanabara . . . . . . . . . | 9.9 | 2,341 | 2.28 | 2.56 | 86 | 6.93 | 7.79 | 95 |
| Santa Catarina and Rio Grande do Sul . . . . | 8.8 | 1,434 | 3.21 | 2.40 | 81 | 5.74 | 4.30 | 52 |
| São Paulo . . . . . . . | 63.4 | 1,836 | 3.31 | 2.98 | 101 | 8.96 | 7.86 | 96 |
| TOTAL | 100.0 | 1,972 | 2.96 | 2.93 | 100 | 8.25 | 8.18 | 100 |

TABLE 90. WORKLOADS IN COTTON WEAVING MILLS,[a] BY MILL SIZE AND BY STATE

(*Number of looms per operative*)[b]

| Mill size (looms) | Over-all average | Rio de Janeiro and Guanabara | Minas Gerais | Santa Catarina and Rio Grande do Sul | São Paulo |
|---|---|---|---|---|---|
| Under 50 . . . . . . . | 1.4 | 1.2 | 1.4 | 1.3 | 1.0 |
| 50 to 99 . . . . . . . | 1.8 | 2.0 | 2.0 | 1.8 | 1.8 |
| 100 to 199 . . . . . . | 2.2 | 2.3 | 2.8 | 1.4 | 2.2 |
| 200 to 499 . . . . . . | 2.9 | 3.9 | 3.2 | 1.6 | 2.5 |
| 500 to 999 . . . . . . | 3.0 | 3.4 | 2.9 | — | 2.7 |
| 1,000 to 1,999 . . . . . | 3.0 | 2.8 | — | — | 4.0 |
| 2,000 and over . . . . . | 5.2 | — | — | — | 5.2 |
| TOTAL | 2.8 | 3.0 | 3.0 | 1.5 | 2.7 |

*Source:* ECLA survey.

[a] Workloads were calculated on the basis of the ratio between weighted productivity and weighted unit output. All workers directly and indirectly employed in preparation for weaving and weaving proper, (excluding winders), and all foremen and assistant foremen in these sections, were taken into account.

[b] Standard: 5 looms per operative.

pancies between this and the previous productivity tables. The average unit output of automatic looms is found to be nearly 8 per cent higher than that of non-automatic looms, rather less difference than might be expected, since as a rule output per loom/hour increases 10-12 per cent as a result of replacing non-automatic with automatic looms.

The analysis by states reveals some anomalies; in Santa Catarina and Rio Grande do Sul for example, unit output is higher for non-automatic looms. This may be either because in those states the labour force is not properly trained to tend automatic looms, or because the looms are used to produce fabrics with a greater number of picks which would explain an output lower than that of non-automatic looms producing fabrics with fewer picks. In default of information on the fabrics made on each type of loom in these two states, the exact incidence of the two factors cannot be determined.

There is a similar discrepancy in Minas Gerais, where although unit output is lower for non-automatic looms, the difference between the two outputs is below average. This may be for the reasons noted above, but it should be pointed out that the automatic looms are operated somewhat less efficiently in this state than in most of the others, as they were only recently introduced, and are being worked by new operatives, whereas the efficiency of operation of the non-automatic looms, on which the experienced workers have been retained, is relatively high. Moreover the State of Minas Gerais produces a high proportion of narrow fabrics (70 centimetres wide), for which automatic looms (generally 100 to 110 centimetres wide) are not suitable because of the waste of loom width. The only way to increase the unit output of narrow fabrics on automatic looms is to use a very wide loom (150 to 160 centimetres) and weave two strips at once, providing that the fabric manufactured can be given the centre type of selvedge. Although these looms work more slowly, they produce twice the quantity of fabric. Output and productivity both rise considerably because one weaver can mind up to 40 such looms. As even the older narrow non-automatic looms have almost the same speed as the wider automatic looms, and the bobbins or shuttles have to be changed much less often, since 25-30 per cent less weft is used than for wider fabrics (90 to 100 centimetres), the workloads for such non-automatic looms may be nearly as high as those in many of the mills using automatic looms. This may be another reason for the high unit output of the non-automatic looms in Minas Gerais.

For the whole area surveyed, productivity is 125 per cent higher for automatic looms, but the difference is even greater in São Paulo and Rio-Guanabara. The high figure of 177 per cent in the latter may be due to the fact that in these two states the productivity for non-automatic looms is very low, well below the over-all average. Rio-Guanabara also has the highest average number of automatic looms per operative.

TABLE 89. UNIT OUTPUT AND PRODUCTIVITY IN COTTON WEAVING MILLS, BY STATE

| | Mills (as a percentage of total) | Picks per square metre | Unit output (metres per loom/hour) Actual | Weighted | Weighted unit output index | Productivity (metres per man/hour) Actual | Weighted | Weighted productivity index |
|---|---|---|---|---|---|---|---|---|
| Minas Gerais | 17.9 | 2,080 | 3.00 | 3.00 | 102 | 9.15 | 9.15 | 112 |
| Rio de Janeiro and Guanabara | 9.9 | 2,341 | 2.28 | 2.56 | 86 | 6.93 | 7.79 | 95 |
| Santa Catarina and Rio Grande do Sul | 8.8 | 1,434 | 3.21 | 2.40 | 81 | 5.74 | 4.30 | 52 |
| São Paulo | 63.4 | 1,836 | 3.31 | 2.98 | 101 | 8.96 | 7.86 | 96 |
| TOTAL | 100.0 | 1,972 | 2.96 | 2.93 | 100 | 8.25 | 8.18 | 100 |

TABLE 90. WORKLOADS IN COTTON WEAVING MILLS,[a] BY MILL SIZE AND BY STATE
(*Number of looms per operative*)[b]

| Mill size (looms) | Over-all average | Rio de Janeiro and Guanabara | Minas Gerais | Santa Catarina and Rio Grande do Sul | São Paulo |
|---|---|---|---|---|---|
| Under 50 | 1.4 | 1.2 | 1.4 | 1.3 | 1.0 |
| 50 to 99 | 1.8 | 2.0 | 2.0 | 1.8 | 1.8 |
| 100 to 199 | 2.2 | 2.3 | 2.8 | 1.4 | 2.2 |
| 200 to 499 | 2.9 | 3.9 | 3.2 | 1.6 | 2.5 |
| 500 to 999 | 3.0 | 3.4 | 2.9 | — | 2.7 |
| 1,000 to 1,999 | 3.0 | 2.8 | — | — | 4.0 |
| 2,000 and over | 5.2 | — | — | — | 5.2 |
| TOTAL | 2.8 | 3.0 | 3.0 | 1.5 | 2.7 |

*Source:* ECLA survey.

[a] Workloads were calculated on the basis of the ratio between weighted productivity and weighted unit output. All workers directly and indirectly employed in preparation for weaving and weaving proper, (excluding winders), and all foremen and assistant foremen in these sections, were taken into account.

[b] Standard: 5 looms per operative.

pancies between this and the previous productivity tables. The average unit output of automatic looms is found to be nearly 8 per cent higher than that of non-automatic looms, rather less difference than might be expected, since as a rule output per loom/hour increases 10-12 per cent as a result of replacing non-automatic with automatic looms.

The analysis by states reveals some anomalies; in Santa Catarina and Rio Grande do Sul for example, unit output is higher for non-automatic looms. This may be either because in those states the labour force is not properly trained to tend automatic looms, or because the looms are used to produce fabrics with a greater number of picks which would explain an output lower than that of non-automatic looms producing fabrics with fewer picks. In default of information on the fabrics made on each type of loom in these two states, the exact incidence of the two factors cannot be determined.

There is a similar discrepancy in Minas Gerais, where although unit output is lower for non-automatic looms, the difference between the two outputs is below average. This may be for the reasons noted above, but it should be pointed out that the automatic looms are operated somewhat less efficiently in this state than in most of the others, as they were only recently introduced, and are being worked by new operatives, whereas the efficiency of operation of the non-automatic looms, on which the experienced workers have been retained, is relatively high. Moreover the State of Minas Gerais produces a high proportion of narrow fabrics (70 centimetres wide), for which automatic looms (generally 100 to 110 centimetres wide) are not suitable because of the waste of loom width. The only way to increase the unit output of narrow fabrics on automatic looms is to use a very wide loom (150 to 160 centimetres) and weave two strips at once, providing that the fabric manufactured can be given the centre type of selvedge. Although these looms work more slowly, they produce twice the quantity of fabric. Output and productivity both rise considerably because one weaver can mind up to 40 such looms. As even the older narrow non-automatic looms have almost the same speed as the wider automatic looms, and the bobbins or shuttles have to be changed much less often, since 25-30 per cent less weft is used than for wider fabrics (90 to 100 centimetres), the workloads for such non-automatic looms may be nearly as high as those in many of the mills using automatic looms. This may be another reason for the high unit output of the non-automatic looms in Minas Gerais.

For the whole area surveyed, productivity is 125 per cent higher for automatic looms, but the difference is even greater in São Paulo and Rio-Guanabara. The high figure of 177 per cent in the latter may be due to the fact that in these two states the productivity for non-automatic looms is very low, well below the over-all average. Rio-Guanabara also has the highest average number of automatic looms per operative.

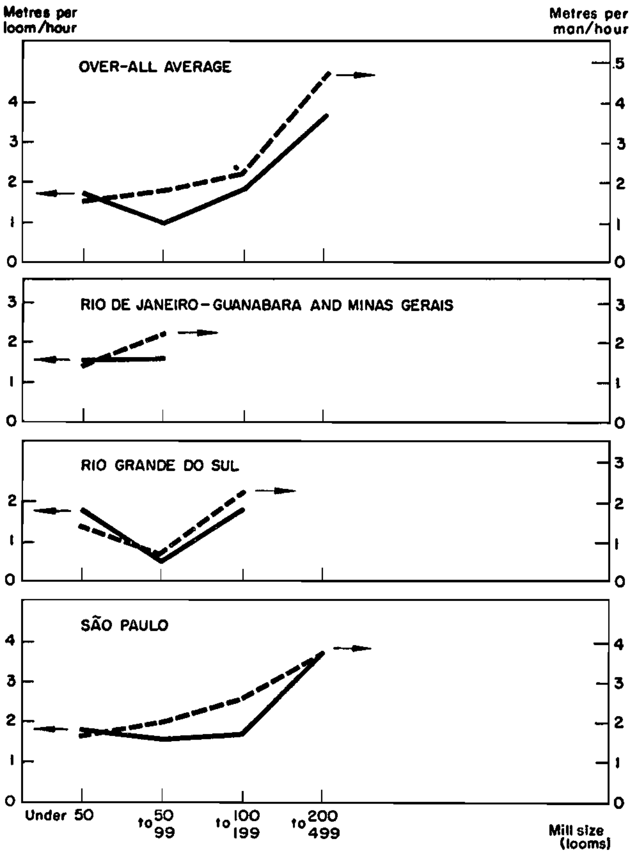
(c) *Comparison by state*

As in the cotton sector, unit output and productivity in wool weaving mills vary considerably from state to state (see table 93 and figure XVI). The unit output of 2.43 metres for Rio-Guanabara and Minas Gerais together, represents about 70 per cent of the standard adopted, but the productivity for this area represents only about 34 per cent of the standard level.

FIGURE XVI

UNIT OUTPUT AND PRODUCTIVITY IN WOOL WEAVING MILLS, BY MILL SIZE AND BY STATE

Natural scale




*Source:* ECLA survey.

(d) *Difference between automatic and non-automatic looms*

Table 94 shows the difference between unit output and productivity levels for automatic and non-automatic looms, for the labour employed in the weaving sector only. The increase in unit output through the use of automatic looms is more striking for wool than for cotton, since when wool is woven on non-automatic looms the bobbins have to be changed more often, and consequently more loom stoppages are eliminated by the introduction of automatic looms.

Productivity is more than doubled when automatic looms are used (in Rio-Guanabara and Minas Gerais nearly trebled) and the number of looms per worker is nearly doubled. However, the average number of looms per weaver is only 2.5, whereas it could be as much as 6; this indicates the need to improve the training of operatives.

## 8. UNIT OUTPUT AND PRODUCTIVITY IN WEAVING MILLS IN THE MAN-MADE FIBRE, FLAX AND JUTE SECTORS

(a) *Man-made fibres*

In the analysis of unit output and productivity in the weaving of man-made fibres, no distinction is drawn between continous filament yarn fabrics and staple yarn fabrics. Consequently the analysis could not be based on comparison with a single common standard.

Tables 95 and 96 show that the average number of picks per metre varies according to mill size and to the state (from 18 to 36 and from 21 to 27 picks per centimetre, respectively).

The most striking point is the high unit output and labour productivity in the top and bottom size categories. However, since in the under-50-loom group the number of picks per centimetre is only about 18, far below the average of 24.5, the difference in level is more apparent than real. In the top size category, on the contrary, where the number of picks per centimetre is close to the average, the high levels of unit output and, in particular, productivity, indicate an advanced degree of organization and mechanization. In these large mills the average number of looms per worker is over 4 (including all operatives employed in weaving and preparation for weaving), which represents a workload of about 12 looms per weaver, an acceptable figure for mills weaving man-made fibre yarns. The average worker/loom ratio is 1.75, not an unsatisfactory figure in view of the large number of non-automatic looms still operating in this sector.

In São Paulo and Minas Gerais the levels are above the over-all average. In São Paulo, pick density is at the average level, whereas in Minas Gerais it is lower, but in both the average workload is 1.8 looms per worker, including all workers employed in preparation for weav-

TABLE 93. UNIT OUTPUT AND PRODUCTIVITY, BY STATE

| | Number of mills (as a percentage of total) | Picks per linear metre | Unit output (metres per loom/hour) Actual | Unit output (metres per loom/hour) Weighted | Weighted unit output index | Productivity (metres per man/hour) Actual | Productivity (metres per man/hour) Weighted | Weighted productivity index |
|---|---|---|---|---|---|---|---|---|
| Rio de Janeiro, Guanabara and Minas Gerais . . . . . . . | 14.8 | 2,692 | 1.61 | 2.43 | 123 | 1.88 | 2.54 | 108 |
| Rio Grande do Sul . . | 8.6 | 1,820 | 1.63 | 1.47 | 74 | 1.94 | 1.75 | 75 |
| São Paulo . . . . . . | 76.6 | 1,963 | 2.10 | 2.10 | 106 | 2.48 | 2.48 | 106 |
| TOTAL | 100.0 | 2,033 | 1.98 | 1.98 | 100 | 2.34 | 2.34 | 100 |

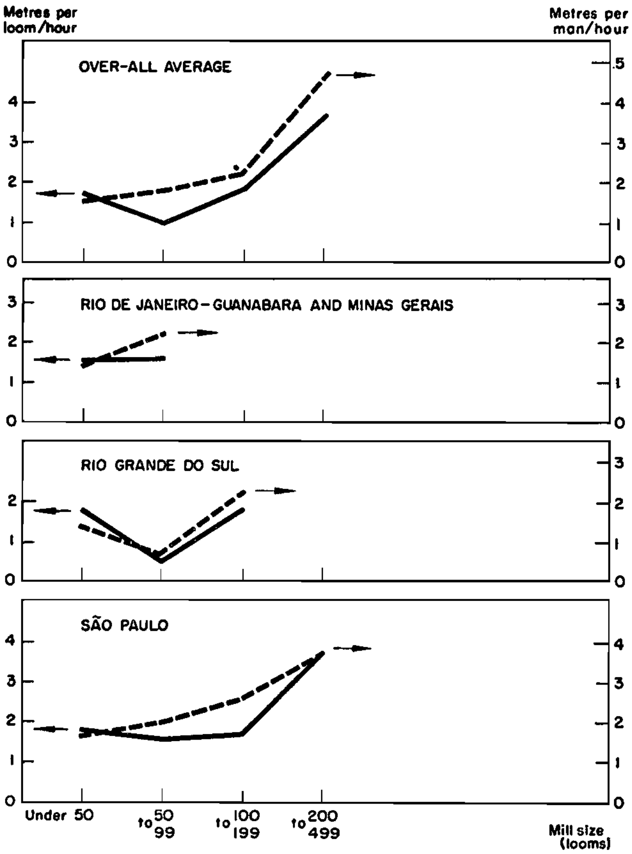
### (c) *Comparison by state*

As in the cotton sector, unit output and productivity in wool weaving mills vary considerably from state to state (see table 93 and figure XVI). The unit output of 2.43 metres for Rio-Guanabara and Minas Gerais together, represents about 70 per cent of the standard adopted, but the productivity for this area represents only about 34 per cent of the standard level.

FIGURE XVI

UNIT OUTPUT AND PRODUCTIVITY IN WOOL WEAVING MILLS, BY MILL SIZE AND BY STATE

Natural scale




*Source:* ECLA survey.

### (d) *Difference between automatic and non-automatic looms*

Table 94 shows the difference between unit output and productivity levels for automatic and non-automatic looms, for the labour employed in the weaving sector only. The increase in unit output through the use of automatic looms is more striking for wool than for cotton, since when wool is woven on non-automatic looms the bobbins have to be changed more often, and consequently more loom stoppages are eliminated by the introduction of automatic looms.

Productivity is more than doubled when automatic looms are used (in Rio-Guanabara and Minas Gerais nearly trebled) and the number of looms per worker is nearly doubled. However, the average number of looms per weaver is only 2.5, whereas it could be as much as 6; this indicates the need to improve the training of operatives.

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The most striking point is the high unit output and labour productivity in the top and bottom size categories. However, since in the under-50-loom group the number of picks per centimetre is only about 18, far below the average of 24.5, the difference in level is more apparent than real. In the top size category, on the contrary, where the number of picks per centimetre is close to the average, the high levels of unit output and, in particular, productivity, indicate an advanced degree of organization and mechanization. In these large mills the average number of looms per worker is over 4 (including all operatives employed in weaving and preparation for weaving), which represents a workload of about 12 looms per weaver, an acceptable figure for mills weaving man-made fibre yarns. The average worker/loom ratio is 1.75, not an unsatisfactory figure in view of the large number of non-automatic looms still operating in this sector.

In São Paulo and Minas Gerais the levels are above the over-all average. In São Paulo, pick density is at the average level, whereas in Minas Gerais it is lower, but in both the average workload is 1.8 looms per worker, including all workers employed in preparation for weav-

TABLE 93. UNIT OUTPUT AND PRODUCTIVITY, BY STATE

| | *Number of mills (as a percentage of total)* | *Picks per linear metre* | *Unit output (metres per loom/hour)* | | *Weighted unit output index* | *Productivity (metres per man/hour)* | | *Weighted productivity index* |
|---|---|---|---|---|---|---|---|---|
| | | | *Actual* | *Weighted* | | *Actual* | *Weighted* | |
| Rio de Janeiro, Guanabara and Minas Gerais | 14.8 | 2,692 | 1.61 | 2.43 | 123 | 1.88 | 2.54 | 108 |
| Rio Grande do Sul | 8.6 | 1,820 | 1.63 | 1.47 | 74 | 1.94 | 1.75 | 75 |
| São Paulo | 76.6 | 1,963 | 2.10 | 2.10 | 106 | 2.48 | 2.48 | 106 |
| TOTAL | 100.0 | 2,033 | 1.98 | 1.98 | 100 | 2.34 | 2.34 | 100 |

Automatic looms are still very inefficiently utilized, since their unit output of 3.50 metres per loom/hour represents only 70 per cent of the potential level, and the workload averages only 3 looms instead of 5 (the standard number). Even so, the foregoing data show the great advantages of replacing non-automatic by automatic looms. With automatic looms unit output increases by 70 per cent and productivity by 41 per cent, and although the latter figure is low, because of the employment of redundant workers, the use of automatic looms in this sector would obviously be highly advantageous.

TABLE 97. UNIT OUTPUT AND PRODUCTIVITY IN LINEN WEAVING MILLS, BY MILL SIZE

| Mill size (looms) | Number of mills (as a percentage of total) | Picks per square metre | Unit output (metres per loom/hour) Actual | Unit output (metres per loom/hour) Weighted | Weighted unit output index | Productivity (metres per man/hour) Actual | Productivity (metres per man/hour) Weighted | Weighted productivity index |
|---|---|---|---|---|---|---|---|---|
| Under 50 . . | 72.7 | 1,775 | 2.99 | 3.14 | 112 | 5.47 | 5.74 | 103 |
| 50 to 99 . . | 13.7 | 1,449 | 3.60 | 3.06 | 110 | 6.52 | 5.53 | 99 |
| 100 to 199 . | 13.6 | 1,807 | 2.19 | 2.32 | 83 | 5.03 | 5.33 | 95 |
| TOTAL | 100.0 | 1,710 | 2.78 | 2.78 | 100 | 5.58 | 5.58 | 100 |

### (c) *Jute*

The situation in jute weaving mills is outlined in table 98. The mills with over 500 looms have the highest unit output, probably because they use shuttle-less or circular looms, whose output is higher than that of non-automatic looms and even that of conventional automatic looms. However, the productivity in these mills is below the over-all average; in the 50-100-loom and 200-500-loom groups it is above average. Circular looms permit a very high output, as much as 30 kilogrammes an hour, which represents about 120 metres per hour of a fabric with a circumference of 100 centimetres; but an operative can tend no more than 3 looms, and if the efficiency with which the loom is utilized falls below the maximum, productivity does not exceed that of automatic looms operated on a basis of 20 to 40 looms per worker.

The data for the various states are presented in table 99.

The highest productivity is not in São Paulo, but in the Rio-Guanabara area. This may be because of the particularly inadequate training of labour in the State of São Paulo, or perhaps because the SENAI Textiles School in that state makes no provision for specialized vocational training of workers for the hard-fibre branches of the industry, especially with a view to providing foremen and assistant foremen with a thorough understanding of the use of up-to-date machines such as the circular and shuttle-less looms that are being installed in mills in the State of São Paulo.

TABLE 98. UNIT OUTPUT AND PRODUCTIVITY IN JUTE WEAVING MILLS, BY MILL SIZE

| Mill size (looms) | Number of mills (as a percentage of total) | Actual unit output (metres per loom/hour) | Actual unit output index | Actual productivity (metres per man/hour) | Actual productivity index |
|---|---|---|---|---|---|
| Under 50 . . . . . . . . . . . | 10 | 6.13 | 45 | 5.12 | 29 |
| 50 to 99 . . . . . . . . . . . | 20 | 12.71 | 92 | 22.41 | 126 |
| 100 to 199 . . . . . . . . . . . | 35 | 12.98 | 95 | 17.04 | 95 |
| 200 to 499 . . . . . . . . . . . | 20 | 12.55 | 91 | 25.21 | 141 |
| 500 to 999 . . . . . . . . . . . | 15 | 16.77 | 122 | 16.00 | 90 |
| TOTAL | 100 | 13.67 | 100 | 17.80 | 100 |

TABLE 99. UNIT OUTPUT AND PRODUCTIVITY IN JUTE WEAVING MILLS, BY STATE

| | Number of mills (as a percentage of total) | Actual unit output (metres per loom/hour) | Actual unit output index | Actual productivity (metres per man/hour) | Actual productivity index |
|---|---|---|---|---|---|
| Rio de Janeiro and Guanabara . . | 25 | 12.80 | 93 | 25.06 | 141 |
| Rio Grande do Sul . . . . . . . | 20 | 9.79 | 72 | 16.91 | 95 |
| São Paulo . . . . . . . . . . . | 55 | 14.55 | 106 | 16.03 | 90 |
| TOTAL | 100 | 13.67 | 100 | 17.80 | 100 |

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|---|---|---|---|---|---|---|---|---|
| | | | *Actual* | *Weighted* | | *Actual* | *Weighted* | |
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| Under 50 . . . . . . . . . . . | 10 | 6.13 | 45 | 5.12 | 29 |
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| São Paulo . . . . . . . . . . . | 55 | 14.55 | 106 | 16.03 | 90 |
| TOTAL | 100 | 13.67 | 100 | 17.80 | 100 |

humidity are maintained (by air conditioning and humidity control, where the local climate leads to considerable variations in these conditions), and how far the spinning room is kept clean (either by continual manual cleaning or by vacuum dust extraction systems). The second is the quality of the roving, which depends on the quality of the preparation for spinning, from the pre-scutcher blending to the production of the roving. The third is the count of the yarn produced, since yarn breaks tend to be more frequent for the finer counts, which require more careful spinning preparation.

Although unavoidable stoppages cannot be eliminated, they can nevertheless be reduced to a minimum if the mill is properly organized. The frequency of this type of stoppage is determined by (i) the yarn count, which governs the number of packages, in that the coarser the yarn the more rapidly the packages are formed; (ii) the dimension of the bobbins that deliver the roving to the drafting section of the ring frames; (iii) the dimension of the bobbins on which the spun yarn is wound (in a well-organized spinning section arrangements can be made to wind the finest yarns on the smallest bobbins in order to reduce bobbin changes) and (iv) the degree of standardization of production, which can reduce to a minimum the changes of setting of the ring frames.

### (*b*) *Productivity*

This is a function both of output — and consequently of the factors described above — and also of the workloads (the number of machines tended by one worker). Workloads are determined by three basic factors: (i) the level of training of the workers (which the management should raise through continuous improvement of the training of the supervisors responsible for instructing the workers); (ii) the frequency of yarn breaks (caused by the factors described above under unit output), which lead to both loss of output and a loss of production time for the workers, and (iii) the workers' machine-tending capacity, which is determined by the same factors that determine unavoidable machine stoppages.

It was found that the atmospheric conditions and the cleanness of the spinning room, the quality of the roving, the yarn count, and the size of the roving bobbins and of the yarn packages, can all have a double effect on productivity by reducing output and increasing the number of workers needed to obtain it.

It should be noted that in spinning preparation the limiting factors are much the same as in spinning proper, and the ill effects of both sets of factors combine to reduce over-all spinning productivity. The same is true for one winding, which has been treated as an integral part of the whole spinning section.

In tables 100 and 101 the limiting factors that appear most frequently are (i) the yarn count; (ii) the quality of the cotton, which sets the pattern for the whole chain of intermediate products and for the final product; (iii) the atmospherie conditions in the spinning sections and their cleanness, and (iv) the degree of standardization. The fact that no mill was found capable of overcoming all the factors that limit output and productivity is sufficient explanation of the dispersion in the spinning productivity figures. In weaving, even more factors are involved.

It should also be noted that when a mill processes blends of various natural and man-made fibres the number of different blends dealt with simultaneously has a considerable effect on productivity, and an additional factor, in these cases, is the size of the consignments supplied for processing.

TABLE 100. FACTORS AFFECTING UNIT OUTPUT AND PRODUCTIVITY IN PREPARATION FOR SPINNING IN COTTON MILLS EQUAL AS TO SIZE, MACHINERY OBSOLESCENCE AND MACHINERY MAINTENANCE

| | | | |
|---|---|---|---|
| (1) *Unit output* | | | |
| *Machinery speed* determined by | Quality of the raw cotton<br>Cleanness of the raw cotton<br>Operational process (carding or combing)<br>Yarn count produced | | |
| *Machine efficiency* determined by | Frequency of sliver or roving breaks | dependent on | Atmospheric conditions and cleanness<br>Quality of the raw cotton<br>Yarn count produced |
| | Unavoidable stoppage | dependent on | Size of the consignments received for processing<br>Type of machine<br>Size of the receptacles used |
| (2) *Productivity* | | | |
| *Number of machines used* determined by | Operational process (carding or combing)<br>Yarn count produced | | |
| *Workloads* determined by | Training of workers | | |
| | Frequency of breaks | dependent on | Atmospheric conditions and cleanness<br>Quality of the raw cotton<br>Yarn count produced |
| | Workers' machine-tending capacity | dependent on | Type of machine<br>Size of the receptacles used<br>Size of the consignments<br>Regularity of the material produced at the preceding stage |

humidity are maintained (by air conditioning and humidity control, where the local climate leads to considerable variations in these conditions), and how far the spinning room is kept clean (either by continual manual cleaning or by vacuum dust extraction systems). The second is the quality of the roving, which depends on the quality of the preparation for spinning, from the pre-scutcher blending to the production of the roving. The third is the count of the yarn produced, since yarn breaks tend to be more frequent for the finer counts, which require more careful spinning preparation.

Although unavoidable stoppages cannot be eliminated, they can nevertheless be reduced to a minimum if the mill is properly organized. The frequency of this type of stoppage is determined by (i) the yarn count, which governs the number of packages, in that the coarser the yarn the more rapidly the packages are formed; (ii) the dimension of the bobbins that deliver the roving to the drafting section of the ring frames; (iii) the dimension of the bobbins on which the spun yarn is wound (in a well-organized spinning section arrangements can be made to wind the finest yarns on the smallest bobbins in order to reduce bobbin changes) and (iv) the degree of standardization of production, which can reduce to a minimum the changes of setting of the ring frames.

### (*b*) *Productivity*

This is a function both of output — and consequently of the factors described above — and also of the workloads (the number of machines tended by one worker). Workloads are determined by three basic factors: (i) the level of training of the workers (which the management should raise through continuous improvement of the training of the supervisors responsible for instructing the workers); (ii) the frequency of yarn breaks (caused by the factors described above under unit output), which lead to both loss of output and a loss of production time for the workers, and (iii) the workers' machine-tending capacity, which is determined by the same factors that determine unavoidable machine stoppages.

It was found that the atmospheric conditions and the cleanness of the spinning room, the quality of the roving, the yarn count, and the size of the roving bobbins and of the yarn packages, can all have a double effect on productivity by reducing output and increasing the number of workers needed to obtain it.

It should be noted that in spinning preparation the limiting factors are much the same as in spinning proper, and the ill effects of both sets of factors combine to reduce over-all spinning productivity. The same is true for one winding, which has been treated as an integral part of the whole spinning section.

In tables 100 and 101 the limiting factors that appear most frequently are (i) the yarn count; (ii) the quality of the cotton, which sets the pattern for the whole chain of intermediate products and for the final product; (iii) the atmospherie conditions in the spinning sections and their cleanness, and (iv) the degree of standardization. The fact that no mill was found capable of overcoming all the factors that limit output and productivity is sufficient explanation of the dispersion in the spinning productivity figures. In weaving, even more factors are involved.

It should also be noted that when a mill processes blends of various natural and man-made fibres the number of different blends dealt with simultaneously has a considerable effect on productivity, and an additional factor, in these cases, is the size of the consignments supplied for processing.

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| | | | |
|---|---|---|---|
| (1) *Unit output* | | | |
| *Machinery speed* determined by | Quality of the raw cotton<br>Cleanness of the raw cotton<br>Operational process (carding or combing)<br>Yarn count produced | | |
| *Machine efficiency* determined by | Frequency of sliver or roving breaks | dependent on | Atmospheric conditions and cleanness<br>Quality of the raw cotton<br>Yarn count produced |
| | Unavoidable stoppage | dependent on | Size of the consignments received for processing<br>Type of machine<br>Size of the receptacles used |
| (2) *Productivity* | | | |
| *Number of machines used* determined by | Operational process (carding or combing)<br>Yarn count produced | | |
| *Workloads* determined by | Training of workers | | |
| | Frequency of breaks | dependent on | Atmospheric conditions and cleanness<br>Quality of the raw cotton<br>Yarn count produced |
| | Workers' machine-tending capacity | dependent on | Type of machine<br>Size of the receptacles used<br>Size of the consignments<br>Regularity of the material produced at the preceding stage |

TABLE 103. FACTORS AFFECTING UNIT OUTPUT (IN TERMS OF PICKS) AND PRODUCTIVITY IN WEAVING IN COTTON MILLS EQUAL AS TO SIZE, MACHINERY OBSOLESCENCE AND MACHINERY MAINTENANCE

| | Determined by | | Dependent on |
|---|---|---|---|
| (1) *Unit output* | | | |
| *Loom speed* determined by | Width of loom | | |
| | Type of loom (plain, check, dobby or jacquard) | | |
| | Type of weave (taffeta, serge, satin, etc.) | | |
| | Warp and weft density (number of threads per centimetre or inch) | | |
| | Number of plain weaves | | |
| | Frequency of yarn breaks | dependent on | Atmospheric conditions and cleanness |
| | | | Quality of yarn and weaving preparation |
| | | | Count of warp yarn |
| | | | Count of weft yarn |
| | Frequency of unavoidable loom stoppages | dependent on | Size of pirn (for non-automatic looms) |
| | | | Length of warp |
| | | | Degree of standardization of production |
| (2) *Productivity* | | | |
| *Workloads* determined by | Training of workers | | |
| | Frequency of yarn breaks | dependent on | Atmospheric conditions and cleanness |
| | | | Quality of the yarn and weaving preparation |
| | | | Warp and weft density |
| | | | Count of warp and weft yarn |
| | Workers' machine-tending capacity | dependent on | Type of loom |
| | | | Width of loom |
| | | | Warp and weft density |
| | | | Type of weave |
| | | | Shuttle changes (for non-automatic looms) |

Although some of the factors involved cannot be controlled without additional investment, a detailed study by the mill management may make it possible to confine the investment to what is essential. This applies to the selection of the technical level suitable for the circumstances both of the mill itself and of the country in general, a reasonable degree of modernization of obsolete equipment, and air conditioning and humidity control.

Many of the limiting factors, however, are directly controllable by good management, without the need for any substantial investment, by means of systematic machinery maintenance and regular cleaning of machinery and workrooms; the selection of good raw cotton; the standardization of production that can often be effected by sound production planning and proper training of the labour force.

Some problems can be solved without any investment; for example, strict control of wastage will reduce the cost of raw material; control of machine stoppages, avoidable or unavoidable, will increase both the efficiency of the machinery and labour productivity; time studies of the machinery operations will permit calculation of reasonable and efficient workloads; frank and friendly relations between management and workers will lead to a fruitful co-operation that will increase output and productivity; and systematic studies of the operational processes will make it possible to reduce production times and increase output, generally with a reduction in the physical effort required from the worker.

Thus it is clear that the better organized mills can overcome the problems caused by the factors that reduce productivity and obtain better results than mills that ignore these problems; that is, the differences in productivity found between mills that are equal as to size and obsolescence of the equipment are due to the effort made to overcome the problems in question.

### 3. BREAKDOWN OF THE OVER-ALL OPERATIONAL DEFICIENCY

For the purpose of analysing the factors that affect productivity levels, the concept of the "over-all operational deficiency" was used. In essence this represents the ratio between the results actually obtained in the productive process and those that could be obtained in an optimum situation with completely modern machinery and normal working conditions. However, there is a third situation, midway between the existing

TABLE 103. FACTORS AFFECTING UNIT OUTPUT (IN TERMS OF PICKS) AND PRODUCTIVITY IN WEAVING IN COTTON MILLS EQUAL AS TO SIZE, MACHINERY OBSOLESCENCE AND MACHINERY MAINTENANCE

| | | | | |
|---|---|---|---|---|
| (1) *Unit output* | | | | |
| *Loom speed* | determined by | Width of loom<br>Type of loom (plain, check, dobby or jacquard)<br>Type of weave (taffeta, serge, satin, etc.)<br>Warp and weft density (number of threads per centimetre or inch)<br>Number of plain weaves | | |
| | | Frequency of yarn breaks | dependent on | Atmospheric conditions and cleanness<br>Quality of yarn and weaving preparation<br>Count of warp yarn<br>Count of weft yarn |
| | | Frequency of unavoidable loom stoppages | dependent on | Size of pirn (for non-automatic looms)<br>Length of warp<br>Degree of standardization of production |
| (2) *Productivity* | | | | |
| *Workloads* | determined by | Training of workers | | |
| | | Frequency of yarn breaks | dependent on | Atmospheric conditions and cleanness<br>Quality of the yarn and weaving preparation<br>Warp and weft density<br>Count of warp and weft yarn |
| | | Workers' machine-tending capacity | dependent on | Type of loom<br>Width of loom<br>Warp and weft density<br>Type of weave<br>Shuttle changes (for non-automatic looms) |

Although some of the factors involved cannot be controlled without additional investment, a detailed study by the mill management may make it possible to confine the investment to what is essential. This applies to the selection of the technical level suitable for the circumstances both of the mill itself and of the country in general, a reasonable degree of modernization of obsolete equipment, and air conditioning and humidity control.

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Thus it is clear that the better organized mills can overcome the problems caused by the factors that reduce productivity and obtain better results than mills that ignore these problems; that is, the differences in productivity found between mills that are equal as to size and obsolescence of the equipment are due to the effort made to overcome the problems in question.

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TABLE 104. EFFECT OF MACHINERY OBSOLESCENCE ON OVER-ALL OPERATIONAL DEFICIENCY IN TWENTY-FIVE SPINNING MILLS GROUPED BY WEIGHTED PRODUCTIVITY LEVEL (BASED ON YARN COUNT 18)

| Productivity (grammes per man/hour) | Number of mills | Total spindles | W.M.H.W.[a] Existing | W.M.H.W.[b] Future | W.M.H.W.[c] Existing improved | Over-all operational deficiency (OOD) | Existing machinery deficiency (EMD) | Machinery obsolescence | Existing deficiency (As percentage of the over-all operational deficiency) | Existing machinery obsolescence (EMO) (As percentage of the over-all operational deficiency) |
|---|---|---|---|---|---|---|---|---|---|---|
| Under 2,000 . . . . | 9 | 249,281 | 44,659,261 | 17,062,616 | 20,415,758 | 261 | 218 | 43 | 74 | 26 |
| 2,001 to 3,000 . . . | 4 | 49,306 | 7,549,521 | 4,716,702 | 5,532,616 | 160 | 139 | 21 | 55 | 35 |
| 3,001 to 4,000 . . . | 6 | 110,316 | 19,270,547 | 12,491,325 | 14,488,649 | 154 | 133 | 21 | 60 | 40 |
| 4,001 to 5,000 . . . | 2 | 69,812 | 13,077,807 | 6,778,491 | 8,651,755 | 193 | 151 | 42 | 55 | 45 |
| 5,001 to 6,000 . . . | 2 | 45,534 | 8,244,585 | 5,861,894 | 6,859,613 | 140 | 120 | 20 | 50 | 50 |
| Over 6,000 . . . . | 2 | 18,044 | 4,541,002 | 3,926,344 | 4,421,518 | 115 | 103 | 12 | 20 | 80 |
| | 25 | 542,293 | 97,342,800 | 50,837,200 | 60,369,700 | 191 | 161 | 30 | 67 | 33 |

*Source:* ECLA.

[a] Weighted machine/hours worked according to the present operational chart.

[b] Weighted machine/hours worked according to the future operational chart.

[c] Theoretical weighted machine/hours worked with existing machinery operating at a level of efficiency equal to the standard adopted.

Table 105 and figure XVIII show the incidence of the EMO by mill size. Strangely enough, it is in the mills with under 20,000 spindles that this incidence is highest and the EMD lowest. In the mills with over 30,000 spindles the reverse is true. This may be due to the fact that in the small and medium-size mills the owner has more direct influence than in the larger mills, and can thus keep a closer watch on the situation, apart from the greater ease of administering and organizing a smaller plant. In addition the larger mills have often expanded in a haphazard fashion without careful planning, and thus have serious layout problems that hamper the production flow and reduce operating efficiency. In any case, the larger the mill, the more complex the administrative problems and the more organizational deficiencies make themselves felt. In the light of all the factors that affect a plant's efficiency, and on the basis of an analysis of the results obtained in a number of Latin American industries, the ideal size, in present conditions in Latin America, would appear to be between 20,000 and 30,000 spindles.[4] In fact the recent study on the textile industry in Chile[5] showed that the highest productivity is not found in the largest mills, because of the organizational problems that arise, largely as a result of the shortage of high-level technical and administrative personnel in the industry.

A reservation should be made as regards the exclusion from the sample group of large modern mills with a high operational efficiency. As a general rule such mills are partly foreign-owned, and many of them have already been brought up to date by means of new machinery supplied in the form of investment without exchange coverage.

As regards the OOD, table 105 shows that it increases with mill size from 149 to 291, which confirms the above finding that the larger mills are those that most need reorganizing (see chapter V on the effect of size on unit output and productivity in cotton spinning mills).

[4] It is interesting to note that the study carried out by ELCA in 1951 led to the same conclusion as to the ideal size, which was suggested as 25,000 spindles, for the same reason, namely the general difficulties of control and administration in large mills.

[5] *La industria textil en América Latina. I. Chile* (United Nations publication, Sales No.: 63.II.G.5).

TABLE 105. EFFECT OF MACHINERY OBSOLESCENCE ON OVER-ALL OPERATIONAL DEFICIENCY IN TWENTY-FIVE SPINNING MILLS BY MILL SIZE

| Size | Number of mills | Total spindles | W.M.H.W.[a] Existing | W.M.H.W.[b] Future | W.M.H.W.[c] Existing improved | Over-all operational deficiency (OOD) | Existing machinery deficiency (EMD) | Machinery obsolescence | Existing deficiency (As a percentage of the over-all operational deficiency) | Existing machinery obsolescence (EMO) (As a percentage of the over-all operational deficiency) |
|---|---|---|---|---|---|---|---|---|---|---|
| Under 10,000 spindles . | 7 | 44,120 | 7,123,574 | 4,758,056 | 5,494,730 | 149 | 129 | 20 | 59 | 41 |
| 10,001 to 20,000 spindles | 8 | 108,660 | 22,143,361 | 14,590,205 | 17,438,767 | 150 | 127 | 23 | 54 | 46 |
| 20,001 to 30,000 spindles | 4 | 100,334 | 15,139,848 | 9,537,057 | 10,384,638 | 159 | 146 | 13 | 78 | 22 |
| 30,001 to 50,000 spindles | 4 | 155,482 | 24,435,434 | 12,168,784 | 13,421,863 | 201 | 182 | 19 | 81 | 19 |
| Over 50,000 spindles . | 2 | 133,697 | 28,500,506 | 9,783,170 | 13,624,711 | 291 | 270 | 21 | 89 | 11 |
| | 25 | 542,293 | 97,342,800 | 50,837,200 | 60,369,700 | 191 | 161 | 30 | 67 | 33 |

*Source:* ECLA.

[a] Weighted machine/hours worked according to the present operational chart.

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[c] Theoretical weighted machine/hours worked with existing machinery operating at a level of efficiency equal to the standard adopted.

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| Productivity (grammes per man/hour) | Number of mills | Total spindles | W.M.H.W.[a] Existing | W.M.H.W.[b] Future | W.M.H.W.[c] Existing improved | Over-all operational deficiency (OOD) | Existing machinery deficiency (EMD) | Machinery obsolescence | Existing deficiency (As percentage of the over-all operational deficiency) | Existing machinery obsolescence (EMO) (As percentage of the over-all operational deficiency) |
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As regards the OOD, table 105 shows that it increases with mill size from 149 to 291, which confirms the above finding that the larger mills are those that most need reorganizing (see chapter V on the effect of size on unit output and productivity in cotton spinning mills).

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| Size | Number of mills | Total spindles | W.M.H.W.[a] Existing | W.M.H.W.[b] Future | W.M.H.W.[c] Existing improved | Over-all operational deficiency (OOD) | Existing machinery deficiency (EMD) | Machinery obsolescence | Existing deficiency (As a percentage of the over-all operational deficiency) | Existing machinery obsolescence (EMO) (As a percentage of the over-all operational deficiency) |
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TABLE 106. RATIO OF PRODUCTIVITY ($X_1$) TO OBSOLESCENCE OF SPINNING EQUIPMENT ($X_2$) AND MILL SIZE ($X_3$)

| *Count of yarn produced* | *Number of mills* | *Correlation coefficient* ($R_{1.23}$) | *Percentage of deviation from over-all output explained by* $X_2$ | $X_3$ | *Standard deviation* |
|---|---|---|---|---|---|
| Under 15 | 43 | 0.438 | 5.8 | 13.2 | 520 |
| 15 to 19 | 38 | 0.473 | 20.3 | 1.9 | 662 |
| 20 to 29 | 73 | 0.645 | 41.4 | 0.2 | 696 |
| 30 to 39 | 38 | 0.349 | 12.1 | 0.1 | 1,367 |
| Over 40 | 12 | 0.464 | 17.9 | 3.6 | 1,082 |
| All counts | 204 | 0.379 | 11.0 | 3.4 | 1,011 |

NOTE: The significance levels of the correlations are as follows: for the mills as a whole and for yarn count group 20 to 29, 1 to 1,000; for the 15 to 19 group, 1 to 100, and for the under 15 group, 5 to 100. The correlations of the other count groups are insignificant.

with 2,400 spindles, classified as 200 per cent obsolete. On the other hand, an equally obsolete mill with 2,100 spindles had the lowest productivity rate, about one-fourth that of the first mill. The most modern mill, only 18 per cent obsolete, had the fourth highest productivity. For count 22, the largest mill had the same productivity level as an equally up-to-date small mill (4,800 spindles). Except for these two extreme cases, productivity levels in this group are fairly similar.

For the yarn count 30 group, the degree of obsolescence (about 70 per cent) is less unequal than in the other groups considered. The highest productivity (6,217 grammes) was found in a mill with a 62 per cent obsolescence and 11,000 spindles. One other mill had a high productivity, but the productivity of the remaining 10 mills ranged from 1,200 to 2,800 grammes.

In the group producing yarn of count 40 and above, productivity ranged from 967 to 4,520 grammes (a ratio of 1 to 5) in mills with a similar degree of obsolescence. A mill with 87,000 spindles had the lowest productivity and a mill with 39,000 spindles the highest.

The above examples show that there is little connexion between mill size and productivity, and that obsolescence plays only a very limited part.

(ii) *Cotton weaving*

For this branch the analysis covers the effect on productivity, of the type of loom, the degree of obsolescence, mill size (number of looms) and average fabric width.

The group selected comprised 173 mills all operating with a single type of loom — 85 with plain looms, 61 with dobby looms and 27 with check looms — which together represent nearly 41 per cent of the total production of the Centro-Sul region of Brazil.

The *plain-loom mills* had a total of 14,500 looms, and in 1960 produced 24,238,000 metres of fabric, with an average weighted productivity of 11.3 metres per man-hour. The output of individual mills ranged from 1.0 to 30.4 metres per man-hour. Table 107 shows that for the mills as a whole 35.6 per cent of the variation in productivity could be accounted for, 10.4 per cent being due to obsolescent equipment, 11.2 per cent to the average width of the fabric produced, and 14 per cent to mill size. The remaining 64.6 per cent of the discrepancy must be regarded as beyond quantitative analysis. This is true, for instance, of such human factors as organization and administration.

TABLE 107. RATIO OF WEAVING PRODUCTIVITY ($X_1$) TO MACHINERY OBSOLESCENCE ($X_2$), MILL SIZE ($X_3$) AND FABRIC WIDTH ($X_4$) IN MILLS USING PLAIN LOOMS

| *Type of fabric produced* | *Number of mills* | *Correlation coefficient* ($R_{1.234}$) | *Variation* *Total* | *Explained* | *Standard deviation* |
|---|---|---|---|---|---|
| Less than 1 metre wide and an average yarn count of less than 15 | 20 | 0.704 | 314 | 156 | 273 |
| Less than 1 metre wide and an average yarn count of over 30 | 16 | 0.717 | 870 | 447 | 336 |
| Less than 1 metre wide and yarns of all counts | 68 | 0.560 | 2,217 | 696 | 1,095 |
| Fabrics of all types | 85 | 0.597 | 2,960 | 1,054 | 1,241 |

NOTE: The levels of significance of the correlations are: for all looms, 1 to 1,000; for the under 15 count group, 1 to 100, and for the over 30 count group, 5 to 100. The correlation for the other count group is insignificant.

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is operating, and to indicate the most promissing lines of action for improving those conditions.

(b) *Effect of diversification of production*

Another factor that may affect productivity levels in addition to those considered above is diversification of production. It has been suggested that excessive diversification, that is, production of many different items, may reduce productivity because the machine stoppages needed to change over to another product result in lost time and thus, in lower output per machine and per worker. While this appears plausible at first sight, it requires further analysis, since the effect of diversification can vary considerably according to how it is defined.

In its simplest form, diversification represents the number of different items manufactured by a mill. But this may apply either to the total range of products manufactured over a given period, or to the number of items produced simultaneously at a given moment. The latter criterion is obviously more relevant as far as productivity is concerned, since simultaneous manufacture of a great many products can result in diseconomies due to the changes and stoppages required. Diversification over a period of a year, on the other hand, may represent merely consecutive seasonal changes of products, and production may continue unchanged for several months.

Another aspect to be taken into account is mill size, since diversification has less effect on productivity in a large mill, and more in a small mill. A large textile mill can easily manufacture a number of products simultaneously without affecting its production flow, whereas diversification in a small mill tends to result in an unbalanced and hence uneconomic production.

Thus attention can be focused mainly on the smaller mills, which are under the greatest pressure — especially in countries with a limited domestic market — to produce a wide range of articles to meet the consumer's requirements. This leads inevitably to the comment (even though it goes beyond the scope of the present chapter) that such a situation could be remedied by the opening-up of regional markets.

A quantitative estimate of the effect of diversification on productivity was hampered by the failure to reach any definition of diversification that was acceptable to all the mills studied. The data obtained on this point by a supplementary survey of several cotton spinning and weaving mills do not suffice for a systematic analysis with a view to quantifying the effect of diversification. Nevertheless, it may be of interest to present, for illustrative purposes, a few isolated data from the survey. Spinning mill production was found to vary from a single count of yarn throughout the year to fifteen different yarn counts produced simultaneously during the same period. Some mills produce twelve types of yarn during the year, eight of which are manufactured simultaneously. Replies to the questionnaires seem to show that diversification of production is largely continuing, that is, the number of yarns manufactured at any given time is approximately the same as the total number of yarns manufactured during the year. One notable exception is a mill producing five different types of yarn in a year, but only one at a time.

As regards mill size, in some cases 10,000 spindles or more are used for the manufacture of a single yarn count, whereas in other cases the theoretical average number of spindles for one count of yarn is less than 50. In the study on the textile industry in Chile[8] it was estimated that the average number of spindles per yarn count ranged from about 800 to approximately 2,500, according to mill size; this is below the level of 4,000 spindles per count which is considered satisfactory.

Comments on weaving mills will also have to be confined, for the reasons explained above, to a few observations taken from the questionnaires. These reveal that the number of looms per fabric ranges from a minimum of two to a maximum of 198, though in most cases the ratio is between ten and fifty looms per fabric. Chilean data for average groups of mills according to size indicate a range from five to thirty-seven looms per fabric, and a study of individual mills indicates that the maximum figure for Chile is eighty-one looms per fabric.

To obtain some idea of the effect of diversification on weaving, account should be taken of the quantity of each fabric produced and the lost time due to changeovers. For want of complete data on which to base such an estimate for the Brazilian mills, a hypothetical calculation is presented which may provide some orientation. Given that: (i) the length of the warp beam varies from a minimum of 700 to a maximum of 2,000 metres; (ii) the lost time for every change of warp beam ranges from half an hour to one and a half hours; (iii) the number of picks per hour, according to type and width of loom, ranges from 6,000 to 10,800 and (iv) the fabric contains 1,972 picks per metre, then the minimum effect of diversification, that is the change of fabric, would represent only 0.075 per cent of the time taken by the loom to produce a given fabric, while the maximum effect would not exceed 1.150 per cent of that time.[9]

These minimum and maximum levels, of course, indicate only the limits of variation of the effect of diversification for the above hypotheses.

These figures indicate that in cotton weaving the effect of diversification is apparently insignificant. The effect might perhaps be greater in spinning, preparation for spinning, and fabric processing. In fact diversification is likely to have a greater effect in spinning and weaving preparation. Frequent changes in the material processed by the scutcher, cards and other spinning preparation processes require frequent machine stoppages, and cause lost time at each stage. In a fully integrated mill these repeated production losses, plus those that occur in spinning, winding and preparation for weaving, can easily triple or quadruple the estimated loss in productivity in the weaving section caused by frequent changes of warp beams.

Where a wide range of blends is processed, as in the man-made fibre industry, productivity is progressively reduced as the number of different blends processed in-

[8] *La industria textil en América Latina. I. Chile, op. cit.*

[9] According to the following calculations:

$$\text{Minimum} \quad i' = \frac{0.50\ (100)}{\dfrac{2{,}000 \times 1{,}972 + 0.50}{6{,}000}} = 0.075$$

$$\text{Maximum} \quad i'' = \frac{1.50\ (100)}{\dfrac{700 \times 1{,}972 + 1.50}{10{,}800}} = 1.150$$

is operating, and to indicate the most promissing lines of action for improving those conditions.

### (b) *Effect of diversification of production*

Another factor that may affect productivity levels in addition to those considered above is diversification of production. It has been suggested that excessive diversification, that is, production of many different items, may reduce productivity because the machine stoppages needed to change over to another product result in lost time and thus, in lower output per machine and per worker. While this appears plausible at first sight, it requires further analysis, since the effect of diversification can vary considerably according to how it is defined.

In its simplest form, diversification represents the number of different items manufactured by a mill. But this may apply either to the total range of products manufactured over a given period, or to the number of items produced simultaneously at a given moment. The latter criterion is obviously more relevant as far as productivity is concerned, since simultaneous manufacture of a great many products can result in diseconomies due to the changes and stoppages required. Diversification over a period of a year, on the other hand, may represent merely consecutive seasonal changes of products, and production may continue unchanged for several months.

Another aspect to be taken into account is mill size, since diversification has less effect on productivity in a large mill, and more in a small mill. A large textile mill can easily manufacture a number of products simultaneously without affecting its production flow, whereas diversification in a small mill tends to result in an unbalanced and hence uneconomic production.

Thus attention can be focused mainly on the smaller mills, which are under the greatest pressure — especially in countries with a limited domestic market — to produce a wide range of articles to meet the consumer's requirements. This leads inevitably to the comment (even though it goes beyond the scope of the present chapter) that such a situation could be remedied by the opening-up of regional markets.

A quantitative estimate of the effect of diversification on productivity was hampered by the failure to reach any definition of diversification that was acceptable to all the mills studied. The data obtained on this point by a supplementary survey of several cotton spinning and weaving mills do not suffice for a systematic analysis with a view to quantifying the effect of diversification. Nevertheless, it may be of interest to present, for illustrative purposes, a few isolated data from the survey. Spinning mill production was found to vary from a single count of yarn throughout the year to fifteen different yarn counts produced simultaneously during the same period. Some mills produce twelve types of yarn during the year, eight of which are manufactured simultaneously. Replies to the questionnaires seem to show that diversification of production is largely continuing, that is, the number of yarns manufactured at any given time is approximately the same as the total number of yarns manufactured during the year. One notable exception is a mill producing five different types of yarn in a year, but only one at a time.

As regards mill size, in some cases 10,000 spindles or more are used for the manufacture of a single yarn count, whereas in other cases the theoretical average number of spindles for one count of yarn is less than 50. In the study on the textile industry in Chile[8] it was estimated that the average number of spindles per yarn count ranged from about 800 to approximately 2,500, according to mill size; this is below the level of 4,000 spindles per count which is considered satisfactory.

Comments on weaving mills will also have to be confined, for the reasons explained above, to a few observations taken from the questionnaires. These reveal that the number of looms per fabric ranges from a minimum of two to a maximum of 198, though in most cases the ratio is between ten and fifty looms per fabric. Chilean data for average groups of mills according to size indicate a range from five to thirty-seven looms per fabric, and a study of individual mills indicates that the maximum figure for Chile is eighty-one looms per fabric.

To obtain some idea of the effect of diversification on weaving, account should be taken of the quantity of each fabric produced and the lost time due to changeovers. For want of complete data on which to base such an estimate for the Brazilian mills, a hypothetical calculation is presented which may provide some orientation. Given that: (i) the length of the warp beam varies from a minimum of 700 to a maximum of 2,000 metres; (ii) the lost time for every change of warp beam ranges from half an hour to one and a half hours; (iii) the number of picks per hour, according to type and width of loom, ranges from 6,000 to 10,800 and (iv) the fabric contains 1,972 picks per metre, then the minimum effect of diversification, that is the change of fabric, would represent only 0.075 per cent of the time taken by the loom to produce a given fabric, while the maximum effect would not exceed 1.150 per cent of that time.[9]

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## 5. Implications for a textile industry policy

The foregoing attempts to identify and evaluate some of the factors influencing productivity clearly indicate that it is virtually impossible to determine the individual effect on productivity of each factor involved, or explain the variations between mills as regards the incidence of each factor. The study of the twenty-five old spinning mills showed that only one-third of their total deficiency is due to obsolete equipment. The sample of spinning mills of different sizes and at varying stages of up-to-dateness also revealed a fairly weak correlation between these two factors and productivity, although in a sample of weaving mills which also took account of the type of loom used, the correlation between the three factors was somewhat more marked. Even so, most of the variation in productivity in relation to the average could not be explained by these factors. For weaving mills the diversification factor was introduced, and although it was not possible to make a systematic analysis, it appeared that in the loom section this factor had no significant effect on productivity. However, it seems clear that in a vertically integrated weaving mill as a whole diversification could affect productivity considerably, especially in small mills.

It will be seen from the foregoing that what might be called physical factors or production characteristics do not explain the sharp variations in productivity levels in Brazilian mills. Consequently, after studying the limited data available, it must be concluded that the explanation of that part of the variation in productivity not attributable to the physical factors involved must be looked for in the human factors in the production process. The most important is mill management, including the whole concept of the entrepreneur's or manager's responsibility as regards use of satisfactory raw material, careful machinery maintenance, manpower training and so forth. The question arises whether manpower training is the direct responsibility of the entrepreneur or whether he should make use of the services of existing training institutions. The plain fact is that labour productivity in some mills is many times that in others, and the explanation of such very different results in the same country would appear to be the concern of the entrepreneur. Differences in productivity, given the same conditions of obsolescence, mill size and even type of product, call for a more searching analysis, which is beyond the scope of the present study. Nevertheless, a more thorough knowledge of the reasons for this situation and of the role played therein by the entrepreneur will contribute to the more efficient operation of Brazil's textile industry.

The apparent co-existence, within so wide a market as Brazil's, of factories whose productive results are so different raises the question of how these differences are reflected in final production costs, and what variations exist in this respect. From the standpoint of the possible reorganization or remodelling of the industry in view of the opening up of prospective new markets through regional economic integration (and the reciprocal opening up of the Brazilian market for textile goods from the region), production costs (in which labour, and consequently productivity represents the most important input after raw materials) will become a key factor. At the same time the existence in one country of mills working under optimum conditions side-by-side with others where conditions are sadly deficient proves that the levels regarded as optimum can be attained even under existing conditions. For the inefficient mills, attaining these standards might require some time, and perhaps provision of appropriate incentives, but there do not appear to be any insuperable difficulties since the more progressive mills have been able to reach their present standard with the resources now available. The foregoing implies also, *inter alia*, that Brazil possesses sufficient know-how to attain productivity levels comparable with those of Europe, and that this kind of knowledge — whether administrative or technical — could well be channelled into an effort to reorganize the industry on a rational basis to meet future requirements.

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certain cases, voluntary benefits provided by industrialists. Of the total of seventeen mills that constituted the sample reviewed in the brief special survey, it was found that ten gave a Christmas bonus varying from a minimum of 0.5 per cent to a maximum of 11.7 per cent of the wage paid, the average being about 3 per cent; thirteen provided social welfare and medical services to the value of approximately 0.3 to 12 per cent; three maintained voluntary services for primary education and vocational training at an average cost of 1 per cent; three granted study fellowships, and two offered general unspecified benefits equivalent to slightly over 1 per cent. The voluntary benefits given in addition to the 43 per cent exacted by law account for an average of 5.5 per cent of the wage. To generalize from these few observations, the charges over and above the wage may therefore be estimated to represent an average of 48 to 50 per cent, i.e., in the case of a monthly wage of 10,000 cruzeiros, the various social welfare contributions would average 4,800 to 5,000 cruzeiros. Hence, the total average remuneration would be about 15,000 cruzeiros, which at the rate of 200 working hours a month represents an average cost of 75 cruzeiros per man/hour.

The labour costs per kilogramme of yarn resulting from the productivity levels[4] for the various fibres are as shown in table 110.

TABLE 109. BREAKDOWN OF THE ANNUAL AVERAGE WAGE IN THE TEXTILE INDUSTRY IN SÃO PAULO

| *Wage component* | *Cost (cruzeiros)* | *Index* |
|---|---|---|
| Annual basic wage (10,000 × 12) . . . . | 120,000 | 100.0 |
| Annual social security charges . . . . . | 51,464 | 42.7 |
| Holidays and national holidays (10,000 ÷ 25 × 22) . . . . . . . . . . . . | 8,800 | 7.3 |
| Weekly time off (52 × 400) . . . . . | 20,800 | 17.3 |
| IAPI = 0.09 (120,000 ÷ 20,800 + 8,800) . . . . . . . . . . . . . . | 13,464 | 11.2 |
| SENAI, SESI, LBA, SSR . . . . . . | 5,400 | 4.5 |
| Industrial accident insurance . . . . . | 3,000 | 2.5 |
| | 171,464 | 142.7 |

TABLE 110. LABOUR COSTS OF ONE KILOGRAMME OF YARN OF SELECTED FIBRES

| *Fibre* | *Yarn count* | *Productivity (kg of yarn per man/hour)*[a] | *Labour costs per kg of yarn produced (cruzeiros)* |
|---|---|---|---|
| Cotton . . . . . . . . . | 18[b] | 1.966 | 38.1 |
| Wool (carded) . . . . . . | 17[c] | 1.119 | 67.0 |
| Wool (combed) . . . . . | 32[c] | 0.700 | 107.0 |
| Linen . . . . . . . . . | 32[d] | 3.180 | 24.0 |

[a] Including direct and indirect labour, foremen and overseers.
[b] English count.
[c] Metric count.
[d] Lea.

[4] The labour productivity figures given here are the averages for the different fibres worked out in the preceding chapters for the spinning industry in the Centro-Sul.

3. COST OF RAW MATERIALS

(a) *Cotton*

As São Paulo and the Nordeste States are the principal cotton producers in Brazil, the cost of this fibre will be analyzed by origin solely on the basis of production in these states, calculated at the average free exchange rate of 260 cruzeiros to the dollar prevailing in August 1961.

(i) *Paulista cotton.* The cost of No. 5, which is the most common, was 132.50 cruzeiros per kg in August 1961. This cotton is of fairly good quality and is suitable for the manufacture of yarn with a count of up to 22/24, since the commercial length of the fibre is somewhere between 28 and 30 mm.[5] It is graded in the usual way by the São Paulo Bolsa de Mercaderías, which uses standards based on the norms laid down by the Ministry of Agriculture. It should be noted that some of the consignments marketed contain unripe and fragile cotton, mainly from the first pickings, sometimes in fairly large proportions. This lack of uniformity makes it difficult to process the cotton, since the fact that the micronaire is not the same for ripe and unripe cotton reduces the efficiency of the different spinning operations and leads to irregularities in the quality of the product, for example, in the dyeing of fabrics.

Paulista cotton is satisfactory as regards cleanliness and fibre length, and as far as these aspects are concerned yield should be normal, with wastage not exceeding standard proportions.

(ii) *Nordestino medium-staple cotton.* The types of Nordestino cotton most widely used outside the production region itself are 3 and 4, with a commercial length of 30/32 and 32/34 mm respectively. The c.i.f. price at Rio or Santos was 140.50 cruzeiros per kg in August 1961. Yarn of counts 30 and 40 can be spun from the two cottons.

Both are of fairly good quality with satisfactory fibre strength, but their classification leaves a good deal to be desired, which means that the mill-owners have to reclassify every lot arriving from their warehouses. The lots are mixed, consisting of fibres of different lengths; as a rule they are not clean enough to meet normal standards, and this leads to a relatively high proportion of wastage. Worst of all, Nordestino cotton is often mixed with caroá or other fibres as a result of contact with the cloths made of those fibres which are used in cotton picking and as a temporary wrapping for the cotton on its way from the gins located near the plantations to the baling centres. These fibres cannot be entirely eliminated in the preparation for spinning and cause a large number of breaks at later stages; some mills consider that a particularly high proportion of breaks are due to the presence of caroá fibres. This is obviously one of the main causes of inefficiency and low productivity in spinning, and results in production losses. It also tends to increase the amount of wastage, and to lower the quality of the yarn, a defect that ultimately affects weaving output.

(iii) *Nordestino long-staple cotton.* This cotton, which is of the Mocó type and has a long fibre with a commercial length of up to 36/38 mm, is suitable for combed

[5] The Brazilian classification of fibre length differs from the international classification in inches. The São Paulo Bolsa de Mercaderías compares cotton of the No. 5 Paulista type to American Middling Upland 1.

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[5] The Brazilian classification of fibre length differs from the international classification in inches. The São Paulo Bolsa de Mercaderías compares cotton of the No. 5 Paulista type to American Middling Upland 1.

(d) *Hard fibres*

The principal hard fibres used by Brazilian industry are the following:

(i) *Jute and mallow.* Both are grown in the Amazon region. Domestic production is enough for the country's industrial consumption (about 80,000 tons a year) plus a small exportable surplus. The industrialist's main problem is the time taken to transport these raw materials from Manaus to Santos; this is usually a month, but it often happens that the 60 days allowed for payment of the goods have elapsed before they have reached their port of destination.

The c.i.f. price of jute was 95 to 100 cruzeiros per kg at the end of the 1961 season, or approximately 0.36 dollar cents at 260 cruzeiros to the dollar. The world price c.i.f. New York was 0.40 cents, and thus the Brazilian price was 10 per cent lower.

(ii) *Flax.* About 1,800 tons have been produced annually in Brazil, grown almost entirely by the same industrialists who use this raw material. Consequently there are no domestic quotations for flax. Internal production is supplemented by imports of nearly 4,000 tons annually at 0.53 dollar cents per kg f.o.b. At 260 cruzeiros to the dollar and with the addition of 15 per cent for freight, 35 per cent for customs duties and 7 per cent for miscellaneous import charges, the approximate ex-factory price per kg of the raw material was 215 cruzeiros.

(iii) *Ramie.* Brazil is one of the two biggest producers of ramie in the world, and the major part of its output is used by local industry, usually in combination with flax. The average price quoted for ramie per gross kg in 1961 was 120 cruzeiros. However, the heavy losses incurred during stripping practically double the price per kg.

To sum up, the raw materials used by the Brazilian textile industry are almost entirely domestic in origin, prices are sometimes below and sometimes above world market prices, but broadly speaking the industry does not go short of domestic raw materials save in exceptional circumstances.

The financing of purchases is perhaps the main problem, since purchases are made over a short period of time, which tends to tie up large amounts of capital in the inventories to be drawn upon in the course of the year. Low-interest credit is scarce, which creates difficulties for the industry and raises costs.

(e) *Wastage*

The incidence of wastage on costs is fairly heavy; average percentages in the spinning mills are:[10]

| *Fibre* | *Wastage* Brazil | *Wastage* Standard |
|---|---|---|
| Cotton: (78 per cent carded, 22 per cent combed) | 21.4 | 14 |
| Wool: (35 per cent carded, 65 per cent combed) | 14.4 | 13 |
| Artificial fibres (100 per cent carded) | 12.2 | 9 |
| Jute | 7.1 | 7 |
| Flax | 26.4 | 23 |

[10] The difference between the total volume of raw material inputs into the mills surveyed and the total volume of yarn coming off the spinning frames represents waste material not reused. Dividing this difference by the volume of raw material entering the plant gives the percentage shown in the table.

No data are available on weaving mills, since the volume of yarn inputs in the sector is not known.

In the cotton spinning mills there is a very high proportion of loss between the raw material and the finished product (nearly 50 per cent higher than the standard) because the cotton is not properly cleaned, the machinery is out of date and the operatives are not adequately supervised.

For wool, wastage is slightly above normal, even though two-thirds of the output is combed yarn and only one third carded. As a rule, carding wastage is nearly 9 per cent; wastage is usually 30 per cent, but 15 per cent of this can be reused in the carding process. The normal amount of wastage for the two processes taken together would be about 13 per cent in Brazil; hence the excess wastage amounts to approximately 10 per cent of the standard.

The figure for artificial fibres (representing 33 per cent above the standard) seems rather high in view of the fact that the cut fibres give rise to less wastage than cotton in spinning because they are cleaner and because they are all of the same length and therefore cause fewer losses in processing. Better supervision might result in a saving of some 3 per cent in the volume of raw material consumed.

Jute wastage is within normal limits. For flax the figure (15 per cent above the standard) is a little too high, assuming re-use of waste.

In general the wastage in the different sectors is above normal and has an adverse effect on production costs. Steps should therefore be taken to (i) improve the quality of the raw material (which is outside the scope of the industry); (ii) establish standards and controls for the different production sectors; (iii) keep the equipment in reasonably good state, with particular attention to the parts that must be kept clean, and (iv) use raw material most suitable in quality for the type of product to be made from it.

(f) *Auxiliary materials*

The situation is the same in all the textile sectors; chemical products and direct dyes are produced mainly in Brazil at satisfactory levels of price and quality. Fast idanthrene dyes are mostly imported, as is caustic soda. The imports are effected at the free rate of exchange, and are subject to customs duties of 15 per cent plus 5 per cent specific duties; thus the prices of imported products for domestic industry are directly bound up with the price of the dollar.

4. MACHINERY COSTS

Most of the machinery in use is very old, and is generally not properly maintained. The units are of almost every type, make and origin, and are already fully amortized, with the exception of a certain number of machines imported since the war. To this last group must be added the machines produced domestically, which make possible a certain degree of re-equipment in some branches. No estimate of amortization can be made, as neither the value of the machinery as a whole nor that of the as yet unamortized machinery is known,

Domestic production covers only a portion of the machinery required for the spinning and weaving of cotton and artificial fibres, together with certain machines for the preparation and conditioning of yarns and

### (d) *Hard fibres*

The principal hard fibres used by Brazilian industry are the following:

(i) *Jute and mallow.* Both are grown in the Amazon region. Domestic production is enough for the country's industrial consumption (about 80,000 tons a year) plus a small exportable surplus. The industrialist's main problem is the time taken to transport these raw materials from Manaus to Santos; this is usually a month, but it often happens that the 60 days allowed for payment of the goods have elapsed before they have reached their port of destination.

The c.i.f. price of jute was 95 to 100 cruzeiros per kg at the end of the 1961 season, or approximately 0.36 dollar cents at 260 cruzeiros to the dollar. The world price c.i.f. New York was 0.40 cents, and thus the Brazilian price was 10 per cent lower.

(ii) *Flax.* About 1,800 tons have been produced annually in Brazil, grown almost entirely by the same industrialists who use this raw material. Consequently there are no domestic quotations for flax. Internal production is supplemented by imports of nearly 4,000 tons annually at 0.53 dollar cents per kg f.o.b. At 260 cruzeiros to the dollar and with the addition of 15 per cent for freight, 35 per cent for customs duties and 7 per cent for miscellaneous import charges, the approximate ex-factory price per kg of the raw material was 215 cruzeiros.

(iii) *Ramie.* Brazil is one of the two biggest producers of ramie in the world, and the major part of its output is used by local industry, usually in combination with flax. The average price quoted for ramie per gross kg in 1961 was 120 cruzeiros. However, the heavy losses incurred during stripping practically double the price per kg.

To sum up, the raw materials used by the Brazilian textile industry are almost entirely domestic in origin, prices are sometimes below and sometimes above world market prices, but broadly speaking the industry does not go short of domestic raw materials save in exceptional circumstances.

The financing of purchases is perhaps the main problem, since purchases are made over a short period of time, which tends to tie up large amounts of capital in the inventories to be drawn upon in the course of the year. Low-interest credit is scarce, which creates difficulties for the industry and raises costs.

### (e) *Wastage*

The incidence of wastage on costs is fairly heavy; average percentages in the spinning mills are:[10]

| *Fibre* | *Wastage* Brazil | *Wastage* Standard |
|---|---|---|
| Cotton: (78 per cent carded, 22 per cent combed) | 21.4 | 14 |
| Wool: (35 per cent carded, 65 per cent combed) | 14.4 | 13 |
| Artificial fibres (100 per cent carded) | 12.2 | 9 |
| Jute | 7.1 | 7 |
| Flax | 26.4 | 23 |

[10] The difference between the total volume of raw material inputs into the mills surveyed and the total volume of yarn coming off the spinning frames represents waste material not reused. Dividing this difference by the volume of raw material entering the plant gives the percentage shown in the table.

No data are available on weaving mills, since the volume of yarn inputs in the sector is not known.

In the cotton spinning mills there is a very high proportion of loss between the raw material and the finished product (nearly 50 per cent higher than the standard) because the cotton is not properly cleaned, the machinery is out of date and the operatives are not adequately supervised.

For wool, wastage is slightly above normal, even though two-thirds of the output is combed yarn and only one third carded. As a rule, carding wastage is nearly 9 per cent; wastage is usually 30 per cent, but 15 per cent of this can be reused in the carding process. The normal amount of wastage for the two processes taken together would be about 13 per cent in Brazil; hence the excess wastage amounts to approximately 10 per cent of the standard.

The figure for artificial fibres (representing 33 per cent above the standard) seems rather high in view of the fact that the cut fibres give rise to less wastage than cotton in spinning because they are cleaner and because they are all of the same length and therefore cause fewer losses in processing. Better supervision might result in a saving of some 3 per cent in the volume of raw material consumed.

Jute wastage is within normal limits. For flax the figure (15 per cent above the standard) is a little too high, assuming re-use of waste.

In general the wastage in the different sectors is above normal and has an adverse effect on production costs. Steps should therefore be taken to (i) improve the quality of the raw material (which is outside the scope of the industry); (ii) establish standards and controls for the different production sectors; (iii) keep the equipment in reasonably good state, with particular attention to the parts that must be kept clean, and (iv) use raw material most suitable in quality for the type of product to be made from it.

### (f) *Auxiliary materials*

The situation is the same in all the textile sectors; chemical products and direct dyes are produced mainly in Brazil at satisfactory levels of price and quality. Fast idanthrene dyes are mostly imported, as is caustic soda. The imports are effected at the free rate of exchange, and are subject to customs duties of 15 per cent plus 5 per cent specific duties; thus the prices of imported products for domestic industry are directly bound up with the price of the dollar.

## 4. Machinery costs

Most of the machinery in use is very old, and is generally not properly maintained. The units are of almost every type, make and origin, and are already fully amortized, with the exception of a certain number of machines imported since the war. To this last group must be added the machines produced domestically, which make possible a certain degree of re-equipment in some branches. No estimate of amortization can be made, as neither the value of the machinery as a whole nor that of the as yet unamortized machinery is known,

Domestic production covers only a portion of the machinery required for the spinning and weaving of cotton and artificial fibres, together with certain machines for the preparation and conditioning of yarns and joint input of labour and raw material per unit of output (fabric of a given type) little lower than that found in the United States, the comparative values of the two currencies being based on the free rate of exchange (260 cruzeiros to the dollar) at the time when the study was made.[14]

Let us first consider labour costs. Table 112 and figure XX show the labour inputs, in terms of spinning and weaving man/hours, for the production of 100 yards of a specified grey cotton fabric, in Brazil and in four other countries.[15] Whereas 2.33 man/hours are needed to produce 100 yards of fabric in the United States (and 4.74 in Japan), in Brazil 16.49 are needed, which represents a ratio of 1 to 7 (or 1 to 3.5 in comparison with Japan). A comparison on the same basis with Peru or Chile is naturally less unfavourable, but also worthy of note and perhaps even more revealing, since in those two countries the textile industry faces many problems that are very similar to those existing in Brazil. The figure for Brazil is 46 per cent more than in Peru and 27 per cent more than in Chile.

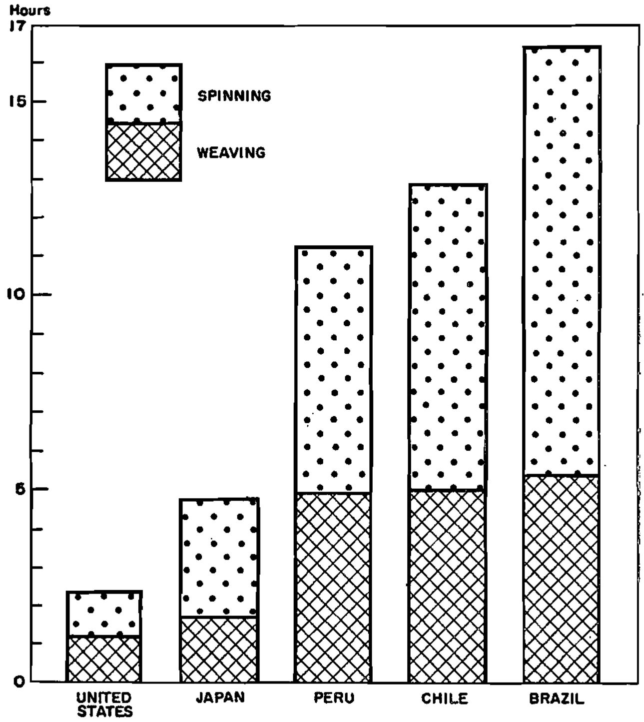
[14] See ECLA, *Comparative Prices and the Purchasing Power of Currencies in Selected Latin American Countries* (E/CN.12/589). According to this study, the cruzeiro has tended to be consistently undervalued in recent years on the free exchange market. If this is so, the introduction of the necessary correction factor, however low this might be, would probably eliminate the difference referred to.

[15] The corresponding data for Chile, Peru and Brazil were obtained on the basis of productivity. In spinning (Chile 1,940 grammes per man-hour, Brazil 1,996 and Peru 1,975) the number of man/hours was obtained by dividing the weight of 100 yards of fabric—10,600 grammes—by the productivity of each of the countries. For weaving, the number of hours needed to produce 100 yards was calculated by dividing the equivalent in metres (91.40) by the average productivity of each country in metres (Chile 11.6 metres per man/hour, Brazil 8.18 and Peru 14.43).

FIGURE XX

NUMBER OF HOURS REQUIRED TO PRODUCE 100 YARDS OF CLOTH IN SELECTED COUNTRIES

Natural scale




*Source:* Table 112.

These differences are due to the low productivity in spinning and weaving, particularly the latter. The ratio between unit labour input in Brazil and in each of the other countries is even higher for weaving; the number of man/hours required to produced 100 yards of fabrics is 864 per cent higher in Brazil than in the United States, and 42 per cent higher than in Chile, where the figures are closer to those of Brazil than in any of the other countries included in this comparison.

TABLE 112. MAN/HOURS NEEDED TO PRODUCE 100 YARDS OF COTTON FABRIC[a] IN SELECTED COUNTRIES

| | *Spinning* | | *Weaving* | | *Total* | |
|---|---|---|---|---|---|---|
| *Country* | *Number of man/hours* | *Index* | *Number of man/hours* | *Index* | *Number of man/hours* | *Index* |
| United States . . | 1.17 | 100 | 1.16 | 100 | 2.33 | 100 |
| Japan . . . . . | 1.73 | 156 | 3.01 | 260 | 4.74 | 200 |
| Peru . . . . . . | 4.91 | 419 | 6.38 | 550 | 11.29 | 484 |
| Chile . . . . . | 5.00 | 427 | 7.85 | 675 | 12.85 | 556 |
| Brazil . . . . . | 5.31 | 454 | 11.18 | 964 | 16.49 | 707 |

*Sources:* For the United States and Japan, United States Department of Commerce, *Comparative Fabric Production Costs in United States and Four Other Countries* (1961).
For Peru, Ministry of Development and Public Works of Peru, *Industria textil peruana 1959.* Statistics of the Industries Sub-Division.
For Brazil and Chile, ECLA surveys.

[a] Fabric weighing 106 grammes per yard, 98/100 cm. wide, yarn count 18/20.

Taking as a reference standard labour productivity (in terms of man/hours per unit of output) in spinning and weaving in the United States (which gives a single standard, since the number of hours required in the example given is practically identical in the two processes), we find that productivity in weaving in Brazil is joint input of labour and raw material per unit of output (fabric of a given type) little lower than that found in the United States, the comparative values of the two currencies being based on the free rate of exchange (260 cruzeiros to the dollar) at the time when the study was made.[14]

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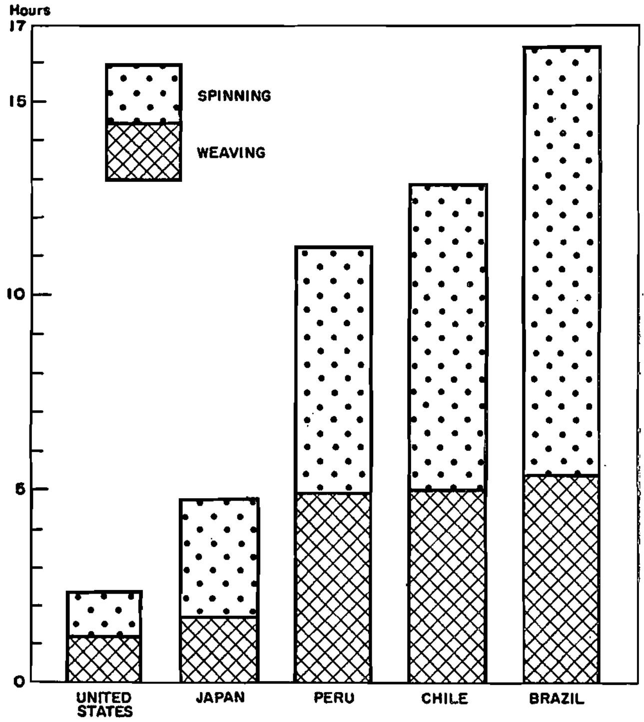


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This brief comparison leads to the conclusion that if Brazil used a better quality cotton, leading to a lower percentage of wastage, and if the number of man/hours to produce 100 yards of the fabric referred to were reduced from 16.16 to 8.5 (in which case Brazil's productivity would still only be about half that of Japan), Brazil could compete successfully on the world market. In fact this is already the case for certain Brazilian plants whose productivity levels are appreciably higher than the national average.

Nevertheless, it must be borne in mind that this comparison relates only to the cost of two inputs. If the others are taken into account, Brazil's relative position would probably be less favourable, since the prices of related materials and machinery are higher than those in the United States and Japan. However, the incidence of the other components in the cost of production should not represent more than a third of the total cost, and if this is so, the price differences referred to would not have an appreciable effect on the situation.

It should also be borne in mind, however, that the amortization of a substantial modernization of the machinery would constitute an important component of the cost of the product. Consequently it would be necessary to reduce to the minimum the portion represented by other costs (mainly general and administrative costs).

Chapter VIII will consider, among other alternatives, a programme for the reorganization and re-equipment of the spinning and weaving industry that should lead within a few years to a two-fold increase in present productivity levels. The analysis of costs is taken up again at the end of that chapter, in order to show in some detail the probable effect of such structural changes on Brazilian textile costs.

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to in previous chapters. There follow some suggestions as to what action, as regards these five factors, is most needed to complement re-equipment, and thus ensure the most effective use of the funds spent on reconditioning and purchase of machinery, and at the same time yield the most rapid results.

### (a) *Quality of the raw material*

A better quality of cotton is essential in order to produce strong and regular yarn that will permit yarn breaks and wastage to be kept within normal limits. As indicated in chapter VII on production costs, Brazilian cotton has many defects that reduce output and productivity. Without going into the question of cotton genetics and cultivation (on which a number of bodies are actively engaged, such as the National Cotton Board, departments of the Ministry of Agriculture, regional bodies such as the Campinas Agronomical Institute, and SUDENE, for the Nordeste region) attention must be drawn to the importance of better cotton grading and marketing. At present cotton ginning is generally carried out with obsolete machinery that fails to remove a large part of the impurities and weakens or even breaks the fibres. Thus it is common practice to use saw gins instead of roller gins for long-staple cotton, although this cannot but harm the cotton by reducing fibre length.

The grading leaves much to be desired; the resulting bales do not generally correspond to the standards for the grades concerned, and most of the bales contain fibres of different lengths, which has a pronounced effect on production efficiency. In addition they commonly contain seed husks, leaves, pieces of twig, grit, and other foreign bodies that represent losses and damage the machinery. However, it is not these foreign bodies that are most prejudicial to output, since they are usually eliminated in the scutchers or cards, but the caroá[2] fibres that are commonly mixed with the cotton. The latter are not eliminated, and remain in the cotton till the spinning stage, when they lead to frequent yarn breaks. Some mills that keep a proper check on the number of breaks and analyse their causes conclude that a high percentage of breaks are due to caroá fibres. This defect is found only in Nordeste cottons, and is due to the use of caroá sacks for picking and also for temporary wrapping. Thus combined action to improve cotton ginning and grading, and completely prohibit the use of caroá or sisal sacks for picking, would undoubtedly be highly effective and have a marked effect in improving the raw material.

### (b) *Manpower training*

Adequate training of both operatives and technicians is essential if workloads are to be increased to a level considered normal for the operation of modern machinery. Visits to a number of mills in the Nordeste, Central and Southern regions of Brazil confirmed that badly trained labour is an obstacle to proper utilization even of the antiquated machinery now in use. The productivity of these workers would undoubtedly fall still lower if it were transferred from the machines that they understand, at least to some extent, to more modern and faster machines. Proper training could lead to an appreciable rise in the output of the present machinery, and for the handling of new or reconditioned units it is essential. Re-equipment necessarily involves more automation, however modest the level of up-to-dateness aspired to, and consequently an increase in workloads (number of machines per operative). Thus it cannot be expected that a worker accustomed to tending only a few hundred spindles will be able, without further training, to take over 2,000 spindles, or that a weaver now minding 4 power looms will be able to give the proper attention to 40 automatic looms.

Prior training of the workers is therefore an essential condition for the proper use of the machinery that is to be reconditioned. The most economical and perhaps the most practical method, according to experience in many countries and also in the Nordeste region of Brazil itself, is to train a group of assistant foremen or intermediate level supervisors who can subsequently pass on what they have learned to those working under them. Those responsible foi the SUDENE programme in the Nordeste region, faced with a re-equipment problem and aware that little could be achieved without a prior raising of the level of training of the operatives, laid down as an essential prerequisite an intensive programme for the training of foremen and assistant foremen in the region's textile industry.

Such courses could take place: (i) in a mill, when the number of assistant foremen is sufficient to justify the attendance of an instructor; (ii) in classes held near a number of mills whose assistant foremen can be trained together (in this case the practical training would be given at the mills themselves); and (iii) at a SENAI school, when there is one near a group of mills. It is preferable to hold the courses during the day, but when this is not possible, good results can be obtained even with night classes.

In São Paulo and Rio de Janeiro SENAI is equipped, according to the information available, to provide proper training for assistant foremen, but the courses currently offered do not appear to be very frequent, and in addition, it was found that in the SENAI night courses in São Paulo for foremen and assistant foremen, 80 per cent of the students were employed by only two large and very modern mills. From these and similar observations and information, it was concluded that either the small and medium size plants are unaware of the facilities offered by SENAI, or they are not interested in improving the level of their workers, despite the fact that by doing so they could effect a sharp increase in productivity even with the same machinery. With modern machinery even a moderately economic use of the equipment is not possible without a properly trained labour force.

### (c) *Organization and management of the mills*

The organizational defects existing in many plants include the lack of systems of control and supervision, or the failure to use them when they exist, the lack of accurate knowledge of production costs, excessive wastage of raw materials, lack of standardization of raw materials and chemicals and chemical products, excessively long operating hours due to neglect of the operational system, the existence of operations that could be eliminated or simplified, and other defects that keep output low and would be likely largely to nullify the benefits obtainable from expensive new and modern equipment.

[2] A hard fibre.

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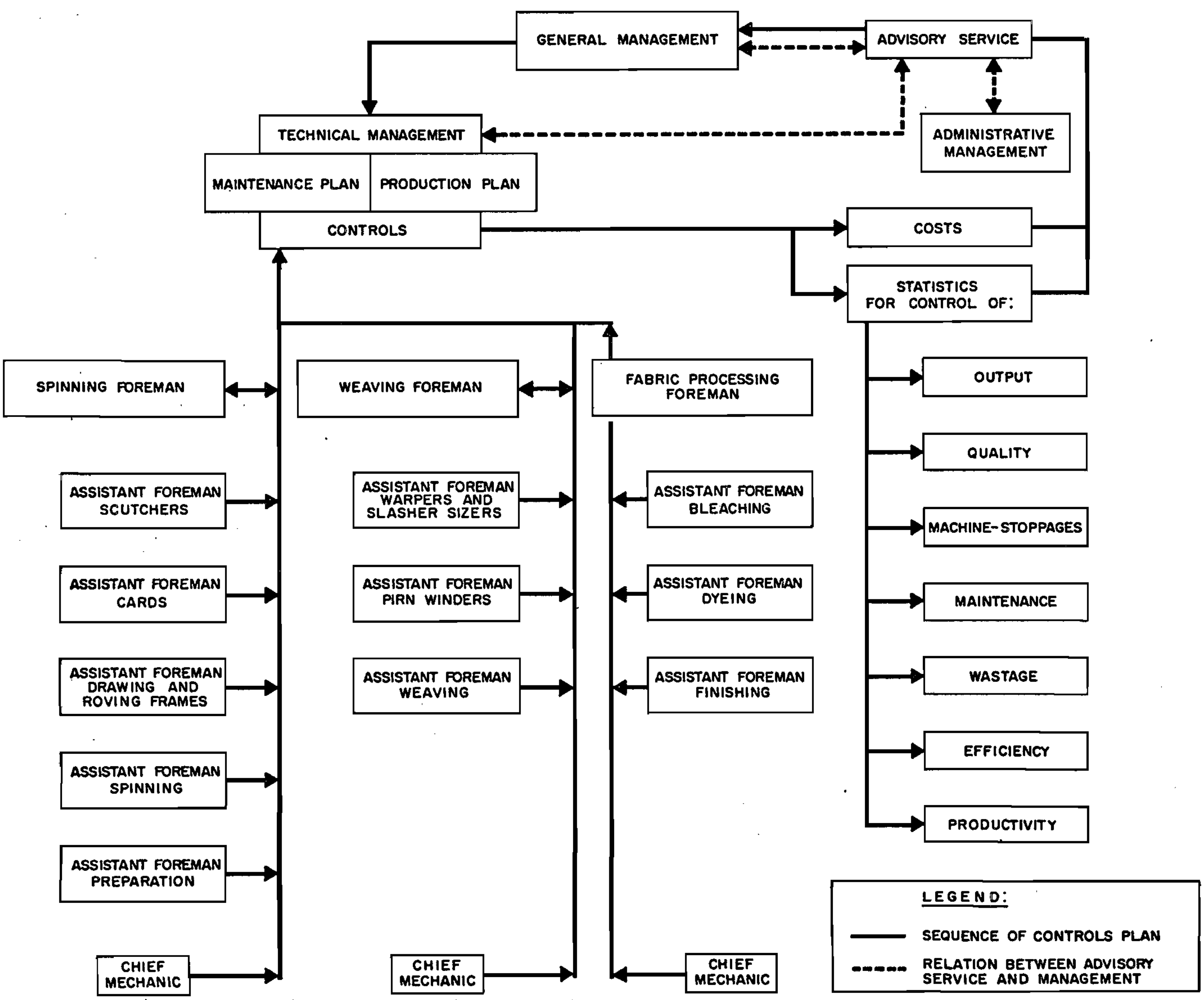
propose solutions to the various problems that arise, and point out the defects to be avoided. A number of Brazilian mills are already using a system that has been found very effective, which is to have an adviser or advisers (according to the size of the mill) working at the side of the technical and administrative directors, whose function is to conduct a continuing study of the operational system of each section and sub-section in the plant and propose to the management solutions to the various problems encountered. This system provides the directors with suggestions for improving both working methods and the various controls. The advisory service should constitute a truly autonomous organ within the organization, with the task of resolving any problems in either the operational or administrative sphere. It should keep a check on production costs and on the general indices of efficiency and productivity, and compare them with established standards and inform the management of any discrepancies that appear. The advisory service should not have any executive power, and should confine its activities to providing the material that will enable management to take decisions and apply the new methods suggested.

The organizational charts presented in figures XXI and XXII indicate the position of the advisory service in the plant and the scope of its activities. On the basis of first-hand experience and the information obtained, it can be confidently asserted that such an advisory service will more than pay for itself by the economies achieved through reduced production costs resulting from its suggestions in the field of efficiency, productivity and work safety.

FIGURE XXII

ADVISORY SERVICE AND SYSTEM OF CONTROLS IN A COTTON SPINNING AND WEAVING MILL



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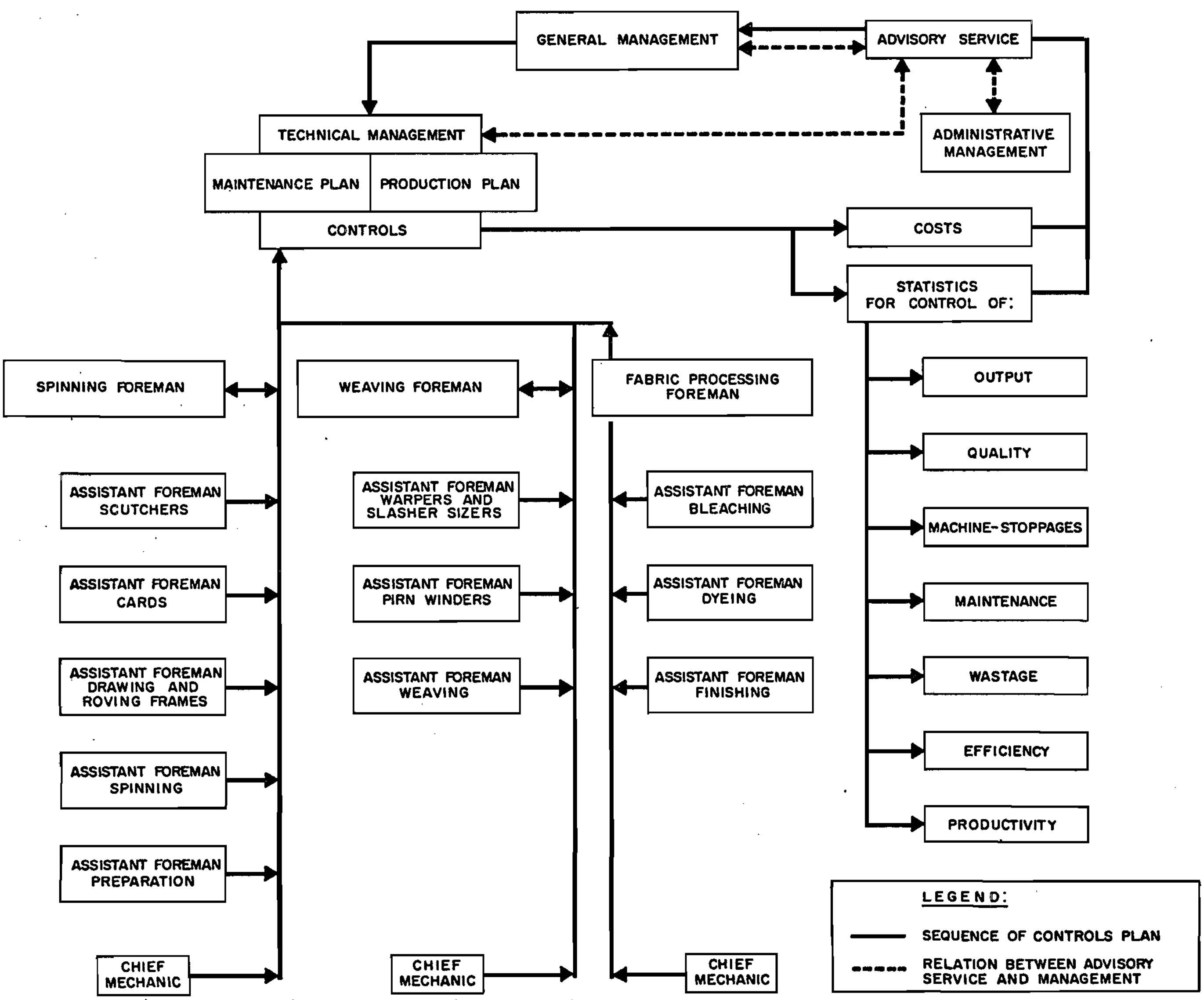

TABLE 114. TECHNOLOGICAL LEVEL REPRESENTED BY THE VARIOUS EQUIPMENT HYPOTHESES CONSIDERED

| *Type of machine* | *Hypothesis I Obsolete technology* | *Hypothesis II Modern conventional technology* | *Hypothesis III Highly automatic modern technology* | *Hypothesis IV Fully automatic and experimental technology* |
|---|---|---|---|---|
| Opener-scutcher | Sometimes separate units[a] | Sequence of machines | "Carrousel" type | |
| Cards | Ordinary clothing[a]<br>Small cans<br>Manual stripping | Rigid clothing<br>Large cans<br>Vacuum stripping | Vacuum or double card without stripping | Automatic system with no manual handling |
| Drawing frames | Ordinary draft[b]<br>Small cans<br>Several passages needed | High draft<br>Large cans<br>Single passage | High draft<br>High speed<br>With sliver regulator | |
| Roving frames | Ordinary draft[b]<br>Two or three passages | High draft<br>Large bobbins<br>Single passage | High draft<br>High speed | (Process eliminated) |
| Ring spinning frames | Ordinary draft[a]<br>Small package | High draft<br>Large package<br>Manual doffing<br>Pneumafil | High draft<br>High speed<br>Automatic doffing<br>Pneumafil and blowers | Direct double draft, high-speed, automatic doffing |
| Cone winders | Non-automatic[b] | Automatic<br>Manual tying-in | High speed, automatic, with automatic tying-in | |
| Pirn winders | Non-automatic[b] | Automatic | Automatic high speed | (Process eliminated) |
| Warping machines | Non-automatic[b] | Automatic<br>Large beams | Automatic, double creels, high speed, large beams | |
| Slasher sizers | Non-automatic[a] | Automatic controls | Automatic controls and high speed | |
| Looms | Non-automatic[a] or semi-automatic | Automatic (200 picks per minute)<br>Large beams | Automatic, high, speed, (230 picks per minute), large beams, Unifil<br>Loom winder or box loader | Shuttle-less |

[a] It may be possible to recondition certain old machines to bring them up to the same technological level as the new machines contemplated in hypothesis II.

[b] It is either impossible or inadvisable to recondition these machines, and they must be replaced by new machines as provided in hypothesis II.

Hypothesis II envisages partial re-equipment with up-to-date machines of the conventional type, like those used in the average mill in most western European countries, plus the reconditioning of existing machinery, whenever this is an economically and technically sound proposition. This would involve, for instance, the use of high-draft ring frames with large spindles (over 7 inches), and automatic looms with bobbin changers and a speed of about 180 to 200 picks per minute. This hypothesis also provides for the reconditioning of some machines, such as the opener-scutchers, the cards, the ring spindles, and in some cases the looms, so as to bring them into line with the new machines.

Hypothesis III provides for re-equipment with highly automatic machinery with a high output capacity, such as that now being manufactured by various international firms and used by the best textile mills in Europe and the United States. In this case, the machinery and equip-

TABLE 114. TECHNOLOGICAL LEVEL REPRESENTED BY THE VARIOUS EQUIPMENT HYPOTHESES CONSIDERED

| *Type of machine* | *Hypothesis I Obsolete technology* | *Hypothesis II Modern conventional technology* | *Hypothesis III Highly automatic modern technology* | *Hypothesis IV Fully automatic and experimental technology* |
|---|---|---|---|---|
| Opener-scutcher | Sometimes separate units[a] | Sequence of machines | "Carrousel" type | Automatic system with no manual handling (covers opener-scutcher, cards and drawing frames) |
| Cards | Ordinary clothing[a]<br>Small cans<br>Manual stripping | Rigid clothing<br>Large cans<br>Vacuum stripping | Vacuum or double card without stripping | |
| Drawing frames | Ordinary draft[b]<br>Small cans<br>Several passages needed | High draft<br>Large cans<br>Single passage | High draft<br>High speed<br>With sliver regulator | |
| Roving frames | Ordinary draft[b]<br>Two or three passages | High draft<br>Large bobbins<br>Single passage | High draft<br>High speed | (Process eliminated) |
| Ring spinning frames | Ordinary draft[a]<br>Small package | High draft<br>Large package<br>Manual doffing<br>Pneumafil | High draft<br>High speed<br>Automatic doffing<br>Pneumafil and blowers | Direct double draft, high-speed, automatic doffing |
| Cone winders | Non-automatic[b] | Automatic<br>Manual tying-in | High speed, automatic, with automatic tying-in (Hypotheses III and IV) | |
| Pirn winders | Non-automatic[b] | Automatic | Automatic high speed | (Process eliminated) |
| Warping machines | Non-automatic[b] | Automatic<br>Large beams | Automatic, double creels, high speed, large beams (Hypotheses III and IV) | |
| Slasher sizers | Non-automatic[a] | Automatic controls | Automatic controls and high speed (Hypotheses III and IV) | |
| Looms | Non-automatic[a] or semi-automatic | Automatic (200 picks per minute)<br>Large beams | Automatic, high, speed, (230 picks per minute), large beams, Unifil<br>Loom winder or box loader | Shuttle-less |

[a] It may be possible to recondition certain old machines to bring them up to the same technological level as the new machines contemplated in hypothesis II.

[b] It is either impossible or inadvisable to recondition these machines, and they must be replaced by new machines as provided in hypothesis II.

Hypothesis II envisages partial re-equipment with up-to-date machines of the conventional type, like those used in the average mill in most western European countries, plus the reconditioning of existing machinery, whenever this is an economically and technically sound proposition. This would involve, for instance, the use of high-draft ring frames with large spindles (over 7 inches), and automatic looms with bobbin changers and a speed of about 180 to 200 picks per minute. This hypothesis also provides for the reconditioning of some machines, such as the opener-scutchers, the cards, the ring spindles, and in some cases the looms, so as to bring them into line with the new machines.

Hypothesis III provides for re-equipment with highly automatic machinery with a high output capacity, such as that now being manufactured by various international firms and used by the best textile mills in Europe and the United States. In this case, the machinery and equip-

TABLE 115. LABOUR PRODUCTIVITY AND COSTS IN THE SAMPLE COTTON SPINNING AND WEAVING MILL, ACCORDING TO DIFFERENT RE-EQUIPMENT HYPOTHESES[a]

| Process | *Existing situation* | | *Hypothesis I* | | *Hypothesis II* | | *Hypothesis III* | |
|---|---|---|---|---|---|---|---|---|
| | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* |
| *Spinning* | | | | | | | | |
| Number of spindles | 22,100 | 22,100 | 22,100 | 22,100 | 17,800 | 17,800 | 12,600 | 12,600 |
| Daily output (kg) | 5,680 | 7,810 | 6,720 | 9,240 | 5,680 | 7,810 | 5,680 | 7,810 |
| Number of workers | 352 | 528 | 352 | 528 | 180 | 270 | 75 | 113 |
| Number of man/hours daily | 2,816 | 3,872 | 2,816 | 3,872 | 1,440 | 1,980 | 600 | 828 |
| Productivity (gr. per man/hour) | 2,010 | 2,010 | 2,390 | 2,390 | 3,945 | 3,945 | 9,440 | 9,440 |
| Hourly wage (cruzeiros) | 75.00 | 83.33 | 75.00 | 83.33 | 86.25 | 95.75 | 100.0 | 111.00 |
| Labour cost per kg (cruzeiros) | 37.30 | 41.45 | 31.38 | 34.86 | 21.86 | 24.27 | 10.60 | 11.70 |
| Labour cost per metre (cruzeiros) | 4.18 | 4.64 | 3.51 | 3.90 | 2.45 | 2.72 | 1.19 | 1.31 |
| *Weaving* | | | | | | | | |
| Number of looms | 450 | 450 | 450 | 450 | 252 | 252 | 160 | 160 |
| Daily output (metres) | 22,333 | 30,666 | 31,967 | 43,953 | 22,333 | 30,666 | 22,333 | 30,666 |
| Number of workers | 340 | 510 | 340 | 510 | 100 | 150 | 40 | 60 |
| Number of man/hours daily | 2,720 | 3,740 | 2,720 | 3,740 | 800 | 1,200 | 320 | 440 |
| Productivity (metres per man/hour) | 8.18 | 8.18 | 11.75 | 11.75 | 27 | 27 | 70 | 70 |
| Hourly wage (cruzeiros) | 75.00 | 83.33 | 75.00 | 83.33 | 86.25 | 95.75 | 100.00 | 111.00 |
| Labour cost per metre (cruzeiros) | 9.17 | 10.19 | 6.38 | 7.09 | 3.20 | 3.54 | 1.43 | 1.44 |
| Total cost per metre | 13.35 | 14.83 | 9.89 | 10.99 | 5.65 | 6.26 | 2.62 | 2.75 |

*Source:* As indicated in the text.

[a] Fabric 90 centimetres wide, weighing 110 grammes per metre, yarn count Ne 20.

According to hypothesis I, which postulates that the mill will operate with the same machinery and personnel, but at higher standards of efficiency equivalent to those adopted in evaluating the unit output attainable with old-fashioned machinery (see Methodological Annex), productivity would be higher in both the spinning and weaving sections, amounting to 2,390 grammes and 11.75 metres per man/hour, respectively. Thus the value of the labour required to produce one metre of fabric drops to 3.51 cruzeiros for spinning and 6.38 cruzeiros for weaving, giving a total of 9.89 cruzeiros per metre.

According to hypothesis II (re-equipment effected economically but permitting the attainment of the Latin American standard levels of unit output and productivity adopted here) productivity would increase to 3,945 grammes per man/hour in the spinning section (it should be noted that the yarn count is 20, whereas the standard of 4,300 grammes is for a yarn count of 18), and to 27 metres per man/hour in the weaving section. Thus labour costs would represent, respectively, 2.45 and 3.20 cruzeiros per metre, i.e., a total of 5.65[4] cruzeiros, the unit wage being raised by 16 per cent,[5] to 86.25 cruzeiros an hour.

[4] If a weaving productivity standard of 43 metres per man/hour were adopted, labour costs in the weaving mills would drop to 2.01 cruzeiros per metre and the total cost of labour inputs in a metre of fabric would be only 4.46 cruzeiros.

[5] In order to calculate this increment, which corresponds to an increase in workloads, it was assumed that one-third of the saving under the production cost item "labour" through the increase in productivity would be allocated to the workers.

Hypothesis II provides for re-equipment with the most modern conventional machinery, that would permit productivity to be raised to 9,440 grammes and 70 metres per man/hour and labour costs per metre would amount to only 1.19 and 1.43 cruzeiros, or a total of 2.62 cruzeiros per metre, even though the unit wage was estimated on the basis of a 33 per cent increment, bringing it up to 100 cruzeiros per hour.

All the labour costs set forth above are for two work-shifts. If three shifts were worked, the basic wage of the operatives on the third shift would have to be raised by 33 per cent and their working day reduced by one hour, measures required by law to make up for the extra effort involved in night work. This would mean that the average unit wage for a three-shift system as a whole would be 11 per cent higher than for two shifts.

Thus the estimated labour costs for three shifts would be: existing cost, 14.83 cruzeiros per metre; hypothesis I, 10.99 cruzeiros; hypothesis II, 6.26 cruzeiros; hypothesis III, 2.75 cruzeiros. This shows that labour costs are significantly reduced by mill modernization, since in hypothesis II they represent only 42 per cent, and in hypothesis III only 20 per cent, of their present level.

### (b) *Cost of re-equipment: amortization and interest on capital*

In order to assess amortization and capital costs on the basis of hypotheses I, II and III, the machinery had first to be evaluated in quantitative and monetary terms (see table 116).

TABLE 115. LABOUR PRODUCTIVITY AND COSTS IN THE SAMPLE COTTON SPINNING AND WEAVING MILL, ACCORDING TO DIFFERENT RE-EQUIPMENT HYPOTHESES[a]

| Process | *Existing situation* | | *Hypothesis I* | | *Hypothesis II* | | *Hypothesis III* | |
|---|---|---|---|---|---|---|---|---|
| | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* |
| *Spinning* | | | | | | | | |
| Number of spindles | 22,100 | 22,100 | 22,100 | 22,100 | 17,800 | 17,800 | 12,600 | 12,600 |
| Daily output (kg) | 5,680 | 7,810 | 6,720 | 9,240 | 5,680 | 7,810 | 5,680 | 7,810 |
| Number of workers | 352 | 528 | 352 | 528 | 180 | 270 | 75 | 113 |
| Number of man/hours daily | 2,816 | 3,872 | 2,816 | 3,872 | 1,440 | 1,980 | 600 | 828 |
| Productivity (gr. per man/hour) | 2,010 | 2,010 | 2,390 | 2,390 | 3,945 | 3,945 | 9,440 | 9,440 |
| Hourly wage (cruzeiros) | 75.00 | 83.33 | 75.00 | 83.33 | 86.25 | 95.75 | 100.0 | 111.00 |
| Labour cost per kg (cruzeiros) | 37.30 | 41.45 | 31.38 | 34.86 | 21.86 | 24.27 | 10.60 | 11.70 |
| Labour cost per metre (cruzeiros) | 4.18 | 4.64 | 3.51 | 3.90 | 2.45 | 2.72 | 1.19 | 1.31 |
| *Weaving* | | | | | | | | |
| Number of looms | 450 | 450 | 450 | 450 | 252 | 252 | 160 | 160 |
| Daily output (metres) | 22,333 | 30,666 | 31,967 | 43,953 | 22,333 | 30,666 | 22,333 | 30,666 |
| Number of workers | 340 | 510 | 340 | 510 | 100 | 150 | 40 | 60 |
| Number of man/hours daily | 2,720 | 3,740 | 2,720 | 3,740 | 800 | 1,200 | 320 | 440 |
| Productivity (metres per man/hour) | 8.18 | 8.18 | 11.75 | 11.75 | 27 | 27 | 70 | 70 |
| Hourly wage (cruzeiros) | 75.00 | 83.33 | 75.00 | 83.33 | 86.25 | 95.75 | 100.00 | 111.00 |
| Labour cost per metre (cruzeiros) | 9.17 | 10.19 | 6.38 | 7.09 | 3.20 | 3.54 | 1.43 | 1.44 |
| Total cost per metre | 13.35 | 14.83 | 9.89 | 10.99 | 5.65 | 6.26 | 2.62 | 2.75 |

*Source:* As indicated in the text.

[a] Fabric 90 centimetres wide, weighing 110 grammes per metre, yarn count Ne 20.

According to hypothesis I, which postulates that the mill will operate with the same machinery and personnel, but at higher standards of efficiency equivalent to those adopted in evaluating the unit output attainable with old-fashioned machinery (see Methodological Annex), productivity would be higher in both the spinning and weaving sections, amounting to 2,390 grammes and 11.75 metres per man/hour, respectively. Thus the value of the labour required to produce one metre of fabric drops to 3.51 cruzeiros for spinning and 6.38 cruzeiros for weaving, giving a total of 9.89 cruzeiros per metre.

According to hypothesis II (re-equipment effected economically but permitting the attainment of the Latin American standard levels of unit output and productivity adopted here) productivity would increase to 3,945 grammes per man/hour in the spinning section (it should be noted that the yarn count is 20, whereas the standard of 4,300 grammes is for a yarn count of 18), and to 27 metres per man/hour in the weaving section. Thus labour costs would represent, respectively, 2.45 and 3.20 cruzeiros per metre, i.e., a total of 5.65[4] cruzeiros, the unit wage being raised by 16 per cent,[5] to 86.25 cruzeiros an hour.

[4] If a weaving productivity standard of 43 metres per man/hour were adopted, labour costs in the weaving mills would drop to 2.01 cruzeiros per metre and the total cost of labour inputs in a metre of fabric would be only 4.46 cruzeiros.

[5] In order to calculate this increment, which corresponds to an increase in workloads, it was assumed that one-third of the saving under the production cost item "labour" through the increase in productivity would be allocated to the workers.

Hypothesis II provides for re-equipment with the most modern conventional machinery, that would permit productivity to be raised to 9,440 grammes and 70 metres per man/hour and labour costs per metre would amount to only 1.19 and 1.43 cruzeiros, or a total of 2.62 cruzeiros per metre, even though the unit wage was estimated on the basis of a 33 per cent increment, bringing it up to 100 cruzeiros per hour.

All the labour costs set forth above are for two work-shifts. If three shifts were worked, the basic wage of the operatives on the third shift would have to be raised by 33 per cent and their working day reduced by one hour, measures required by law to make up for the extra effort involved in night work. This would mean that the average unit wage for a three-shift system as a whole would be 11 per cent higher than for two shifts.

Thus the estimated labour costs for three shifts would be: existing cost, 14.83 cruzeiros per metre; hypothesis I, 10.99 cruzeiros; hypothesis II, 6.26 cruzeiros; hypothesis III, 2.75 cruzeiros. This shows that labour costs are significantly reduced by mill modernization, since in hypothesis II they represent only 42 per cent, and in hypothesis III only 20 per cent, of their present level.

### (b) *Cost of re-equipment: amortization and interest on capital*

In order to assess amortization and capital costs on the basis of hypotheses I, II and III, the machinery had first to be evaluated in quantitative and monetary terms (see table 116).

TABLE 117. ESTIMATED VALUE OF AMORTIZATION AND INTEREST ON CAPITAL IN THE SAMPLE COTTON SPINNING AND WEAVING MILL ACCORDING TO DIFFERENT RE-EQUIPMENT HYPOTHESES

| | *Existing situation* | | *Hypothesis I* | | *Hypothesis II* | | *Hypothesis III* | |
|---|---|---|---|---|---|---|---|---|
| *Process* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* |
| *Spinning* | | | | | | | | |
| Value of machinery (thousands of cruzeiros) . . . . . . . | 126,140 | 126,140 | 126,140 | 126,140 | 359,629 | 359,629 | 409,446 | 409,446 |
| Amortization (10 per cent) . . | 12,614 | 12,614 | 12,614 | 12,614 | 35,963 | 35,963 | 40,945 | 40,945 |
| Interest on capital (12 per cent) | 4,128 | 14,128 | 14,128 | 14,128 | 40,279 | 40,279 | 45,858 | 45,858 |
| Annual production (tons) . . . | 1,700 | 2,340 | 2,000 | 2,770 | 1,700 | 2,340 | 1,700 | 2,340 |
| Amortization per kg (cruzeiros) | 7.42 | 5.39 | 6.31 | 4.55 | 21.04 | 15.37 | 24.09 | 17.50 |
| Interest on capital per kg (cruzeiros) . . . . . . . . | 8.31 | 6.04 | 7.06 | 5.10 | 23.69 | 17.21 | 26.98 | 19.60 |
| Amortization and interest on capital per metre of fabric[a] (cruzeiros) . . . . . . . . | 1.77 | 1.28 | 1.50 | 1.08 | 5.01 | 3.65 | 5.72 | 4.15 |
| *Weaving* | | | | | | | | |
| Value of machinery (thousands of cruzeiros) . . . . . . . | 99,776 | 99,776 | 99,776 | 99,776 | 137,805 | 137,805 | 262,365 | 262,365 |
| Amortization (10 per cent) . . | 9,978 | 9,978 | 9,978 | 9,978 | 13,780 | 13,780 | 26,237 | 26,237 |
| Interest on capital (12 per cent) | 11,175 | 11,175 | 11,175 | 11,175 | 15,434 | 15,434 | 29,385 | 29,385 |
| Annual production (thousands of metres) . . . . . . . . | 6,700 | 9,200 | 9,590 | 13,186 | 6,700 | 9,200 | 6,700 | 9,200 |
| Amortization per metre (cruzeiros) . . . . . . . . . . | 1.49 | 1.08 | 1.04 | 0.76 | 2.05 | 1.50 | 3.92 | 2.85 |
| Interest on capital per metre (cruzeiros) . . . . . . . . | 1.67 | 1.21 | 1.17 | 0.85 | 2.30 | 1.57 | 4.39 | 3.19 |
| Amortization and interest on capital per metre (cruzeiros) | 3.16 | 2.29 | 2.21 | 1.61 | 4.36 | 3.07 | 8.31 | 6.04 |
| Indices for amortization and interest on capital | | | | | | | | |
| Spinning . . . . . . . . . | 100.0 | 72.3 | 84.7 | 61.0 | 283.1 | 203.9 | 323.2 | 234.5 |
| Weaving . . . . . . . . . | 100.0 | 72.5 | 69.9 | 50.9 | 138.0 | 97.2 | 263.0 | 191.1 |
| TOTAL | 100.0 | 72.4 | 75.2 | 54.6 | 190.1 | 136.3 | 284.6 | 182.9 |

*Source:* As indicated in the text.
[a] At the rate of 8.93 metres per kg of yarn.

A complete estimate of the cost of production would have to take into account other cost factors which cannot be considered here, such as expenditures on power, fuel and upkeep, as well as overheads and administrative expenditure. However, the fact that the part cost, covering labour, machinery (amortization and interest) and raw materials, represents about three quarters of the total cost of grey fabric justifies its use as an importnat criterion in evaluating these hypotheses.

It seems likely that the use of new machinery, the application of efficient control systems and the improvement of the quality of the cotton would enable the percentage of waste to be cut down to the reference standard level, which is 11 per cent for spinning and 2 per cent for weaving, or 13 per cent in all.

If the existing part cost of a metre of fabric is taken as the base (see table 118), the following observations may be made:

(i) Of the different hypotheses considered, hypothesis II (reconditioning combined with replacement of machinery), with either three work shifts or two (indices 81.9 and 84.6), appears to effect the greatest reduction in the part cost.

(ii) Hypothesis III (re-equipment involving more intensive investment) would result in a higher part cost than hypothesis II, with either two shifts of three (indices 92.4 and 82.2, respectively), despite the rapid increase in productivity that would ensue. The reason is that the incidence of capital costs would more than offset the increase in productivity, because of the relative prices in labour and capital now prevailing in Brazil.

(iii) Hypothesis I (a better use of the existing machinery) would result in an appreciable reduction in part cost compared with the present figure. This reduction does not appear to be affected by the number of operating shifts worked (indices 87.1 and 87.3, respectively) because the existing incidence of capital charges on the part cost is relatively slight.

(iv) A comparison of hypotheses I and II reveals a difference at the three-shift level only (87.3 against 81.9). Two shifts would not permit the increase in productivity to offset the capital charges imposed by the high level of investment postulated in hypothesis II.

(v) It should be noted that the figures in the foregoing table are intended to provide some guide-lines for the average spinning and weaving mills, and do not exclude

TABLE 117. ESTIMATED VALUE OF AMORTIZATION AND INTEREST ON CAPITAL IN THE SAMPLE COTTON SPINNING AND WEAVING MILL ACCORDING TO DIFFERENT RE-EQUIPMENT HYPOTHESES

| | *Existing situation* | | *Hypothesis I* | | *Hypothesis II* | | *Hypothesis III* | |
|---|---|---|---|---|---|---|---|---|
| *Process* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* | *Two shifts* | *Three shifts* |
| *Spinning* | | | | | | | | |
| Value of machinery (thousands of cruzeiros) | 126,140 | 126,140 | 126,140 | 126,140 | 359,629 | 359,629 | 409,446 | 409,446 |
| Amortization (10 per cent) | 12,614 | 12,614 | 12,614 | 12,614 | 35,963 | 35,963 | 40,945 | 40,945 |
| Interest on capital (12 per cent) | 4,128 | 14,128 | 14,128 | 14,128 | 40,279 | 40,279 | 45,858 | 45,858 |
| Annual production (tons) | 1,700 | 2,340 | 2,000 | 2,770 | 1,700 | 2,340 | 1,700 | 2,340 |
| Amortization per kg (cruzeiros) | 7.42 | 5.39 | 6.31 | 4.55 | 21.04 | 15.37 | 24.09 | 17.50 |
| Interest on capital per kg (cruzeiros) | 8.31 | 6.04 | 7.06 | 5.10 | 23.69 | 17.21 | 26.98 | 19.60 |
| Amortization and interest on capital per metre of fabric[a] (cruzeiros) | 1.77 | 1.28 | 1.50 | 1.08 | 5.01 | 3.65 | 5.72 | 4.15 |
| *Weaving* | | | | | | | | |
| Value of machinery (thousands of cruzeiros) | 99,776 | 99,776 | 99,776 | 99,776 | 137,805 | 137,805 | 262,365 | 262,365 |
| Amortization (10 per cent) | 9,978 | 9,978 | 9,978 | 9,978 | 13,780 | 13,780 | 26,237 | 26,237 |
| Interest on capital (12 per cent) | 11,175 | 11,175 | 11,175 | 11,175 | 15,434 | 15,434 | 29,385 | 29,385 |
| Annual production (thousands of metres) | 6,700 | 9,200 | 9,590 | 13,186 | 6,700 | 9,200 | 6,700 | 9,200 |
| Amortization per metre (cruzeiros) | 1.49 | 1.08 | 1.04 | 0.76 | 2.05 | 1.50 | 3.92 | 2.85 |
| Interest on capital per metre (cruzeiros) | 1.67 | 1.21 | 1.17 | 0.85 | 2.30 | 1.57 | 4.39 | 3.19 |
| Amortization and interest on capital per metre (cruzeiros) | 3.16 | 2.29 | 2.21 | 1.61 | 4.36 | 3.07 | 8.31 | 6.04 |
| Indices for amortization and interest on capital | | | | | | | | |
| Spinning | 100.0 | 72.3 | 84.7 | 61.0 | 283.1 | 203.9 | 323.2 | 234.5 |
| Weaving | 100.0 | 72.5 | 69.9 | 50.9 | 138.0 | 97.2 | 263.0 | 191.1 |
| TOTAL | 100.0 | 72.4 | 75.2 | 54.6 | 190.1 | 136.3 | 284.6 | 182.9 |

*Source:* As indicated in the text.
[a] At the rate of 8.93 metres per kg of yarn.

A complete estimate of the cost of production would have to take into account other cost factors which cannot be considered here, such as expenditures on power, fuel and upkeep, as well as overheads and administrative expenditure. However, the fact that the part cost, covering labour, machinery (amortization and interest) and raw materials, represents about three quarters of the total cost of grey fabric justifies its use as an importnat criterion in evaluating these hypotheses.

It seems likely that the use of new machinery, the application of efficient control systems and the improvement of the quality of the cotton would enable the percentage of waste to be cut down to the reference standard level, which is 11 per cent for spinning and 2 per cent for weaving, or 13 per cent in all.

If the existing part cost of a metre of fabric is taken as the base (see table 118), the following observations may be made:

(i) Of the different hypotheses considered, hypothesis II (reconditioning combined with replacement of machinery), with either three work shifts or two (indices 81.9 and 84.6), appears to effect the greatest reduction in the part cost.

(ii) Hypothesis III (re-equipment involving more intensive investment) would result in a higher part cost than hypothesis II, with either two shifts of three (indices 92.4 and 82.2, respectively), despite the rapid increase in productivity that would ensue. The reason is that the incidence of capital costs would more than offset the increase in productivity, because of the relative prices in labour and capital now prevailing in Brazil.

(iii) Hypothesis I (a better use of the existing machinery) would result in an appreciable reduction in part cost compared with the present figure. This reduction does not appear to be affected by the number of operating shifts worked (indices 87.1 and 87.3, respectively) because the existing incidence of capital charges on the part cost is relatively slight.

(iv) A comparison of hypotheses I and II reveals a difference at the three-shift level only (87.3 against 81.9). Two shifts would not permit the increase in productivity to offset the capital charges imposed by the high level of investment postulated in hypothesis II.

(v) It should be noted that the figures in the foregoing table are intended to provide some guide-lines for the average spinning and weaving mills, and do not exclude tioning of the machinery capable of modernization in accordance with the technical standards indicated, and the replacement of machinery that, according to the survey data and the above-mentioned technical criteria, is hopelessly obsolete. This assessment, of which a detailed account is given in the next chapter, is limited to the Centro-Sul States, since a programme for the re-equipment of the textile industry in the Nordeste States is already being carried out by SUDENE, under the special legislation establishing the terms of reference for this regional development organization.

In this illustrative assessment the following principles were observed:

(*a*) Reconditioning of the machinery should be as economical as possible, in view of the shortage of investment resources in Brazil and the many pressing needs in other sectors.

(*b*) Preference should be given to machinery made in Brazil, provided it complies with the minimum standards required by the technological level proposed for Brazil's future textile inventory. The use of domestically manufactured machinery would still be contingent on the quantities of each type that could be made in the country during a period which should not in principle exceed five years—this being regarded as the right length of time to allow for a co-ordinated effort to reorganize and re-equip.

The basic principle of using domestically manufactured machinery in the main was adopted not only because of the need to keep expenditure in foreign currency to the minimum, but also because re-equipment on this basis would, besides directly benefiting the textile industry, encourage the domestic manufacture of machinery. This, in turn, would give rise to further capital investment, make for new employment opportunities, facilitate the future replacement of machinery and its regular maintenance, and also create conditions that would enable Brazil to consider becoming a supplier of textile machinery to other Latin American countries that were members of the Latin American Free-Trade Association.

(*c*) Machinery should be imported, firstly, if it is not produced in Brazil and if heavy investment in future domestic production is out of the question because the machinery is not of a type that can be produced in Brazil on an economic scale; and secondly, the impossibility of doing so on an economic scale, or if it is not yet being turned out in sufficient quantity to meet the requirements of the re-equipment plan for the next five years.

(*d*) The estimates of the machinery required to achieve the same output as at present were based on two equal shifts a day, except in the case of certain machines that prepare the raw material (opener-scutchers), which have a higher output than those used in subsequent processes (cards, drawing frames, etc.). In their case, the operating time was assumed to be whatever was needed to keep the succeeding machines supplied.

(*e*) The re-equipment programme should also aim at minimizing the displacement of labour that might be caused by the higher degree of automation that re-equipment would entail.

(*f*) Consequently, it was considered that the level of up-to-dateness suitable for Brazil's present stage of economic development would be one sufficient to enable certain minimum levels of productivity to be reached without the drastic reduction in employment that would result from the introduction of highly automatic modern machinery, and is justifiable only in countries where the cost of labour is much higher than in Brazil. The even more modern non-conventional processes used experimentally in the cotton industry were also left out of account, for the same reason, and also because the machinery required for such processes will probably be difficult to obtain for the next ten years at least. Thus the technology considered most suitable is that corresponding to hypothesis II.

(*g*) The re-equipment should be carried out in conjunction with measures to improve the training of the labour force and to rationalize operational methods, maintenance and administration in general. The importance of these parallel measures should be emphasized by some scheme of government benefits or incentives that would be conditional upon their adoption, as approved by some technical body. Otherwise the introduction of new machinery will not produce the increases in labour productivity and unit output per machine/hour that are technically possible and that were assumed in the comparisons in the preceding section.

In accordance with these principles the following alternatives were used as a basis for calculating requirements:

(1) Reconditioning of old machinery, provided that its design and present condition justify the expenditure involved. This entails an estimate of the number of machines (by type), that, in view of age and technical characteristics as reported by the mills, can be regarded as fit for reconditioning. The over-all total of equipment to be reconditioned was divided into two groups, the first comprising machinery that could be reconditioned by Brazilian firms specializing in that work, and the second machinery that would require imported parts or accessories.

(2) When the old machines cannot be reconditioned, they should be replaced by modern machinery of Brazilian origin. Only in the cases referred to above, when domestic manufacture of such machines is insufficient or non-existent, should they be imported.

However large the number of machines to be reconditioned, it will still be necessary to replace a fairly large number of obsolete units; consequently a policy must be formulated to determine what is to be done with the machines that are no longer used. The following courses are open:

(i) The machines can be put out of commission and left in the mills;

(ii) An attempt can be made to sell them abroad;

(iii) They can be scrapped on the basis of productive capacity, that is, if a new machine produces as much as two old ones, the latter will be replaced by the new machine and scrapped;

(iv) The old equipment can be scrapped machine by machine, as it is replaced by modern units.

The first course is the least satisfactory, since machines left in the mills would take up space and would undoubtedly be used whenever there was an increase in demand that could not be met by the new machinery. Thus the mill would be back in the same situation, and as average productivity fell, costs would increase, and so would prices. The second course would be the best, tioning of the machinery capable of modernization in accordance with the technical standards indicated, and the replacement of machinery that, according to the survey data and the above-mentioned technical criteria, is hopelessly obsolete. This assessment, of which a detailed account is given in the next chapter, is limited to the Centro-Sul States, since a programme for the re-equipment of the textile industry in the Nordeste States is already being carried out by SUDENE, under the special legislation establishing the terms of reference for this regional development organization.

In this illustrative assessment the following principles were observed:

(*a*) Reconditioning of the machinery should be as economical as possible, in view of the shortage of investment resources in Brazil and the many pressing needs in other sectors.

(*b*) Preference should be given to machinery made in Brazil, provided it complies with the minimum standards required by the technological level proposed for Brazil's future textile inventory. The use of domestically manufactured machinery would still be contingent on the quantities of each type that could be made in the country during a period which should not in principle exceed five years—this being regarded as the right length of time to allow for a co-ordinated effort to reorganize and re-equip.

The basic principle of using domestically manufactured machinery in the main was adopted not only because of the need to keep expenditure in foreign currency to the minimum, but also because re-equipment on this basis would, besides directly benefiting the textile industry, encourage the domestic manufacture of machinery. This, in turn, would give rise to further capital investment, make for new employment opportunities, facilitate the future replacement of machinery and its regular maintenance, and also create conditions that would enable Brazil to consider becoming a supplier of textile machinery to other Latin American countries that were members of the Latin American Free-Trade Association.

(*c*) Machinery should be imported, firstly, if it is not produced in Brazil and if heavy investment in future domestic production is out of the question because the machinery is not of a type that can be produced in Brazil on an economic scale; and secondly, the impossibility of doing so on an economic scale, or if it is not yet being turned out in sufficient quantity to meet the requirements of the re-equipment plan for the next five years.

(*d*) The estimates of the machinery required to achieve the same output as at present were based on two equal shifts a day, except in the case of certain machines that prepare the raw material (opener-scutchers), which have a higher output than those used in subsequent processes (cards, drawing frames, etc.). In their case, the operating time was assumed to be whatever was needed to keep the succeeding machines supplied.

(*e*) The re-equipment programme should also aim at minimizing the displacement of labour that might be caused by the higher degree of automation that re-equipment would entail.

(*f*) Consequently, it was considered that the level of up-to-dateness suitable for Brazil's present stage of economic development would be one sufficient to enable certain minimum levels of productivity to be reached without the drastic reduction in employment that would result from the introduction of highly automatic modern machinery, and is justifiable only in countries where the cost of labour is much higher than in Brazil. The even more modern non-conventional processes used experimentally in the cotton industry were also left out of account, for the same reason, and also because the machinery required for such processes will probably be difficult to obtain for the next ten years at least. Thus the technology considered most suitable is that corresponding to hypothesis II.

(*g*) The re-equipment should be carried out in conjunction with measures to improve the training of the labour force and to rationalize operational methods, maintenance and administration in general. The importance of these parallel measures should be emphasized by some scheme of government benefits or incentives that would be conditional upon their adoption, as approved by some technical body. Otherwise the introduction of new machinery will not produce the increases in labour productivity and unit output per machine/hour that are technically possible and that were assumed in the comparisons in the preceding section.

In accordance with these principles the following alternatives were used as a basis for calculating requirements:

(1) Reconditioning of old machinery, provided that its design and present condition justify the expenditure involved. This entails an estimate of the number of machines (by type), that, in view of age and technical characteristics as reported by the mills, can be regarded as fit for reconditioning. The over-all total of equipment to be reconditioned was divided into two groups, the first comprising machinery that could be reconditioned by Brazilian firms specializing in that work, and the second machinery that would require imported parts or accessories.

(2) When the old machines cannot be reconditioned, they should be replaced by modern machinery of Brazilian origin. Only in the cases referred to above, when domestic manufacture of such machines is insufficient or non-existent, should they be imported.

However large the number of machines to be reconditioned, it will still be necessary to replace a fairly large number of obsolete units; consequently a policy must be formulated to determine what is to be done with the machines that are no longer used. The following courses are open:

(i) The machines can be put out of commission and left in the mills;

(ii) An attempt can be made to sell them abroad;

(iii) They can be scrapped on the basis of productive capacity, that is, if a new machine produces as much as two old ones, the latter will be replaced by the new machine and scrapped;

(iv) The old equipment can be scrapped machine by machine, as it is replaced by modern units.

The first course is the least satisfactory, since machines left in the mills would take up space and would undoubtedly be used whenever there was an increase in demand that could not be met by the new machinery. Thus the mill would be back in the same situation, and as average productivity fell, costs would increase, and so would prices. The second course would be the best, The introduction of a third full shift would require an increase in manpower of 50 per cent of that needed for two shifts. On the basis of the additional labour required for the increased output needed to satisfy demand subsequent to 1967, and assuming that this additional output would be produced by using the machinery at the technological level envisaged for the future machinery inventory, the total labour force required on a three-shift basis, in terms of percentage of the present labour force, would be as shown in table 119. In other words, the reorganization and re-equipment programme, when completed, will mean that in the cotton and wool sectors the labour force will be reduced by about 24 per cent in the spinning mills and about 38.5 per cent in the weaving mills. As in the cotton and wool sectors about 53 per cent of the labour force is employed in the spinning mills, the average reduction of employment for spinning and weaving mills together would be about 31.8 per cent of the present level.[6] As previously stated, this calculation

TABLE 119. ESTIMATED LABOUR FORCE REQUIRED FOR THE PROPOSED FUTURE TEXTILE MACHINERY INVENTORY

*(Percentage of present labour force)*

| | |
|---|---|
| *Spinning* | |
| For two shifts | 44.0 |
| For a third shift | 22.0 |
| Effect of expanding the machinery inventory | 10.0 |
| TOTAL | 76.0 |
| *Weaving* | |
| For two shifts | 36.5 |
| For a third shift | 18.7 |
| Effect of expanding the machinery inventory | 6.3 |
| TOTAL | 61.5 |
| TOTAL for spinning and weaving together | 68.2 |

[6] It should be noted that if the standard adopted for weaving were 43 metres per man/hour, instead of 27 (see Methodological Annex, Section 7 (*b*)), the reduction in employment would be much greater, because only 47 per cent of the labour force now employed would be needed. The total reduction in employment for spinning and weaving together would then be 45 per cent instead of 31.8 per cent.

is something of an approximation because its aggregate nature does not take account of the variations from mill to mill which may affect the final results. Moreover, it is assumed that the position as regards the other fibres will be much the same as for cotton and wool.

The reduction in employment is not likely to take place all at once, but will probably be gradual, as it becomes possible, through adequate training and vigorous measures of internal reorganization in the mills, to reach optimum workloads without affecting the efficiency of the machinery or the quality of the product, and this may well take two or three years. It should also be noted that a reorganization and modernization programme in a branch of industry with levels of efficiency and productivity as low as those in the Brazilian weaving industry must inevitably produce an appreciable reduction in the labour employed, since redundant manpower is one symptom of the archaic operating conditions that the programme is intended to abolish.

However, there are a few points that show how in practice the situation may be viewed in a less unfavourable light. The measures of internal reorganization and improved working methods which are intended to go hand in hand with the replacement of obsolete equipment may not in practice be fully synchronized with the machinery replacement in some years (at least as regards achieving full results). There will thus be a tendency for the figures for manpower reduction given above to be substantially modified through the effect of the increase in apparent consumption. Moreover, the expansion of the domestic market may take place more rapidly than expected if the high gross product growth rates recorded in past years are accompanied in the next few years by a more balanced distribution, both between regions and between classes of the population. Reduction in textile costs may also have a favourable effect on the consumption of the low income groups. Another point is that there is a steady staff turn-over in the textile mills, representing an average of 10 per cent of the labour force employed in the Brazilian spinning and weaving industry. If during the period when the operatives are adapting themselves to the new machinery no additional labour is recruited to replace those lost through turn-over, the manpower displaced by modernization might be completely reabsorbed by the industry itself.

The introduction of a third full shift would require an increase in manpower of 50 per cent of that needed for two shifts. On the basis of the additional labour required for the increased output needed to satisfy demand subsequent to 1967, and assuming that this additional output would be produced by using the machinery at the technological level envisaged for the future machinery inventory, the total labour force required on a three-shift basis, in terms of percentage of the present labour force, would be as shown in table 119. In other words, the reorganization and re-equipment programme, when completed, will mean that in the cotton and wool sectors the labour force will be reduced by about 24 per cent in the spinning mills and about 38.5 per cent in the weaving mills. As in the cotton and wool sectors about 53 per cent of the labour force is employed in the spinning mills, the average reduction of employment for spinning and weaving mills together would be about 31.8 per cent of the present level.[6] As previously stated, this calculation is something of an approximation because its aggregate nature does not take account of the variations from mill to mill which may affect the final results. Moreover, it is assumed that the position as regards the other fibres will be much the same as for cotton and wool.

TABLE 119. ESTIMATED LABOUR FORCE REQUIRED FOR THE PROPOSED FUTURE TEXTILE MACHINERY INVENTORY

*(Percentage of present labour force)*

| | |
|---|---|
| *Spinning* | |
| For two shifts | 44.0 |
| For a third shift | 22.0 |
| Effect of expanding the machinery inventory | 10.0 |
| TOTAL | 76.0 |
| *Weaving* | |
| For two shifts | 36.5 |
| For a third shift | 18.7 |
| Effect of expanding the machinery inventory | 6.3 |
| TOTAL | 61.5 |
| TOTAL for spinning and weaving together | 68.2 |

[6] It should be noted that if the standard adopted for weaving were 43 metres per man/hour, instead of 27 (see Methodological Annex, Section 7 (*b*)), the reduction in employment would be much greater, because only 47 per cent of the labour force now employed would be needed. The total reduction in employment for spinning and weaving together would then be 45 per cent instead of 31.8 per cent.

The reduction in employment is not likely to take place all at once, but will probably be gradual, as it becomes possible, through adequate training and vigorous measures of internal reorganization in the mills, to reach optimum workloads without affecting the efficiency of the machinery or the quality of the product, and this may well take two or three years. It should also be noted that a reorganization and modernization programme in a branch of industry with levels of efficiency and productivity as low as those in the Brazilian weaving industry must inevitably produce an appreciable reduction in the labour employed, since redundant manpower is one symptom of the archaic operating conditions that the programme is intended to abolish.

However, there are a few points that show how in practice the situation may be viewed in a less unfavourable light. The measures of internal reorganization and improved working methods which are intended to go hand in hand with the replacement of obsolete equipment may not in practice be fully synchronized with the machinery replacement in some years (at least as regards achieving full results). There will thus be a tendency for the figures for manpower reduction given above to be substantially modified through the effect of the increase in apparent consumption. Moreover, the expansion of the domestic market may take place more rapidly than expected if the high gross product growth rates recorded in past years are accompanied in the next few years by a more balanced distribution, both between regions and between classes of the population. Reduction in textile costs may also have a favourable effect on the consumption of the low income groups. Another point is that there is a steady staff turn-over in the textile mills, representing an average of 10 per cent of the labour force employed in the Brazilian spinning and weaving industry. If during the period when the operatives are adapting themselves to the new machinery no additional labour is recruited to replace those lost through turn-over, the manpower displaced by modernization might be completely reabsorbed by the industry itself.

1.5 per cent. The requirements of the jute sector are large in relation to its size; the reverse is true of the flax sector. This is because jute-processing machinery is the oldest and flax processing machinery the most up-to-date (see chapter IV).

Each sector's requirements are given below in tabular form (see tables 120 to 125), with comments on the loom and spindle requirements.

### (a) *Cotton sector*

(i) *Spinning*. It was estimated, on the basis of the criteria of up-to-dateness adopted, that a future up-to-date inventory of 1.7 million spindles would be needed to produce the amount of yarn now produced by a largely obsolete inventory of 2.9 million spindles, a reduction of 40 per cent. This reduction is possible because one new spindle can produce as much as three old ones, and thus over a million obsolete spindles could be replaced by 350,000 new spindles (representing about 20 per cent of the new inventory). Table 120 shows that a substantial proportion of the cotton processing machinery requirements can be supplied through reconditioning; in spinning the 843,000 reconditioned spindles would represent nearly 50 per cent of the new inventory. The remainder of the inventory would consist of the existing 529,000 up-to-date spindles.

(ii) *Weaving*. The estimated reduction of the weaving inventory would be 43 per cent, from 71,000 looms to 40,500. The new inventory would be made up of 18,000 existing up-to-date looms (44 per cent), 7,000 reconditioned looms (18 per cent), and 15,500 newly purchased looms (38 per cent).

TABLE 120. COTTON: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| | *Composition of future inventory* | | | *Total number of machines* | |
|---|---|---|---|---|---|
| | *Existing machinery* | | *Machinery to be purchased* | | |
| *Type of machine* | *Up-to-date* | *To be reconditioned* | | *Future* | *Existing* |
| ***Preparation for spinning*** | | | | | |
| Scutchers | 166 | 7 | 129 | 302 | 420 |
| Cards | 1,625 | 2,421 | 2,595 | 6,641 | 9,956 |
| Sliver lap machines (heads) | 82 | 2 | 42 | 126 | 315 |
| Ribbon lap machines (heads) | 69 | 2 | 61 | 132 | 209 |
| Combers (heads) | 169 | 61 | 771 | 1,001 | 2,157 |
| Drawing frames (heads) | 70 | — | 2,270 | 2,340 | 11,233 |
| Roving frames (spindles) | 24,191 | 15,294 | 21,671 | 61,156 | 338,324 |
| Slubbing frames (spindles) | 2,840 | 2,724 | 3,264 | 8,828 | 59,132 |
| Intermediate frames (spindles) | 4,498 | 324 | — | 4,822 | 93,148 |
| Roving and fine roving frames (spindles) | — | — | — | — | 166,921 |
| High-draft roving frames (spindles) | 16,853 | 12,246[a] | 18,407 | 47,506 | 19,123 |
| ***Spinning*** | | | | | |
| Spindles | 528,704 | 843,984 | 354,370 | 1,727,058 | 2,894,782 |
| ***Preparation for weaving*** | | | | | |
| Reeling machines (heads) | 4,019 | 1,576 | 2,616 | 8,211 | 32,521 |
| Cheese winders (spindles) | 34,904 | — | 16,399 | 51,303 | 107,639 |
| Doubling frames (spindles) | 172,229 | 77,121 | 38,042 | 287,392 | 461,815 |
| Pirn winders (spindles) | 13,745 | — | 3,164 | 16,909 | 44,844 |
| Warping machines | 193 | — | 294 | 487 | 1,277 |
| Slasher sizers | 75 | 17 | 149 | 241 | 426 |
| ***Weaving*** | | | | | |
| Non-automatic looms | 2,189 | — | 56 | 2,245 | 49,517 |
| Plain looms | 1 | — | — | 1 | 25,967 |
| Check looms | 2,038 | — | 20 | 2,058 | 10,245 |
| Dobby looms | — | — | — | — | 10,581 |
| Jacquard looms | 150 | — | 36 | 186 | 2,724 |
| Automatic looms | 15,746 | 7,084[b] | 15,431 | 38,261 | 21,496 |
| Plain looms | 11,451 | 4,556[b] | 8,808 | 24,815 | 15,442 |
| Check looms | 449 | 82[b] | 3,167 | 3,698 | 775 |
| Dobby looms | 3,749 | 1,938[b] | 3,005 | 8,692 | 5,173 |
| Jacquard looms | 97 | 508[b] | 451 | 1,056 | 106 |
| All looms | 17,935 | 7,084[b] | 15,487 | 40,506 | 71,013 |

*Source:* ECLA and textile associations.

[a] Intermediate frames converted into high-draft roving frames.

[b] Non-automatic looms converted into automatic looms.

1.5 per cent. The requirements of the jute sector are large in relation to its size; the reverse is true of the flax sector. This is because jute-processing machinery is the oldest and flax processing machinery the most up-to-date (see chapter IV).

Each sector's requirements are given below in tabular form (see tables 120 to 125), with comments on the loom and spindle requirements.

### (a) *Cotton sector*

(i) *Spinning.* It was estimated, on the basis of the criteria of up-to-dateness adopted, that a future up-to-date inventory of 1.7 million spindles would be needed to produce the amount of yarn now produced by a largely obsolete inventory of 2.9 million spindles, a reduction of 40 per cent. This reduction is possible because one new spindle can produce as much as three old ones, and thus over a million obsolete spindles could be replaced by 350,000 new spindles (representing about 20 per cent of the new inventory). Table 120 shows that a substantial proportion of the cotton processing machinery requirements can be supplied through reconditioning; in spinning the 843,000 reconditioned spindles would represent nearly 50 per cent of the new inventory. The remainder of the inventory would consist of the existing 529,000 up-to-date spindles.

(ii) *Weaving.* The estimated reduction of the weaving inventory would be 43 per cent, from 71,000 looms to 40,500. The new inventory would be made up of 18,000 existing up-to-date looms (44 per cent), 7,000 reconditioned looms (18 per cent), and 15,500 newly purchased looms (38 per cent).

TABLE 120. COTTON: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| *Type of machine* | *Composition of future inventory* — *Existing machinery* — *Up-to-date* | *To be reconditioned* | *Machinery to be purchased* | *Total number of machines* — *Future* | *Existing* |
|---|---|---|---|---|---|
| *Preparation for spinning* | | | | | |
| Scutchers | 166 | 7 | 129 | 302 | 420 |
| Cards | 1,625 | 2,421 | 2,595 | 6,641 | 9,956 |
| Sliver lap machines (heads) | 82 | 2 | 42 | 126 | 315 |
| Ribbon lap machines (heads) | 69 | 2 | 61 | 132 | 209 |
| Combers (heads) | 169 | 61 | 771 | 1,001 | 2,157 |
| Drawing frames (heads) | 70 | — | 2,270 | 2,340 | 11,233 |
| Roving frames (spindles) | 24,191 | 15,294 | 21,671 | 61,156 | 338,324 |
| Slubbing frames (spindles) | 2,840 | 2,724 | 3,264 | 8,828 | 59,132 |
| Intermediate frames (spindles) | 4,498 | 324 | — | 4,822 | 93,148 |
| Roving and fine roving frames (spindles) | — | — | — | — | 166,921 |
| High-draft roving frames (spindles) | 16,853 | 12,246[a] | 18,407 | 47,506 | 19,123 |
| *Spinning* | | | | | |
| Spindles | 528,704 | 843,984 | 354,370 | 1,727,058 | 2,894,782 |
| *Preparation for weaving* | | | | | |
| Reeling machines (heads) | 4,019 | 1,576 | 2,616 | 8,211 | 32,521 |
| Cheese winders (spindles) | 34,904 | — | 16,399 | 51,303 | 107,639 |
| Doubling frames (spindles) | 172,229 | 77,121 | 38,042 | 287,392 | 461,815 |
| Pirn winders (spindles) | 13,745 | — | 3,164 | 16,909 | 44,844 |
| Warping machines | 193 | — | 294 | 487 | 1,277 |
| Slasher sizers | 75 | 17 | 149 | 241 | 426 |
| *Weaving* | | | | | |
| Non-automatic looms | 2,189 | — | 56 | 2,245 | 49,517 |
| Plain looms | 1 | — | — | 1 | 25,967 |
| Check looms | 2,038 | — | 20 | 2,058 | 10,245 |
| Dobby looms | — | — | — | — | 10,581 |
| Jacquard looms | 150 | — | 36 | 186 | 2,724 |
| Automatic looms | 15,746 | 7,084[b] | 15,431 | 38,261 | 21,496 |
| Plain looms | 11,451 | 4,556[b] | 8,808 | 24,815 | 15,442 |
| Check looms | 449 | 82[b] | 3,167 | 3,698 | 775 |
| Dobby looms | 3,749 | 1,938[b] | 3,005 | 8,692 | 5,173 |
| Jacquard looms | 97 | 508[b] | 451 | 1,056 | 106 |
| All looms | 17,935 | 7,084[b] | 15,487 | 40,506 | 71,013 |

*Source:* ECLA and textile associations.

[a] Intermediate frames converted into high-draft roving frames.

[b] Non-automatic looms converted into automatic looms.

(c) *Man-made fibres*

(i) *Spinning*. The current inventory of 52,908 spindles could be replaced by a more up-to-date inventory of only 44,120, a reduction of 17 per cent. The composition of the new inventory would be: 37,560 existing up-to-date spindles (85 per cent), 1,873 reconditioned spindles (4.4 per cent), and 4,687 newly purchased spindles (10.6 per cent).

(ii) *Weaving*. As there is a high proportion of obsolete looms in this branch, the 14,493 existing looms could be replaced by a more up-to-date inventory, consisting of the existing 2,233 up-to-date looms, plus 3,864 reconditioned looms and 1,256 newly purchased looms, a total of 7,353 looms that would represent a reduction of 43 per cent compared with the present inventory.

TABLE 122. MAN-MADE FIBRES: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | Existing machinery: To be reconditioned | Machinery to be purchased | Total number of machines: Future | Existing |
|---|---|---|---|---|---|
| *Preparation for spinning* | | | | | |
| Scutchers | 5 | — | 1 | 6 | 7 |
| Cards | 86 | 32 | 7 | 125 | 139 |
| Drawing frames (heads) | 8 | — | 40 | 48 | 184 |
| Roving frames (spindles) | 1,949 | 56[a] | 26 | 2,031 | 4,206 |
| Slubbing frames (spindles) | — | — | — | — | 20 |
| Intermediate frames (spindles) | — | — | — | — | 2,662 |
| Roving and fine roving frames (spindles) | 1,331 | — | — | 1,331 | 864 |
| High-draft roving frames (spindles) | 618 | 56[a] | 26 | 700 | 660 |
| *Spinning* | | | | | |
| Spindles | 37,560 | 1,873 | 4,687 | 44,120 | 52,908 |
| *Preparation for weaving* | | | | | |
| Reeling machines (spindles) | 599 | 213 | 58 | 870 | 2,620 |
| Cheese winders (spindles) | 4,006 | — | 786 | 4,792 | 13,989 |
| Doubling frames (spindles) | 50,870 | 19,124 | 2,726 | 72,720 | 184,704 |
| Pirn winders (spindles) | 3,024 | — | 653 | 3,677 | 18,674 |
| Warping machines | 162 | 183 | 40 | 385 | 814 |
| Slasher sizers | 14 | 9 | 7 | 30 | 52 |
| *Weaving* | | | | | |
| Non-automatic looms | 1,178 | — | 6 | 1,184 | 13,333 |
| Plain looms | 5 | — | — | 5 | 792 |
| Check looms | 994 | — | 3 | 997 | 2,742 |
| Dobby looms | — | — | — | — | 9,081 |
| Jacquard looms | 179 | — | 3 | 182 | 718 |
| Automatic looms | 1,055 | 3,864[b] | 1,250 | 6,169 | 1,160 |
| Plain looms | 222 | 121[b] | 31 | 374 | 242 |
| Check looms | 279 | 20[b] | 390 | 689 | 284 |
| Dobby looms | 464 | 3,588[b] | 800 | 4,852 | 537 |
| Jacquard looms | 90 | 135[b] | 29 | 254 | 97 |
| All looms | 2,233 | 3,864 | 1,256 | 7,353 | 14,493 |

*Source:* ECLA and textile associations.

[a] Intermediate grammes converted into high-draft roving frames.

[b] Non-automatic looms converted into automatic looms.

(d) *Jute sector*

(i) *Spinning*. Current output in this sector could be maintained with an up-to-date inventory of less than 20,000 spindles in place of the existing 43,000 (a reduction of 54 per cent), since one new spindle could do the work of 2.8 old spindles. The new inventory would consist of the existing 7,285 up-to-date spindles, plus 12,611 new spindles.

(ii) *Weaving*. In this branch there are only 424 up-to-date looms. The term "up-to-date" is used with qualifications, because there are only a few circular and shuttle-less looms, and these new looms are recognized as giving particularly good results with jute. The existing 3,484 looms could be replaced by only 1,356, consisting of 932 new looms plus the existing 434 up-to-date looms. Thus the inventory would be reduced by 61 per cent, one new loom taking the place of three obsolete looms.

(c) *Man-made fibres*

(i) *Spinning*. The current inventory of 52,908 spindles could be replaced by a more up-to-date inventory of only 44,120, a reduction of 17 per cent. The composition of the new inventory would be: 37,560 existing up-to-date spindles (85 per cent), 1,873 reconditioned spindles (4.4 per cent), and 4,687 newly purchased spindles (10.6 per cent).

(ii) *Weaving*. As there is a high proportion of obsolete looms in this branch, the 14,493 existing looms could be replaced by a more up-to-date inventory, consisting of the existing 2,233 up-to-date looms, plus 3,864 reconditioned looms and 1,256 newly purchased looms, a total of 7,353 looms that would represent a reduction of 43 per cent compared with the present inventory.

TABLE 122. MAN-MADE FIBRES: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| Type of machine | *Composition of future inventory* — *Existing machinery* — *Up-to-date* | *To be reconditioned* | *Machinery to be purchased* | *Total number of machines* — *Future* | *Existing* |
|---|---|---|---|---|---|
| ***Preparation for spinning*** | | | | | |
| Scutchers | 5 | — | 1 | 6 | 7 |
| Cards | 86 | 32 | 7 | 125 | 139 |
| Drawing frames (heads) | 8 | — | 40 | 48 | 184 |
| Roving frames (spindles) | 1,949 | 56[a] | 26 | 2,031 | 4,206 |
| Slubbing frames (spindles) | — | — | — | — | 20 |
| Intermediate frames (spindles) | — | — | — | — | 2,662 |
| Roving and fine roving frames (spindles) | 1,331 | — | — | 1,331 | 864 |
| High-draft roving frames (spindles) | 618 | 56[a] | 26 | 700 | 660 |
| ***Spinning*** | | | | | |
| Spindles | 37,560 | 1,873 | 4,687 | 44,120 | 52,908 |
| ***Preparation for weaving*** | | | | | |
| Reeling machines (spindles) | 599 | 213 | 58 | 870 | 2,620 |
| Cheese winders (spindles) | 4,006 | — | 786 | 4,792 | 13,989 |
| Doubling frames (spindles) | 50,870 | 19,124 | 2,726 | 72,720 | 184,704 |
| Pirn winders (spindles) | 3,024 | — | 653 | 3,677 | 18,674 |
| Warping machines | 162 | 183 | 40 | 385 | 814 |
| Slasher sizers | 14 | 9 | 7 | 30 | 52 |
| ***Weaving*** | | | | | |
| Non-automatic looms | 1,178 | — | 6 | 1,184 | 13,333 |
| Plain looms | 5 | — | — | 5 | 792 |
| Check looms | 994 | — | 3 | 997 | 2,742 |
| Dobby looms | — | — | — | — | 9,081 |
| Jacquard looms | 179 | — | 3 | 182 | 718 |
| Automatic looms | 1,055 | 3,864[b] | 1,250 | 6,169 | 1,160 |
| Plain looms | 222 | 121[b] | 31 | 374 | 242 |
| Check looms | 279 | 20[b] | 390 | 689 | 284 |
| Dobby looms | 464 | 3,588[b] | 800 | 4,852 | 537 |
| Jacquard looms | 90 | 135[b] | 29 | 254 | 97 |
| All looms | 2,233 | 3,864 | 1,256 | 7,353 | 14,493 |

*Source:* ECLA and textile associations.

[a] Intermediate grammes converted into high-draft roving frames.

[b] Non-automatic looms converted into automatic looms.

(d) *Jute sector*

(i) *Spinning*. Current output in this sector could be maintained with an up-to-date inventory of less than 20,000 spindles in place of the existing 43,000 (a reduction of 54 per cent), since one new spindle could do the work of 2.8 old spindles. The new inventory would consist of the existing 7,285 up-to-date spindles, plus 12,611 new spindles.

(ii) *Weaving*. In this branch there are only 424 up-to-date looms. The term "up-to-date" is used with qualifications, because there are only a few circular and shuttle-less looms, and these new looms are recognized as giving particularly good results with jute. The existing 3,484 looms could be replaced by only 1,356, consisting of 932 new looms plus the existing 434 up-to-date looms. Thus the inventory would be reduced by 61 per cent, one new loom taking the place of three obsolete looms.

(e) *Flax sector*

(i) *Spinning*. In this sector over 50 per cent of the existing spindles are up-to-date, and the remainder are all obsolete; consequently the replacement requirements are proportionately less than in the other sectors. The output of the existing 26,614 spindles could be equalled by a more up-to-date inventory of 16,627 spindles, composed of the existing 13,671 up-to-date spindles plus 2,956 new spindles, operating on a two-shift basis at 90 per cent efficiency. The consequent reduction of 38 per cent would be possible partly because at present the machinery is inefficiently used (see chapter V) and partly because about 46 per cent of the existing spindles are obsolete.

(ii) *Weaving*. It is estimated that the existing inventory of 1,335 looms could be replaced by a more modern inventory of only 867 (a reduction of about 35 per cent), consisting of the 423 existing up-to-date looms, plus 409 reconditioned and 45 newly purchased looms.

(f) *Silk sector*

The current inventory of 112 looms could be replaced by one of 66, comprising the 38 existing up-to-date looms plus 7 reconditioned and 21 newly purchased looms.

TABLE 125. SILK: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| | *Composition of future inventory* | | | *Total number of machines* | |
|---|---|---|---|---|---|
| | *Existing machinery* | | | | |
| *Type of machine* | *Up-to-date* | *To be reconditioned* | *Machinery to be purchased* | *Future* | *Existing* |
| Silk reeling machines (spindles) . . | 180 | — | — | 180 | 1,610 |
| Skein winders . . . . . . . . . . | 8 | — | — | 8 | 186 |
| Cone winders (spindles) . . . . . . | — | — | — | — | 100 |
| Twisting frames (spindles) . . . . . | 1,500 | — | — | 1,500 | 8,900 |
| Pirn winders (spindles) . . . . . . | — | — | 24 | 24 | 420 |
| Warping machines . . . . . . . . | — | 5 | 1 | 6 | 9 |
| Looms . . . . . . . . . . . . . . | 38 | 7 | 21 | 66 | 112 |

*Source:* ECLA survey.

4. THE FUTURE EQUIPMENT INVENTORY

The foregoing estimates show that the equipment inventory based on the particular hypothesis considered appropriate for purposes of illustration would consist of far fewer machines than at present. The future inventory, made up of modern units only, would have an output capacity on a two-shift basis equal to present output, and a possible third shift would provide a margin for expansion. Moreover, some mills now have a larger number of up-to-date machines, for certain stages of the production process, than are really needed on a basis of efficient production, and these could form a reserve for future expansion. Table 126 shows the principal types of production machinery in the present and future inventories by sectors, and the respective percentage reductions. These reductions are in the neighbourhood of 40 or 50 per cent, except for man-made fibre spindles (17 per cent) and jute looms (61 per cent). The figures in tables 120 to 125 above indicate that the reductions for the other types of equipment would in most cases be on a similar scale.

TABLE 126. COMPARISON OF PRESENT AND FUTURE MACHINE INVENTORIES, BY SECTOR

| | *Machine inventory* | | |
|---|---|---|---|
| *Type* | *Present* | *Future* | *Percentage decrease in inventory* |
| *Cotton* | | | |
| Spindles . . . . . . . . . . . . . . | 2,894,782 | 1,727,058 | 40 |
| Looms . . . . . . . . . . . . . . | 71,013 | 40,506 | 43 |
| *Wool* | | | |
| Combers (heads) . . . . . . . . . . | 563 | 290 | 48 |
| Spindles . . . . . . . . . . . . . . | 241,085 | 139,215 | 42 |
| Looms . . . . . . . . . . . . . . | 4,296 | 2,594 | 40 |
| *Man-made fibres* | | | |
| Spindles . . . . . . . . . . . . . . | 52,908 | 44,120 | 17 |
| Looms . . . . . . . . . . . . . . | 14,493 | 7,353 | 49 |
| *Flax* | | | |
| Spindles . . . . . . . . . . . . . . | 26,614 | 16,627 | 38 |
| Looms . . . . . . . . . . . . . . | 1,335 | 867 | 35 |
| *Jute* | | | |
| Spindles . . . . . . . . . . . . . . | 42,968 | 19,896 | 54 |
| Looms . . . . . . . . . . . . . . | 3,484 | 1,358 | 61 |

### (e) *Flax sector*

(i) *Spinning.* In this sector over 50 per cent of the existing spindles are up-to-date, and the remainder are all obsolete; consequently the replacement requirements are proportionately less than in the other sectors. The output of the existing 26,614 spindles could be equalled by a more up-to-date inventory of 16,627 spindles, composed of the existing 13,671 up-to-date spindles plus 2,956 new spindles, operating on a two-shift basis at 90 per cent efficiency. The consequent reduction of 38 per cent would be possible partly because at present the machinery is inefficiently used (see chapter V) and partly because about 46 per cent of the existing spindles are obsolete.

(ii) *Weaving.* It is estimated that the existing inventory of 1,335 looms could be replaced by a more modern inventory of only 867 (a reduction of about 35 per cent), consisting of the 423 existing up-to-date looms, plus 409 reconditioned and 45 newly purchased looms.

### (f) *Silk sector*

The current inventory of 112 looms could be replaced by one of 66, comprising the 38 existing up-to-date looms plus 7 reconditioned and 21 newly purchased looms.

TABLE 125. SILK: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| | Composition of future inventory | | | Total number of machines | |
|---|---|---|---|---|---|
| | Existing machinery | | | | |
| *Type of machine* | *Up-to-date* | *To be reconditioned* | *Machinery to be purchased* | *Future* | *Existing* |
| Silk reeling machines (spindles) | 180 | — | — | 180 | 1,610 |
| Skein winders | 8 | — | — | 8 | 186 |
| Cone winders (spindles) | — | — | — | — | 100 |
| Twisting frames (spindles) | 1,500 | — | — | 1,500 | 8,900 |
| Pirn winders (spindles) | — | — | 24 | 24 | 420 |
| Warping machines | — | 5 | 1 | 6 | 9 |
| Looms | 38 | 7 | 21 | 66 | 112 |

*Source:* ECLA survey.

## 4. THE FUTURE EQUIPMENT INVENTORY

The foregoing estimates show that the equipment inventory based on the particular hypothesis considered appropriate for purposes of illustration would consist of far fewer machines than at present. The future inventory, made up of modern units only, would have an output capacity on a two-shift basis equal to present output, and a possible third shift would provide a margin for expansion. Moreover, some mills now have a larger number of up-to-date machines, for certain stages of the production process, than are really needed on a basis of efficient production, and these could form a reserve for future expansion. Table 126 shows the principal types of production machinery in the present and future inventories by sectors, and the respective percentage reductions. These reductions are in the neighbourhood of 40 or 50 per cent, except for man-made fibre spindles (17 per cent) and jute looms (61 per cent). The figures in tables 120 to 125 above indicate that the reductions for the other types of equipment would in most cases be on a similar scale.

TABLE 126. COMPARISON OF PRESENT AND FUTURE MACHINE INVENTORIES, BY SECTOR

| | Machine inventory | | |
|---|---|---|---|
| *Type* | *Present* | *Future* | *Percentage decrease in inventory* |
| ***Cotton*** | | | |
| Spindles | 2,894,782 | 1,727,058 | 40 |
| Looms | 71,013 | 40,506 | 43 |
| ***Wool*** | | | |
| Combers (heads) | 563 | 290 | 48 |
| Spindles | 241,085 | 139,215 | 42 |
| Looms | 4,296 | 2,594 | 40 |
| ***Man-made fibres*** | | | |
| Spindles | 52,908 | 44,120 | 17 |
| Looms | 14,493 | 7,353 | 49 |
| ***Flax*** | | | |
| Spindles | 26,614 | 16,627 | 38 |
| Looms | 1,335 | 867 | 35 |
| ***Jute*** | | | |
| Spindles | 42,968 | 19,896 | 54 |
| Looms | 3,484 | 1,358 | 61 |

spindles. If the industry is to play a more important part both in the suggested re-equipment and in supplying future replacement requirements, and if it is to be able to compete on the Latin American market, its output would have to be diversified, which would imply an expansion of installed capacity. Such an expansion would obviously have to be the subject of a specific plan for this industrial sector, but it is clear that any such plan could not afford to ignore, in mapping out future expansion and diversification of production capacity, the new processes that are currently still at an experimental stage.

Another possibility that could be further explored is machine reconditioning, since even in the United States it has been found that efficiency and productivity can be substantially increased by reconditioning. In view of the great need to modernize textile equipment in all the Latin American countries, particularly in the ALALC countries, it can justifiably be assumed that in addition to the domestic market there will be a vast field open to the Brazilian plants that devote themselves to machine reconditioning.

In mid-1961 the great majority of the textile equipment plants were working at only half capacity during one eight-hour shift. According to the survey carried out by the Machinery Manufacturers' Association, nearly all the plants estimated that their output in 1962 would be twice that for 1961, which would mean that their installed capacity would be fully used during one complete daily shift. In the light of this possible increase in production, the contribution of the domestic industry in meeting requirements was itemized machine by machine. The results are presented in tables 128 to 132, which show that this contribution could cover a large proportion of the equipment needed.

One advantage in approaching re-equipment on the basis of a co-ordinated programme embracing a whole body of measures is that importing of the more complex types of machine can be linked up with their future manufacture in Brazil, that is, in placing orders abroad preference could be given to suppliers who undertake to manufacture their products in Brazil in the future. Re-equipment could thus turn out to be an effective way of promoting both the modernization and the expansion of the domestic textile equipment industry, either through the conclusion of agreements between established local plants and well known international manufacturers, or through the initiative of these manufacturers themselves.

The linking up of imports and domestic manufactures has another advantage. The problem as regards machinery that is not yet produced in Brazil is to assess whether the market is large enough to justify its production. While the re-equipment programme is being implemented there would naturally be a greater need for different types of machine, which could therefore be manufactured economically in Brazil on the basis of the temporarily expanded market. But once the programme has been completed requirements would shrink to the level required for normal replacement, and the market would in most cases revert to its usual size. The problem might perhaps be solved by combining a production programme tailored to normal market requirements with imports at an above-normal level during the limited re-equipment period, but which would be made contingent on arrangements to manufacture the equipment in question in Brazil.

Another problem is posed by the machines which the new cotton processing techniques, now at an experimental stage, are bound to render obsolete in the not very distant future. Whatever the solution, Brazilian textile equipment manufacturers should plan to diversify production so as to be ready, when the time comes, to manufacture the new types of machine needed for the simplified and highly automatic cotton spinning and weaving processes.

Another basic method of reducing costs, in addition to greater utilization of productive capacity, is standardization. In some cases local industry itself could undertake the standardization by doing what it could to co-ordinate production. For example, the many plants now manufacturing different types of loom in very small quantities could arrange to produce a few standard types of loom fitted with the latest modern improvements. Each plant that now manufactures one type of loom in its entirety would then be able to concentrate on the production of specific parts for the new types, the whole unit being eventually put together in a special assembly plant. This kind of decentralization would make it possible to rationalize and increase production and thus to turn out looms that could compete in both price and quality with the best foreign looms. Another method of standardizing equipment would be to centralize orders. This could be done through an agency responsible for reviewing and approving individual re-equipment projects, or by the industrialists themselves organized in the form of a committee for this and other purposes related to the re-equipment programme. The government agency or private committee could place the orders in such a way as to permit well-planned production in each plant.

Again, manufacturers of parts and accessories could undoubtedly operate at a lower cost if the orders put in by the different textile industries were grouped together so as to produce an even flow of large-scale orders. Another possibility would be to make a survey of the engineering plants in each state to ascertain which were best suited to manufacture particular parts. The findings of the survey would then be sent to the Spinning and Weaving Associations of those states so that they could send their orders for given types of part to particular plants, which would thus be able to concentrate on supplying a few parts and accessories.

There now follows an analysis of machinery requirements for the re-equipment of the textile industry in the Centro-Sul region, and of the proportion that could be furnished by domestic manufacturers. The data presented should not be taken to represent anything but an order of magnitude, since although they were obtained on the basis of operational charts for each plant, they are merely estimates.

### (b) *Source of the equipment for refitting the industry*

(i) *Cotton sector*. The requirements for this sector are itemized in table 128, which indicates whether the equipment could be supplied by domestic producers or would have to be imported. It shows that domestic industry could supply all the new and reconditioned spindles needed, half the reconditioned looms, and two-thirds of the new looms. It could also supply all or a spindles. If the industry is to play a more important part both in the suggested re-equipment and in supplying future replacement requirements, and if it is to be able to compete on the Latin American market, its output would have to be diversified, which would imply an expansion of installed capacity. Such an expansion would obviously have to be the subject of a specific plan for this industrial sector, but it is clear that any such plan could not afford to ignore, in mapping out future expansion and diversification of production capacity, the new processes that are currently still at an experimental stage.

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The linking up of imports and domestic manufactures has another advantage. The problem as regards machinery that is not yet produced in Brazil is to assess whether the market is large enough to justify its production. While the re-equipment programme is being implemented there would naturally be a greater need for different types of machine, which could therefore be manufactured economically in Brazil on the basis of the temporarily expanded market. But once the programme has been completed requirements would shrink to the level required for normal replacement, and the market would in most cases revert to its usual size. The problem might perhaps be solved by combining a production programme tailored to normal market requirements with imports at an above-normal level during the limited re-equipment period, but which would be made contingent on arrangements to manufacture the equipment in question in Brazil.

Another problem is posed by the machines which the new cotton processing techniques, now at an experimental stage, are bound to render obsolete in the not very distant future. Whatever the solution, Brazilian textile equipment manufacturers should plan to diversify production so as to be ready, when the time comes, to manufacture the new types of machine needed for the simplified and highly automatic cotton spinning and weaving processes.

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Again, manufacturers of parts and accessories could undoubtedly operate at a lower cost if the orders put in by the different textile industries were grouped together so as to produce an even flow of large-scale orders. Another possibility would be to make a survey of the engineering plants in each state to ascertain which were best suited to manufacture particular parts. The findings of the survey would then be sent to the Spinning and Weaving Associations of those states so that they could send their orders for given types of part to particular plants, which would thus be able to concentrate on supplying a few parts and accessories.

There now follows an analysis of machinery requirements for the re-equipment of the textile industry in the Centro-Sul region, and of the proportion that could be furnished by domestic manufacturers. The data presented should not be taken to represent anything but an order of magnitude, since although they were obtained on the basis of operational charts for each plant, they are merely estimates.

(b) *Source of the equipment for refitting the industry*

(i) *Cotton sector*. The requirements for this sector are itemized in table 128, which indicates whether the equipment could be supplied by domestic producers or would have to be imported. It shows that domestic industry could supply all the new and reconditioned spindles needed, half the reconditioned looms, and two-thirds of the new looms. It could also supply all or a

(iii) *Man-made fibre and silk sectors.* In these sectors domestic industry could furnish relatively high proportions of the new and reconditioned machines needed (see table 130). In the man-made fibre sector all the new and reconditioned spindles and all the new looms could be provided locally. In view of the large numbers of reconditioned looms that would be needed in the cotton sector it was considered that the local facilities should not be overburdened with additional orders, and it was therefore assumed that the loom reconditioning in the man-made fibre sector should be based on imports. A substantial proportion of the other machines could be locally manufactured or reconditioned. In the silk sector all the requirements could be met by domestic industry.

(iv) *Flax sector.* Brazilian industry could supply all the reconditioned units needed, and the new twisting frames, pirn winders, warping machines and looms (see table 131).

(v) *Jute sector.* No supplies would be forthcoming locally, since jute-processing machinery is not yet produced in Brazil (see table 132).

TABLE 130. MAN-MADE FIBRE AND SILK SECTORS: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| Type of machine | *Machines to be reconditioned* | | | *Machines to be purchased* | | |
|---|---|---|---|---|---|---|
| | *Domestic* | *Imported* | *Total* | *Domestic* | *Imported* | *Total* |
| | | *Man-made fibres* | | | | |
| *Preparation for spinning* | | | | | | |
| Opener/scutchers | — | — | — | — | 1 | 1 |
| Cards | 32 | — | 32 | — | 7 | 7 |
| Drawing frames (heads) | — | — | — | — | 40 | 40 |
| Roving frames (spindles) | 56 | — | 56 | — | 26 | 26 |
| *Spinning* | | | | | | |
| Spindles | 1,873 | — | 1,873 | 4,687 | — | 4,687 |
| *Preparation for weaving* | | | | | | |
| Reeling machines (spindles) | — | 213 | 213 | — | 58 | 58 |
| Cheese winders (spindles) | — | — | — | 786 | — | 786 |
| Doubling frames (spindles) | 19,124 | — | 19,124 | 2,726 | — | 2,726 |
| Pirn winders (spindles) | — | — | — | 653 | — | 653 |
| Warping machines | 183 | — | 183 | 40 | — | 40 |
| Slasher sizers | — | 9 | 9 | — | 7 | 7 |
| *Weaving* | | | | | | |
| Looms | — | 3,864 | 3,864 | 1,256 | — | 1,256 |
| | | *Silk* | | | | |
| *Preparation for weaving* | | | | | | |
| Pirn winders (spindles) | — | — | — | 24 | — | 24 |
| Warping machines | 5 | — | 5 | 1 | — | 1 |
| *Weaving* | | | | | | |
| Looms | 7 | — | 7 | 21 | — | 21 |

TABLE 131. FLAX SECTOR: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| Type of machine | *Machines to be reconditioned* | | | *Machines to be purchased* | | |
|---|---|---|---|---|---|---|
| | *Domestic* | *Imported* | *Total* | *Domestic* | *Imported* | *Total* |
| *Preparation for spinning* | | | | | | |
| Hackling machines | — | — | — | — | 1 | 1 |
| Drawing frames (heads) | — | — | — | — | 322 | 322 |
| Cards | — | — | — | — | 3 | 3 |
| Rectilinear combers (heads) | — | — | — | — | 36 | 36 |
| Roving frames (spindles) | — | — | — | — | 742 | 742 |
| *Spinning* | | | | | | |
| Spindles | — | — | — | — | 2,956 | 2,956 |
| *Preparation for weaving* | | | | | | |
| Reeling machines (spindles) | — | — | — | — | 530 | 530 |
| Cheese winders (spindles) | — | — | — | — | 486 | 486 |
| Doubling frames (spindles) | 900 | — | 900 | 40 | — | 40 |
| Pirn winders (spindles) | — | — | — | 43 | — | 43 |
| Warping machines | — | — | — | 27 | — | 27 |
| Slasher sizers | 3 | — | 3 | — | 2 | 2 |
| *Weaving* | | | | | | |
| Looms | 409 | — | 409 | 45 | — | 45 |

(iii) *Man-made fibre and silk sectors.* In these sectors domestic industry could furnish relatively high proportions of the new and reconditioned machines needed (see table 130). In the man-made fibre sector all the new and reconditioned spindles and all the new looms could be provided locally. In view of the large numbers of reconditioned looms that would be needed in the cotton sector it was considered that the local facilities should not be overburdened with additional orders, and it was therefore assumed that the loom reconditioning in the man-made fibre sector should be based on imports. A substantial proportion of the other machines could be locally manufactured or reconditioned. In the silk sector all the requirements could be met by domestic industry.

(iv) *Flax sector.* Brazilian industry could supply all the reconditioned units needed, and the new twisting frames, pirn winders, warping machines and looms (see table 131).

(v) *Jute sector.* No supplies would be forthcoming locally, since jute-processing machinery is not yet produced in Brazil (see table 132).

TABLE 130. MAN-MADE FIBRE AND SILK SECTORS: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| Type of machine | Machines to be reconditioned | | | Machines to be purchased | | |
|---|---|---|---|---|---|---|
| | *Domestic* | *Imported* | *Total* | *Domestic* | *Imported* | *Total* |
| | | | *Man-made fibres* | | | |
| *Preparation for spinning* | | | | | | |
| Opener/scutchers | — | — | — | — | 1 | 1 |
| Cards | 32 | — | 32 | — | 7 | 7 |
| Drawing frames (heads) | — | — | — | — | 40 | 40 |
| Roving frames (spindles) | 56 | — | 56 | — | 26 | 26 |
| *Spinning* | | | | | | |
| Spindles | 1,873 | — | 1,873 | 4,687 | — | 4,687 |
| *Preparation for weaving* | | | | | | |
| Reeling machines (spindles) | — | 213 | 213 | — | 58 | 58 |
| Cheese winders (spindles) | — | — | — | 786 | — | 786 |
| Doubling frames (spindles) | 19,124 | — | 19,124 | 2,726 | — | 2,726 |
| Pirn winders (spindles) | — | — | — | 653 | — | 653 |
| Warping machines | 183 | — | 183 | 40 | — | 40 |
| Slasher sizers | — | 9 | 9 | — | 7 | 7 |
| *Weaving* | | | | | | |
| Looms | — | 3,864 | 3,864 | 1,256 | — | 1,256 |
| | | *Silk* | | | | |
| *Preparation for weaving* | | | | | | |
| Pirn winders (spindles) | — | — | — | 24 | — | 24 |
| Warping machines | 5 | — | 5 | 1 | — | 1 |
| *Weaving* | | | | | | |
| Looms | 7 | — | 7 | 21 | — | 21 |

TABLE 131. FLAX SECTOR: EXISTING MACHINERY AND FUTURE REQUIREMENTS

| Type of machine | Machines to be reconditioned | | | Machines to be purchased | | |
|---|---|---|---|---|---|---|
| | *Domestic* | *Imported* | *Total* | *Domestic* | *Imported* | *Total* |
| *Preparation for spinning* | | | | | | |
| Hackling machines | — | — | — | — | 1 | 1 |
| Drawing frames (heads) | — | — | — | — | 322 | 322 |
| Cards | — | — | — | — | 3 | 3 |
| Rectilinear combers (heads) | — | — | — | — | 36 | 36 |
| Roving frames (spindles) | — | — | — | — | 742 | 742 |
| *Spinning* | | | | | | |
| Spindles | — | — | — | — | 2,956 | 2,956 |
| *Preparation for weaving* | | | | | | |
| Reeling machines (spindles) | — | — | — | — | 530 | 530 |
| Cheese winders (spindles) | — | — | — | — | 486 | 486 |
| Doubling frames (spindles) | 900 | — | 900 | 40 | — | 40 |
| Pirn winders (spindles) | — | — | — | 43 | — | 43 |
| Warping machines | — | — | — | 27 | — | 27 |
| Slasher sizers | 3 | — | 3 | — | 2 | 2 |
| *Weaving* | | | | | | |
| Looms | 409 | — | 409 | 45 | — | 45 |

# I. METHODOLOGICAL CONCEPTS

## 1. INTRODUCTION

This annex gives an account of the main methodological instruments and concepts used for the calculations made in the various chapters of the present study with respect to unit output of the machinery, labour productivity, production costs, obsolescence of the machinery and evaluation of re-equipment needs.

One of the most important of these concepts is the production charts, covering both the production situation in the plants at the time of the survey, and that which would exist in the future on the assumption that the machinery would be up-to-date and that the production standards postulated for Latin America would be met.

It should be pointed out that since the present study is the first of this kind, both the concepts set forth and the production standards postulated are subject to revision; the present study is part of a series which is to cover the textile industry of all the ALALC countries, and consequently there are many elements of the analysis that will have to be adapted in the light of the data available and the individual characteristics of the industry in each of the countries concerned.

Lastly, it should be stressed that the present account is only a brief summary, since the intention is to include in the regional report, with which it is hoped to conclude the series of countries studied, a special section giving a detailed account of the methodological principles on which those studies are based.

## 2. OPERATIONAL CHARTS

The various chapters in this study give a detailed analysis of present conditions, on the basis of unit output and productivity, machinery requirements and costs, and provide an estimate of re-equipment requirements. It was first necessary to make a mill-by-mill study of existing operating conditions and to compare the results with standards considered suitable for present conditions in Latin America. That is, a picture of the present situation was constructed and another of the future situation, to permit comparison of the two, analysis of the causes of the differences between them, and the most accurate possible assessment of the need for up-to-date machinery.

The mill-by-mill assessment, and the consideration of a number of technical criteria, were of the greatest importance because, as previously pointed out, a mere over-all assessment and consideration only of the age of the machinery would have led to wholly false conclusions. Thus use was made of the charts of existing and hypothetical production, in accordance with the methodology that had already served as the basis for the study on the re-equipment of the textile industry in the Nordeste carried out by SUDENE. These operational charts were based on the charts used by manufacturers of textile machinery to show the production flow for an operational group to be installed in either a spinning or weaving mill, which shows the whole process of the transforming of the raw material, from the yarn to the fabric (see table 134).

The questionnaire submitted to the textile manufacturers were planned so at to permit the construction of operational charts. Thus through the questionnaires information was obtained as to the existing machinery, group by group, the degree of up-to-dateness of each machine, daily output, and the number of hours worked at each processing stage. The future chart was constructed in reserve, that is, starting with the volume of yarn or fabric produced daily and thus arriving at the material used in its production. Thus, starting with a volume of output it was determined, at each stage of production, what machines were needed in the light (i) of the production criteria established as the minimum for each type of up-to-date machine, (ii) of the assumption of a standard working day of two shifts, or sixteen hours.

## 3. MACHINERY SPECIFICATIONS

The production standards[1] adopted for the purposes of the present study may be summarized as follows :

### (a) *Cotton sector*

*Spinning frames.* High-draft ring frames with a ring size of over 7 inches, and output (with an average constant for twist of 4 and an efficiency of 90 per cent) as in table 135; this table also shows the output theoretically possible with old spindles (also working at 90 per cent efficiency), and the weighting coefficients used to convert the actual output of the mills to output for a standard yarn count of Ne 18.

*Looms.* The standards for automatic looms are as shown in table 136 with average standards of speed, and an assumed efficiency of 90 per cent.

### (b) *Wool sector*

*Spinning frames.* High-draft ring spinning frames with a ring size of over 10 inches, with output according to yarn count, as shown in table 137, which also gives the coefficients used in weighting to convert actual output to output for a standard count of Nm 17.

*Looms.* For automatic looms with reed spaces of 180 centimetres operating at 90 per cent efficiency the standards assumed were 140 picks per minute for plain looms, 115 for check looms and 100 for Jacquard looms.

## 4. RAW MATERIAL WASTAGE

The standards for non-re-used waste on which the calculations were based were as shown in table 138.

## 5. CRITERIA USED IN CLASSIFYING THE MACHINERY FOR RECONDITIONING AND REPLACEMENT PURPOSES

### (a) *Description of the criteria*

One of the central points of the present study is the definition of what are regarded as up-to-date machines, machines suitable for reconditioning, and obsolete machines, with a view to assessing the level of obsolescence of the existing machinery, and indicating which machines can continue in operation, and which should be reconditioned or replaced. Up-to-date machinery is that meeting certain minimum technical and output capacity standards, fixed for each machine by applying the criteria referred to. Even an old machine may be considered as up-to-date if it meets or exceeds the basic standards fixed; this applies, for instance, to old machines that have been reconditioned. On the other hand, a recently built machine may be considered obsolete if it fails to meet the

[1] Established by textile technicians employed by the spinning and weaving manufacturers' associations in the Centro-Sul region of Brazil, which were approved by industrialists in the textile industry itself, as well as representatives of the Association of Textile Machinery Manufacturers of the State of São Paulo.

ANNEXES

# I. METHODOLOGICAL CONCEPTS

## 1. Introduction

This annex gives an account of the main methodological instruments and concepts used for the calculations made in the various chapters of the present study with respect to unit output of the machinery, labour productivity, production costs, obsolescence of the machinery and evaluation of re-equipment needs.

One of the most important of these concepts is the production charts, covering both the production situation in the plants at the time of the survey, and that which would exist in the future on the assumption that the machinery would be up-to-date and that the production standards postulated for Latin America would be met.

It should be pointed out that since the present study is the first of this kind, both the concepts set forth and the production standards postulated are subject to revision; the present study is part of a series which is to cover the textile industry of all the ALALC countries, and consequently there are many elements of the analysis that will have to be adapted in the light of the data available and the individual characteristics of the industry in each of the countries concerned.

Lastly, it should be stressed that the present account is only a brief summary, since the intention is to include in the regional report, with which it is hoped to conclude the series of countries studied, a special section giving a detailed account of the methodological principles on which those studies are based.

## 2. Operational charts

The various chapters in this study give a detailed analysis of present conditions, on the basis of unit output and productivity, machinery requirements and costs, and provide an estimate of re-equipment requirements. It was first necessary to make a mill-by-mill study of existing operating conditions and to compare the results with standards considered suitable for present conditions in Latin America. That is, a picture of the present situation was constructed and another of the future situation, to permit comparison of the two, analysis of the causes of the differences between them, and the most accurate possible assessment of the need for up-to-date machinery.

The mill-by-mill assessment, and the consideration of a number of technical criteria, were of the greatest importance because, as previously pointed out, a mere over-all assessment and consideration only of the age of the machinery would have led to wholly false conclusions. Thus use was made of the charts of existing and hypothetical production, in accordance with the methodology that had already served as the basis for the study on the re-equipment of the textile industry in the Nordeste carried out by SUDENE. These operational charts were based on the charts used by manufacturers of textile machinery to show the production flow for an operational group to be installed in either a spinning or weaving mill, which shows the whole process of the transforming of the raw material, from the yarn to the fabric (see table 134).

The questionnaire submitted to the textile manufacturers were planned so at to permit the construction of operational charts. Thus through the questionnaires information was obtained as to the existing machinery, group by group, the degree of up-to-dateness of each machine, daily output, and the number of hours worked at each processing stage. The future chart was constructed in reserve, that is, starting with the volume of yarn or fabric produced daily and thus arriving at the material used in its production. Thus, starting with a volume of output it was determined, at each stage of production, what machines were needed in the light (i) of the production criteria established as the minimum for each type of up-to-date machine, (ii) of the assumption of a standard working day of two shifts, or sixteen hours.

## 3. Machinery specifications

The production standards[1] adopted for the purposes of the present study may be summarized as follows :

### (a) *Cotton sector*

*Spinning frames.* High-draft ring frames with a ring size of over 7 inches, and output (with an average constant for twist of 4 and an efficiency of 90 per cent) as in table 135; this table also shows the output theoretically possible with old spindles (also working at 90 per cent efficiency), and the weighting coefficients used to convert the actual output of the mills to output for a standard yarn count of Ne 18.

*Looms.* The standards for automatic looms are as shown in table 136 with average standards of speed, and an assumed efficiency of 90 per cent.

### (b) *Wool sector*

*Spinning frames.* High-draft ring spinning frames with a ring size of over 10 inches, with output according to yarn count, as shown in table 137, which also gives the coefficients used in weighting to convert actual output to output for a standard count of Nm 17.

*Looms.* For automatic looms with reed spaces of 180 centimetres operating at 90 per cent efficiency the standards assumed were 140 picks per minute for plain looms, 115 for check looms and 100 for Jacquard looms.

## 4. Raw material wastage

The standards for non-re-used waste on which the calculations were based were as shown in table 138.

## 5. Criteria used in classifying the machinery for reconditioning and replacement purposes

### (a) *Description of the criteria*

One of the central points of the present study is the definition of what are regarded as up-to-date machines, machines suitable for reconditioning, and obsolete machines, with a view to assessing the level of obsolescence of the existing machinery, and indicating which machines can continue in operation, and which should be reconditioned or replaced. Up-to-date machinery is that meeting certain minimum technical and output capacity standards, fixed for each machine by applying the criteria referred to. Even an old machine may be considered as up-to-date if it meets or exceeds the basic standards fixed; this applies, for instance, to old machines that have been reconditioned. On the other hand, a recently built machine may be considered obsolete if it fails to meet the

[1] Established by textile technicians employed by the spinning and weaving manufacturers' associations in the Centro-Sul region of Brazil, which were approved by industrialists in the textile industry itself, as well as representatives of the Association of Textile Machinery Manufacturers of the State of São Paulo.

TABLE 135. COTTON[a]: STANDARD UNIT OUTPUT OF SPINNING MILLS PER SPINDLE/HOUR, BY YARN COUNT

*(At 90 per cent efficiency)*

| Yarn count | Machine output (grammes) Old machines | Modern machines | Weighting coefficients | Yarn count | Machine output (grammes) Old machines | Modern machines | Weighting coefficients |
|---|---|---|---|---|---|---|---|
| 5 . . . . . | 45 | 50 | 44.0 | 30 . . . | 11.7 | 13.0 | 169.2 |
| 8 . . . . . | 40 | 45 | 48.9 | 32 . . . | 10.4 | 11.6 | 189.6 |
| 10 . . . . . | 36.5 | 40.5 | 54.3 | 34 . . . | 9.5 | 10.4 | 211.5 |
| 11 . . . . . | 33 | 37.0 | 59.4 | 36 . . . | 8.5 | 9.4 | 234.0 |
| 12 . . . . . | 30.5 | 34.0 | 64.7 | 38 . . . | 7.8 | 8.6 | 255.8 |
| 13 . . . . . | 28 | 31.0 | 70.9 | 40 . . . | 7.2 | 8.0 | 275.0 |
| 14 . . . . . | 25 | 28.0 | 78.5 | 42 . . . | 7.0 | 7.7 | 285.7 |
| 15 . . . . . | 23.5 | 25.0 | 88.0 | 44 . . . | 6.8 | 7.5 | 293.3 |
| 16 . . . . . | 22 | 24.5 | 89.8 | 46 . . . | 6.5 | 7.2 | 305.5 |
| 17 . . . . . | 21 | 23.2 | 94.8 | 48 . . . | 6.2 | 6.8 | 323.5 |
| 18 . . . . . | 20 | 22.0 | 100.0 | 50 . . . | 6.0 | 6.6 | 333.0 |
| 19 . . . . . | 19 | 21.0 | 104.7 | 52 . . . | 5.5 | 6.1 | 360.0 |
| 20 . . . . . | 18 | 20.0 | 110.0 | 54 . . . | 5.1 | 5.7 | 386.0 |
| 22 . . . . . | 16 | 18.0 | 122.2 | 56 . . . | 4.7 | 5.2 | 423.0 |
| 24 . . . . . | 15 | 16.5 | 133.3 | 58 . . . | 4.3 | 4.8 | 458.0 |
| 26 . . . . . | 13.5 | 15.0 | 146.6 | 60 . . . | 4.1 | 4.6 | 478.0 |
| 28 . . . . . | 12.5 | 14.0 | 157.1 | 80 . . . | 2.7 | 3.0 | 733.0 |
| | | | | 100 . . . | 1.8 | 2.0 | 1,100.0 |

*Source:* As indicated in the text.

[a] This table can also be used for artificial fibres, but because of the better yield that results from the absolutely uniform length of these fibres, the standard unit output should be increased by about 20 per cent.

TABLE 136. COTTON WEAVING: STANDARD UNIT OUTPUT FOR AUTOMATIC LOOMS

*(At 90 per cent efficiency)*

| Reed space (centimetres) | Picks per minute: Plain looms | Check looms | Dobby looms | Jacquard looms |
|---|---|---|---|---|
| 75 to 100 . . . . . . . . | 180 | 145 | 165 | 140 |
| 110 to 165 . . . . . . . . | 165 | 140 | ... | ... |
| 165 to 210 . . . . . . . . | 145 | 130 | ... | ... |
| 210 to 230 . . . . . . . . | 110 | 100 | ... | ... |

TABLE 137. WOOL: STANDARD UNIT OUTPUT OF SPINNING MILLS PER SPINDLE/HOUR, BY YARN COUNT

*(At 90 per cent efficiency)*

| Metric yarn count | Output per spindle/hour (grammes) | Weighting coefficient | Metric yarn count | Output per spindle/hour (grammes) | Weighting coefficient |
|---|---|---|---|---|---|
| 4 . . . . . . . | 422 | 0.11 | 22 . . . . . . . . . | 33 | 1.45 |
| 6 . . . . . . . | 230 | 0.21 | 24 . . . . . . . . . | 29 | 1.66 |
| 8 . . . . . . . | 149 | 0.32 | 30 . . . . . . . . . | 21 | 2.29 |
| 12 . . . . . . . | 81 | 0.59 | 32 . . . . . . . . . | 19 | 2.53 |
| 15 . . . . . . . | 58 | 0.83 | 37 . . . . . . . . . | 15 | 3.20 |
| 17 . . . . . . . | 48 | 1.00 | 43 . . . . . . . . . | 12 | 4.00 |
| 19 . . . . . . . | 41 | 1.17 | 46 . . . . . . . . . | 11 | 4.36 |

requirements established as the norm. A machine is suitable for reconditioning if it can be so modified that its output will meet the standards laid down for an up-to-date machine. The possibility of reconditioning a machine can only be shown by a technical examination of the machine itself, and consequently no general rule can be laid down to determine which machines can be reconditioned. The estimate of reconditioning requirements given in the present study was based, in the first place, on an age criterion, it being assumed that all machines less than thirty years old could be reconditioned (and although this is probably not true, there are machines older than this that may be worth reconditioning, which would offset the over-estimate). Secondly, it was based on the views of textile manufacturers on the possibility of reconditioning many of the machines now in use. Thus the estimated number of machines that could be reconditioned is likely to be fairly accurate, although the exact number can only be determined

TABLE 135. COTTON[a]: STANDARD UNIT OUTPUT OF SPINNING MILLS PER SPINDLE/HOUR, BY YARN COUNT

*(At 90 per cent efficiency)*

| Yarn count | Machine output (grammes) Old machines | Modern machines | Weighting coefficients | Yarn count | Machine output (grammes) Old machines | Modern machines | Weighting coefficients |
|---|---|---|---|---|---|---|---|
| 5 . . . . . | 45 | 50 | 44.0 | 30 . . . | 11.7 | 13.0 | 169.2 |
| 8 . . . . . | 40 | 45 | 48.9 | 32 . . . | 10.4 | 11.6 | 189.6 |
| 10 . . . . . | 36.5 | 40.5 | 54.3 | 34 . . . | 9.5 | 10.4 | 211.5 |
| 11 . . . . . | 33 | 37.0 | 59.4 | 36 . . . | 8.5 | 9.4 | 234.0 |
| 12 . . . . . | 30.5 | 34.0 | 64.7 | 38 . . . | 7.8 | 8.6 | 255.8 |
| 13 . . . . . | 28 | 31.0 | 70.9 | 40 . . . | 7.2 | 8.0 | 275.0 |
| 14 . . . . . | 25 | 28.0 | 78.5 | 42 . . . | 7.0 | 7.7 | 285.7 |
| 15 . . . . . | 23.5 | 25.0 | 88.0 | 44 . . . | 6.8 | 7.5 | 293.3 |
| 16 . . . . . | 22 | 24.5 | 89.8 | 46 . . . | 6.5 | 7.2 | 305.5 |
| 17 . . . . . | 21 | 23.2 | 94.8 | 48 . . . | 6.2 | 6.8 | 323.5 |
| 18 . . . . . | 20 | 22.0 | 100.0 | 50 . . . | 6.0 | 6.6 | 333.0 |
| 19 . . . . . | 19 | 21.0 | 104.7 | 52 . . . | 5.5 | 6.1 | 360.0 |
| 20 . . . . . | 18 | 20.0 | 110.0 | 54 . . . | 5.1 | 5.7 | 386.0 |
| 22 . . . . . | 16 | 18.0 | 122.2 | 56 . . . | 4.7 | 5.2 | 423.0 |
| 24 . . . . . | 15 | 16.5 | 133.3 | 58 . . . | 4.3 | 4.8 | 458.0 |
| 26 . . . . . | 13.5 | 15.0 | 146.6 | 60 . . . | 4.1 | 4.6 | 478.0 |
| 28 . . . . . | 12.5 | 14.0 | 157.1 | 80 . . . | 2.7 | 3.0 | 733.0 |
| | | | | 100 . . . | 1.8 | 2.0 | 1,100.0 |

*Source:* As indicated in the text.

[a] This table can also be used for artificial fibres, but because of the better yield that results from the absolutely uniform length of these fibres, the standard unit output should be increased by about 20 per cent.

TABLE 136. COTTON WEAVING: STANDARD UNIT OUTPUT FOR AUTOMATIC LOOMS

*(At 90 per cent efficiency)*

| Reed space (centimetres) | Picks per minute: Plain looms | Check looms | Dobby looms | Jacquard looms |
|---|---|---|---|---|
| 75 to 100 . . . . . . . . | 180 | 145 | 165 | 140 |
| 110 to 165 . . . . . . . . | 165 | 140 | ... | ... |
| 165 to 210 . . . . . . . . | 145 | 130 | ... | ... |
| 210 to 230 . . . . . . . . | 110 | 100 | ... | ... |

TABLE 137. WOOL: STANDARD UNIT OUTPUT OF SPINNING MILLS PER SPINDLE/HOUR, BY YARN COUNT

*(At 90 per cent efficiency)*

| Metric yarn count | Output per spindle/hour (grammes) | Weighting coefficient | Metric yarn count | Output per spindle/hour (grammes) | Weighting coefficient |
|---|---|---|---|---|---|
| 4 . . . . . . . . | 422 | 0.11 | 22 . . . . . . . . . | 33 | 1.45 |
| 6 . . . . . . . . | 230 | 0.21 | 24 . . . . . . . . . | 29 | 1.66 |
| 8 . . . . . . . . | 149 | 0.32 | 30 . . . . . . . . . | 21 | 2.29 |
| 12 . . . . . . . . | 81 | 0.59 | 32 . . . . . . . . . | 19 | 2.53 |
| 15 . . . . . . . . | 58 | 0.83 | 37 . . . . . . . . . | 15 | 3.20 |
| 17 . . . . . . . . | 48 | 1.00 | 43 . . . . . . . . . | 12 | 4.00 |
| 19 . . . . . . . . | 41 | 1.17 | 46 . . . . . . . . . | 11 | 4.36 |

requirements established as the norm. A machine is suitable for reconditioning if it can be so modified that its output will meet the standards laid down for an up-to-date machine. The possibility of reconditioning a machine can only be shown by a technical examination of the machine itself, and consequently no general rule can be laid down to determine which machines can be reconditioned. The estimate of reconditioning requirements given in the present study was based, in the first place, on an age criterion, it being assumed that all machines less than thirty years old could be reconditioned (and although this is probably not true, there are machines older than this that may be worth reconditioning, which would offset the over-estimate). Secondly, it was based on the views of textile manufacturers on the possibility of reconditioning many of the machines now in use. Thus the estimated number of machines that could be reconditioned is likely to be fairly accurate, although the exact number can only be determined

TABLE 139. COTTON SPINNING: STANDARD OF OUTPUT AT PRESENT FEASIBLE FOR AN OLD STANDARD MILL[a]

| Type of machine | Efficiency | Output in kilogrammes per hour, by yarn count category | | | | |
|---|---|---|---|---|---|---|
| | | Under 15 | 15-20 | 20-30 | 30-40 | Over 40 |
| Scutchers | 85 | 175 | 175 | 175 | 175 | 175 |
| Cards | 80 | 6.5 | 5 | 4 | 3.5 | 3 |
| Sliver lap machines | 85 | 73 | 73 | 73 | 73 | 73 |
| Ribbon lap machines | 85 | 73 | 73 | 73 | 73 | 73 |
| Combers | 85 | — | — | 5 | 4.5 | 4 |
| Drawing frames | 80 | 8 | 7 | 6.5 | 6 | 6 |
| Speed frames | 80 | | | | | |
| Slubbing frame | | 1.8 | 1.4 | 1.0 | 0.8 | 0.8 |
| Intermediate frame | | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| Roving frame | | [b] | 0.06 | 0.05 | 0.05 | 0.05 |
| Fine roving frame | | [b] | [b] | [b] | 0.035 | 0.035 |

*Source:* ECLA.

[a] As defined in the 1951 ECLA study—see footnote 2, p. 120.

[b] For the lower counts the hours worked were not taken into account in calculating the theoretical number of hours.

TABLE 140. COTTON SPINNING[a]: STANDARD UNIT OUTPUT PER SPINDLE/HOUR, BY YARN COUNT

(*At 90 per cent efficiency*)

| Yarn count | Output grammes | |
|---|---|---|
| | With old machinery | With modern machinery |
| 5 | 45 | 50.0 |
| 8 | 40 | 45.0 |
| 10 | 36.5 | 40.5 |
| 11 | 33 | 37.0 |
| 12 | 30.5 | 34.0 |
| 13 | 28 | 31.0 |
| 14 | 25 | 28.0 |
| 15 | 23.5 | 25.0 |
| 16 | 22 | 24.5 |
| 17 | 21 | 23.2 |
| 18 | 20 | 22.0 |
| 19 | 19 | 21.0 |
| 20 | 18 | 20.0 |
| 22 | 16 | 18.0 |
| 24 | 15 | 16.5 |
| 26 | 13.5 | 15.0 |
| 28 | 12.5 | 14.0 |
| 30 | 11.7 | 13.0 |
| 32 | 10.4 | 11.6 |
| 34 | 9.5 | 10.4 |
| 36 | 8.5 | 9.4 |
| 38 | 7.8 | 8.6 |
| 40 | 7.2 | 8.0 |
| 42 | 7.0 | 7.7 |
| 44 | 6.75 | 7.5 |
| 46 | 6.5 | 7.2 |
| 48 | 6.2 | 6.8 |
| 50 | 6.0 | 6.6 |
| 52 | 5.5 | 6.1 |
| 54 | 5.1 | 5.7 |
| 56 | 4.7 | 5.2 |
| 58 | 4.3 | 4.8 |
| 60 | 4.1 | 4.6 |
| 80 | 2.7 | 3.0 |
| 100 | 1.8 | 2.0 |

*Source:* As indicated in the text.

[a] This table can also be used for artificial fibres, but because of the better yield that results from the absolutely uniform length of these fibres, unit output should be increased by about 20 per cent.

possibility for Latin American countries, either now or in the near future. Consequently it was considered preferable to work out a special standard for the Latin American countries, based on the unit output criteria previously explained, and accepted by the industry as a reasonable target for the average Brazilian spinning or weaving mill. In calculating the number of man/hours worked in spinning, all foremen, assistant foremen and operatives directly and indirectly employed in the spinning section were included, and all sub-sections from the reception of the raw material to the cone winding. In the weaving sector account was taken of all foremen, assistant foremen, and operators directly and indirectly employed on the work, in all sub-sections from the reception of the yarn in cones until the grey fabric comes off the loom. Dyeing is not included, even when the plants use dyed yarn (whether dyed in the fibre, yarn or warp).

Thus for the two main fibres in the spinning and weaving sector, cotton and wool, the productivity standards were calculated on the following basis:

### (a) *Cotton spinning*

The aforementioned Latin American standard was based on a unit output of 22 grammes per spindle/hour for carded yarn of count 18. The standard workload adopted was five workers (of all types) to 1,000 spindles, which represented 1,600 spindles to each spinning operative. Output per 1,000 spindles was taken as 22 kilogrammes per hour and output per man/hour as 4,400 grammes.

In Brazil, as in other Latin American countries studied, about 80 per cent of the yarn produced is carded and about 20 per cent combed. Combing involves the use of more machinery and hence a greater number of operatives, estimated at about 10 per cent more than those needed for carding. To allow for this difference, the standard output adopted for carded cotton yarn was reduced by 2 per cent, giving an output of 4,300 grammes per man/hour as the average standard output for yarn of count 18 (both carded and combed). This standard, which has already been exceeded by some Brazilian mills, represents a reasonable target for the average spinning mill both in Brazil and in Latin America as a whole.

### (b) *Cotton weaving*

The fabric used as the basis for calculating the standard output was the average fabric produced in Brazil, that is, a fabric 100 centimètres wide with 2,000 picks per metre (20 picks per centimetre or 51 picks per inch), for yarn of count 18 and a weight of about 130 grammes for square cloth (equal distribution of warp and weft on the face).

TABLE 139. COTTON SPINNING: STANDARD OF OUTPUT AT PRESENT FEASIBLE FOR AN OLD STANDARD MILL[a]

| Type of machine | Efficiency | Output in kilogrammes per hour, by yarn count category | | | | |
|---|---|---|---|---|---|---|
| | | Under 15 | 15-20 | 20-30 | 30-40 | Over 40 |
| Scutchers | 85 | 175 | 175 | 175 | 175 | 175 |
| Cards | 80 | 6.5 | 5 | 4 | 3.5 | 3 |
| Sliver lap machines | 85 | 73 | 73 | 73 | 73 | 73 |
| Ribbon lap machines | 85 | 73 | 73 | 73 | 73 | 73 |
| Combers | 85 | — | — | 5 | 4.5 | 4 |
| Drawing frames | 80 | 8 | 7 | 6.5 | 6 | 6 |
| Speed frames | 80 | | | | | |
| Slubbing frame | | 1.8 | 1.4 | 1.0 | 0.8 | 0.8 |
| Intermediate frame | | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| Roving frame | | [b] | 0.06 | 0.05 | 0.05 | 0.05 |
| Fine roving frame | | [b] | [b] | [b] | 0.035 | 0.035 |

*Source:* ECLA.

[a] As defined in the 1951 ECLA study—see footnote 2, p. 120.

[b] For the lower counts the hours worked were not taken into account in calculating the theoretical number of hours.

TABLE 140. COTTON SPINNING[a]: STANDARD UNIT OUTPUT PER SPINDLE/HOUR, BY YARN COUNT

*(At 90 per cent efficiency)*

| Yarn count | Output grammes | |
|---|---|---|
| | With old machinery | With modern machinery |
| 5 | 45 | 50.0 |
| 8 | 40 | 45.0 |
| 10 | 36.5 | 40.5 |
| 11 | 33 | 37.0 |
| 12 | 30.5 | 34.0 |
| 13 | 28 | 31.0 |
| 14 | 25 | 28.0 |
| 15 | 23.5 | 25.0 |
| 16 | 22 | 24.5 |
| 17 | 21 | 23.2 |
| 18 | 20 | 22.0 |
| 19 | 19 | 21.0 |
| 20 | 18 | 20.0 |
| 22 | 16 | 18.0 |
| 24 | 15 | 16.5 |
| 26 | 13.5 | 15.0 |
| 28 | 12.5 | 14.0 |
| 30 | 11.7 | 13.0 |
| 32 | 10.4 | 11.6 |
| 34 | 9.5 | 10.4 |
| 36 | 8.5 | 9.4 |
| 38 | 7.8 | 8.6 |
| 40 | 7.2 | 8.0 |
| 42 | 7.0 | 7.7 |
| 44 | 6.75 | 7.5 |
| 46 | 6.5 | 7.2 |
| 48 | 6.2 | 6.8 |
| 50 | 6.0 | 6.6 |
| 52 | 5.5 | 6.1 |
| 54 | 5.1 | 5.7 |
| 56 | 4.7 | 5.2 |
| 58 | 4.3 | 4.8 |
| 60 | 4.1 | 4.6 |
| 80 | 2.7 | 3.0 |
| 100 | 1.8 | 2.0 |

*Source:* As indicated in the text.

[a] This table can also be used for artificial fibres, but because of the better yield that results from the absolutely uniform length of these fibres, unit output should be increased by about 20 per cent.

possibility for Latin American countries, either now or in the near future. Consequently it was considered preferable to work out a special standard for the Latin American countries, based on the unit output criteria previously explained, and accepted by the industry as a reasonable target for the average Brazilian spinning or weaving mill. In calculating the number of man/hours worked in spinning, all foremen, assistant foremen and operatives directly and indirectly employed in the spinning section were included, and all sub-sections from the reception of the raw material to the cone winding. In the weaving sector account was taken of all foremen, assistant foremen, and operators directly and indirectly employed on the work, in all sub-sections from the reception of the yarn in cones until the grey fabric comes off the loom. Dyeing is not included, even when the plants use dyed yarn (whether dyed in the fibre, yarn or warp).

Thus for the two main fibres in the spinning and weaving sector, cotton and wool, the productivity standards were calculated on the following basis:

(a) *Cotton spinning*

The aforementioned Latin American standard was based on a unit output of 22 grammes per spindle/hour for carded yarn of count 18. The standard workload adopted was five workers (of all types) to 1,000 spindles, which represented 1,600 spindles to each spinning operative. Output per 1,000 spindles was taken as 22 kilogrammes per hour and output per man/hour as 4,400 grammes.

In Brazil, as in other Latin American countries studied, about 80 per cent of the yarn produced is carded and about 20 per cent combed. Combing involves the use of more machinery and hence a greater number of operatives, estimated at about 10 per cent more than those needed for carding. To allow for this difference, the standard output adopted for carded cotton yarn was reduced by 2 per cent, giving an output of 4,300 grammes per man/hour as the average standard output for yarn of count 18 (both carded and combed). This standard, which has already been exceeded by some Brazilian mills, represents a reasonable target for the average spinning mill both in Brazil and in Latin America as a whole.

(b) *Cotton weaving*

The fabric used as the basis for calculating the standard output was the average fabric produced in Brazil, that is, a fabric 100 centimètres wide with 2,000 picks per metre (20 picks per centimetre or 51 picks per inch), for yarn of count 18 and a weight of about 130 grammes for square cloth (equal distribution of warp and weft on the face).

Unit output for automatic looms with a speed of 200 picks per minute at 90 per cent efficiency (that is, 180 picks per minute or 10,800 picks per hour) will be 5.40 metres per loom/hour.

As regards weaving workloads (which determine productivity), the initial assumption was a figure of 2.5 workers (of all kinds) to 20 looms, which represents about 40 looms per weaver. This would provide for 4 workers available for auxiliary services — preparatory weaving processes, machine maintenance and supervision — to each weaver. However, although a number of mills are already operating with this workload, it was decided that the industry as a whole would find it difficult to attain this level at the present stage of reorganization of the country's textile industry. The data set forth in earlier chapters show that the mills with automatic looms have an average of 6 looms per weaver, so that a sudden change to 40 per weaver would be too brusque. Consequently the more modest target of 20 looms per weaver was decided upon. Taking account of the other workers needed for auxiliary services and supervision, the workload proposed represents 4 workers (1 loom tender and 3 auxiliary and supervisory staff) to 20 looms. This makes an average of 5 looms per worker, and since the production of 20 looms is taken as 108 metres an hour, productivity is 27 metres per man/hour. The workload of 40 looms per weaver would give a productivity of 43 metres per man/hour (see table 142).

### (c) *Wool spinning*

The standard mill was considered as 6,000 spindles for combed yarn and 1,500 for carded yarn, all the spindles being modern ring spindles with an annual output of 850 tons of combed yarn of count 22, and 400 tons of carded yarn of average count Nm 7, in all 1,250 tons of yarn of average count Nm 17.[3] In this mill the labour force was calculated as 210 workers in two shifts, including all the processes from the reception of the raw wool to the production of the yarn in cones or hanks, undyed.

To produce 1,250,000 kilogrammes in a 350-day year 523,200 man/hours are required, giving a productivity of 2,380 grammes per man/hour, which was adopted as the standard for yarn of count 17, with a production breakdown of 65 per cent combed yarn and 35 per cent carded. This standard represents a workload of 600 spindles per spinner.

### (d) *Wool weaving*

Standard productivity for wool weaving was based on a unit output of 3.50 metres per loom/hour, for a cloth 165 centimetres wide with 20 picks to the centimetre. Automatic looms were postulated, with an average theoretical speed of 130 picks per minute, or 117 picks per minute at 90 per cent efficiency. Thus the output of one loom in one hour was calculated as 7,020 picks, giving the 3.50 metres established.

The workload established was 2 looms per worker, which represents about 6 looms per weaver. Thus the standard productivity adopted was 7 metres per man/hour.

These standards should be considered as only a first step to be taken within the next five years, which is the minimum period estimated for the modernization of the textile industry.

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[3] See ECLA, *La industria textil en América Latina. I. Chile* (United Nations publications, Sales No.: 63:II.G.5).

Unit output for automatic looms with a speed of 200 picks per minute at 90 per cent efficiency (that is, 180 picks per minute or 10,800 picks per hour) will be 5.40 metres per loom/hour.

As regards weaving workloads (which determine productivity), the initial assumption was a figure of 2.5 workers (of all kinds) to 20 looms, which represents about 40 looms per weaver. This would provide for 4 workers available for auxiliary services — preparatory weaving processes, machine maintenance and supervision — to each weaver. However, although a number of mills are already operating with this workload, it was decided that the industry as a whole would find it difficult to attain this level at the present stage of reorganization of the country's textile industry. The data set forth in earlier chapters show that the mills with automatic looms have an average of 6 looms per weaver, so that a sudden change to 40 per weaver would be too brusque. Consequently the more modest target of 20 looms per weaver was decided upon. Taking account of the other workers needed for auxiliary services and supervision, the workload proposed represents 4 workers (1 loom tender and 3 auxiliary and supervisory staff) to 20 looms. This makes an average of 5 looms per worker, and since the production of 20 looms is taken as 108 metres an hour, productivity is 27 metres per man/hour. The workload of 40 looms per weaver would give a productivity of 43 metres per man/hour (see table 142).

### (c) *Wool spinning*

The standard mill was considered as 6,000 spindles for combed yarn and 1,500 for carded yarn, all the spindles being modern ring spindles with an annual output of 850 tons of combed yarn of count 22, and 400 tons of carded yarn of average count Nm 7, in all 1,250 tons of yarn of average count Nm 17.[3] In this mill the labour force was calculated as 210 workers in two shifts, including all the processes from the reception of the raw wool to the production of the yarn in cones or hanks, undyed.

To produce 1,250,000 kilogrammes in a 350-day year 523,200 man/hours are required, giving a productivity of 2,380 grammes per man/hour, which was adopted as the standard for yarn of count 17, with a production breakdown of 65 per cent combed yarn and 35 per cent carded. This standard represents a workload of 600 spindles per spinner.

### (d) *Wool weaving*

Standard productivity for wool weaving was based on a unit output of 3.50 metres per loom/hour, for a cloth 165 centimetres wide with 20 picks to the centimetre. Automatic looms were postulated, with an average theoretical speed of 130 picks per minute, or 117 picks per minute at 90 per cent efficiency. Thus the output of one loom in one hour was calculated as 7,020 picks, giving the 3.50 metres established.

The workload established was 2 looms per worker, which represents about 6 looms per weaver. Thus the standard productivity adopted was 7 metres per man/hour.

These standards should be considered as only a first step to be taken within the next five years, which is the minimum period estimated for the modernization of the textile industry.

[3] See ECLA, *La industria textil en América Latina. I. Chile* (United Nations publications, Sales No.: 63:II.G.5).

TABLE II. COTTON: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR MINAS GERAIS

| | *Composition of future inventory* | | | *Total number of machines* | |
|---|---|---|---|---|---|
| | *Existing machinery* | | *Machinery to be purchased* | | |
| *Type of machine* | *Up-to-date* | *To be reconditioned* | | *Future* | *Existing* |
| Scutchers | 36 | — | 42 | 78 | 95 |
| Cards | 395 | 334 | 492 | 1,221 | 1,826 |
| Sliver lap machines | 16 | — | 3 | 19 | 46 |
| Ribbon lap machines | 16 | — | 3 | 19 | 29 |
| Combers | 88 | 34 | 59 | 181 | 265 |
| Drawing frames | — | — | 438 | 438 | 2,373 |
| Roving frames | 3,161 | 3,173[a] | 2,921 | 9,255 | 61,317 |
| Slubbing frames | 480 | — | 156 | 636 | 9,316 |
| Intermediate frames | — | — | — | — | 22,434 |
| Roving and fine roving frames | — | — | — | — | 26,802 |
| High-draft roving frames | 2,681 | 3,173[a] | 2,765 | 8,619 | 2,765 |
| Spindles | 78,288 | 156,484 | 80,464 | 315,236 | 531,494 |
| Reeling machines | 1,520 | 1,100 | 26 | 2,646 | 3,788 |
| Cheese winders | 6,695 | — | 2,693 | 9,388 | 15,607 |
| Twisting frames | 11,626 | 1,616 | 3,391 | 16,633 | 29,241 |
| Pirn winders | 3,665 | — | 682 | 4,347 | 9,653 |
| Warping machines | 37 | — | 43 | 80 | 153 |
| Slasher sizers | 24 | 3 | 40 | 67 | 108 |
| Non-automatic looms | 533 | — | 20 | 553 | 13,089 |
| Plain looms | — | — | — | — | 9,768 |
| Check looms | 533 | — | 20 | 553 | 1,994 |
| Dobby looms | — | — | — | — | 1,327 |
| Jacquard looms | — | — | — | — | — |
| Automatic looms | 3,103 | 2,239[b] | 4,829 | 10,171 | 3,541 |
| Plain looms | 2,981 | 1,952[b] | 3,931 | 8,864 | 3,419 |
| Check looms | 22 | — | 622 | 644 | 22 |
| Dobby looms | 100 | 287[b] | 276 | 663 | 100 |
| Jacquard looms | — | — | — | — | — |
| All looms | 3,636 | 2,239[b] | 4,849 | 10,724 | 6,630 |

*Source:* ECLA survey.

[a] Intermediate frames converted into high-draft roving frames.

[b] Non-automatic looms converted into automatic looms.

TABLE II. COTTON: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR MINAS GERAIS

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | Composition of future inventory: Existing machinery: To be reconditioned | Composition of future inventory: Machinery to be purchased | Total number of machines: Future | Total number of machines: Existing |
|---|---|---|---|---|---|
| Scutchers | 36 | — | 42 | 78 | 95 |
| Cards | 395 | 334 | 492 | 1,221 | 1,826 |
| Sliver lap machines | 16 | — | 3 | 19 | 46 |
| Ribbon lap machines | 16 | — | 3 | 19 | 29 |
| Combers | 88 | 34 | 59 | 181 | 265 |
| Drawing frames | — | — | 438 | 438 | 2,373 |
| Roving frames | 3,161 | 3,173[a] | 2,921 | 9,255 | 61,317 |
| Slubbing frames | 480 | — | 156 | 636 | 9,316 |
| Intermediate frames | — | — | — | — | 22,434 |
| Roving and fine roving frames | — | — | — | — | 26,802 |
| High-draft roving frames | 2,681 | 3,173[a] | 2,765 | 8,619 | 2,765 |
| Spindles | 78,288 | 156,484 | 80,464 | 315,236 | 531,494 |
| Reeling machines | 1,520 | 1,100 | 26 | 2,646 | 3,788 |
| Cheese winders | 6,695 | — | 2,693 | 9,388 | 15,607 |
| Twisting frames | 11,626 | 1,616 | 3,391 | 16,633 | 29,241 |
| Pirn winders | 3,665 | — | 682 | 4,347 | 9,653 |
| Warping machines | 37 | — | 43 | 80 | 153 |
| Slasher sizers | 24 | 3 | 40 | 67 | 108 |
| Non-automatic looms | 533 | — | 20 | 553 | 13,089 |
| Plain looms | — | — | — | — | 9,768 |
| Check looms | 533 | — | 20 | 553 | 1,994 |
| Dobby looms | — | — | — | — | 1,327 |
| Jacquard looms | — | — | — | — | — |
| Automatic looms | 3,103 | 2,239[b] | 4,829 | 10,171 | 3,541 |
| Plain looms | 2,981 | 1,952[b] | 3,931 | 8,864 | 3,419 |
| Check looms | 22 | — | 622 | 644 | 22 |
| Dobby looms | 100 | 287[b] | 276 | 663 | 100 |
| Jacquard looms | — | — | — | — | — |
| All looms | 3,636 | 2,239[b] | 4,849 | 10,724 | 6,630 |

*Source:* ECLA survey.

[a] Intermediate frames converted into high-draft roving frames.

[b] Non-automatic looms converted into automatic looms.

TABLE IV. COTTON: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR SÃO PAULO

| Type of machine | Composition of future inventory | | | Total number of machines | |
|---|---|---|---|---|---|
| | Existing machinery | | Machinery to be purchased | | |
| | Up-to-date | To be reconditioned | | Future | Existing |
| Scutchers | 93 | 5 | 58 | 156 | 219 |
| Cards | 1,019 | 1,638 | 1,086 | 3,743 | 5,192 |
| Sliver lap machines | 47 | 2 | 13 | 62 | 158 |
| Ribbon lap machines | 44 | 2 | 15 | 61 | 100 |
| Combers | 72 | 13 | 349 | 434 | 924 |
| Drawing frames | 70 | 0 | 1,222 | 1,292 | 5,487 |
| Roving frames | 16,632 | 9,354[a] | 10,909 | 36,895 | 161,664 |
| Slubbing frames | 2,234 | 2,724 | 2,023 | 6,981 | 28,920 |
| Intermediate frames | 2,690 | 324 | — | 3,014 | 44,724 |
| Roving and fine roving frames | — | — | — | — | 75,718 |
| High-draft roving frames | 11,708 | 6,306[a] | 8,886 | 26,900 | 12,302 |
| Spindles | 247,448 | 498,177 | 140,553 | 886,178 | 1,412,100 |
| Reeling machines | 2,038 | 476 | 1,522 | 4,036 | 20,360 |
| Cheese winders | 21,209 | — | 8,320 | 29,529 | 64,388 |
| Twisting frames | 134,874 | 57,015 | 25,300 | 217,189 | 305,661 |
| Pirn winders | 6,504 | 0 | 1,102 | 7,606 | 21,902 |
| Warping machines | 132 | — | 183 | 315 | 868 |
| Slasher sizers | 38 | 8 | 68 | 114 | 192 |
| Non-automatic looms | 1,234 | — | 36 | 1,270 | 18,719 |
| Plain looms | 1 | — | — | 1 | 8,288 |
| Check looms | 1,177 | — | — | 1,177 | 4,234 |
| Dobby looms | — | — | — | — | 5,119 |
| Jacquard looms | 56 | — | 36 | 92 | 1,078 |
| Automatic looms | 7,789 | 4,014[b] | 4,597 | 16,400 | 12,289 |
| Plain looms | 5,429 | 1,989[b] | 2,074 | 9,492 | 8,567 |
| Check looms | 166 | 76[b] | 1,077 | 1,319 | 189 |
| Dobby looms | 2,161 | 1,593[b] | 1,373 | 5,127 | 3,491 |
| Jacquard looms | 33 | 356[b] | 73 | 462 | 42 |
| All looms | 9,023 | 4,014[b] | 4,633 | 17,670 | 31,008 |

*Source:* ECLA survey.

[a] Intermediate frames converted into high-draft frames.

[b] Non-automatic looms converted into automatic looms.

TABLE IV. COTTON: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR SÃO PAULO

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | To be reconditioned | Machinery to be purchased | Total number of machines: Future | Existing |
|---|---|---|---|---|---|
| Scutchers | 93 | 5 | 58 | 156 | 219 |
| Cards | 1,019 | 1,638 | 1,086 | 3,743 | 5,192 |
| Sliver lap machines | 47 | 2 | 13 | 62 | 158 |
| Ribbon lap machines | 44 | 2 | 15 | 61 | 100 |
| Combers | 72 | 13 | 349 | 434 | 924 |
| Drawing frames | 70 | 0 | 1,222 | 1,292 | 5,487 |
| Roving frames | 16,632 | 9,354[a] | 10,909 | 36,895 | 161,664 |
| Slubbing frames | 2,234 | 2,724 | 2,023 | 6,981 | 28,920 |
| Intermediate frames | 2,690 | 324 | — | 3,014 | 44,724 |
| Roving and fine roving frames | — | — | — | — | 75,718 |
| High-draft roving frames | 11,708 | 6,306[a] | 8,886 | 26,900 | 12,302 |
| Spindles | 247,448 | 498,177 | 140,553 | 886,178 | 1,412,100 |
| Reeling machines | 2,038 | 476 | 1,522 | 4,036 | 20,360 |
| Cheese winders | 21,209 | — | 8,320 | 29,529 | 64,388 |
| Twisting frames | 134,874 | 57,015 | 25,300 | 217,189 | 305,661 |
| Pirn winders | 6,504 | 0 | 1,102 | 7,606 | 21,902 |
| Warping machines | 132 | — | 183 | 315 | 868 |
| Slasher sizers | 38 | 8 | 68 | 114 | 192 |
| Non-automatic looms | 1,234 | — | 36 | 1,270 | 18,719 |
| Plain looms | 1 | — | — | 1 | 8,288 |
| Check looms | 1,177 | — | — | 1,177 | 4,234 |
| Dobby looms | — | — | — | — | 5,119 |
| Jacquard looms | 56 | — | 36 | 92 | 1,078 |
| Automatic looms | 7,789 | 4,014[b] | 4,597 | 16,400 | 12,289 |
| Plain looms | 5,429 | 1,989[b] | 2,074 | 9,492 | 8,567 |
| Check looms | 166 | 76[b] | 1,077 | 1,319 | 189 |
| Dobby looms | 2,161 | 1,593[b] | 1,373 | 5,127 | 3,491 |
| Jacquard looms | 33 | 356[b] | 73 | 462 | 42 |
| All looms | 9,023 | 4,014[b] | 4,633 | 17,670 | 31,008 |

*Source:* ECLA survey.

[a] Intermediate frames converted into high-draft frames.

[b] Non-automatic looms converted into automatic looms.

TABLE VII. WOOL: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR RIO GRANDE DO SUL

| *Type of machine* | *Composition of future inventory* | | | *Total number of machines* | |
|---|---|---|---|---|---|
| | *Existing machinery* | | *Machinery to be purchased* | | |
| | *Up-to-date* | *To be reconditioned* | | *Future* | *Existing* |
| Leviathan washers . . . . . . . . | 5 | — | 2 | 7 | 9 |
| Dryers . . . . . . . . . . . . . . | 5 | — | 1 | 6 | 11 |
| Single cards . . . . . . . . . . . | — | — | — | — | — |
| Double cards . . . . . . . . . . . | 10 | 16 | 4 | 30 | 38 |
| Waste cards . . . . . . . . . . . | 7 | 3 | 8 | 18 | 36 |
| Pre-comber intersecting gill boxes . | 11 | — | 36 | 47 | 51 |
| Combers . . . . . . . . . . . . . | — | — | 40 | 40 | 94 |
| Post-comber intersecting gill boxes . | 9 | — | 16 | 25 | 35 |
| Backwashers . . . . . . . . . . | 2 | 2 | 2 | 6 | 7 |
| Melange gill boxes . . . . . . . . | 17 | — | — | 17 | 18 |
| Preparation systems . . . . . . . | — | — | 7 | 7 | 9 |
| Spindles . . . . . . . . . . . . . | 20,117 | — | 1,988 | 22,105 | 43,403 |
| Doubling frames . . . . . . . . . | 380 | — | 112 | 492 | 708 |
| Reeling machines . . . . . . . . | 340 | — | 37 | 377 | 500 |
| Cheese winders . . . . . . . . . | 1,024 | — | 182 | 1,206 | 2,422 |
| Twisting frames . . . . . . . . . | 6,392 | 3,370 | 20 | 9,782 | 12,032 |
| Pirn winders . . . . . . . . . . . | 90 | — | 30 | 120 | 506 |
| Warping machines . . . . . . . . | 1 | 7 | 4 | 12 | 28 |
| Slasher sizers . . . . . . . . . . | 1 | — | — | 1 | 2 |
| Non-automatic looms . . . . . . | 29 | — | — | 29 | 478 |
| Plain looms . . . . . . . . . . | — | — | — | — | 35 |
| Check looms . . . . . . . . . | 29 | — | — | 29 | 158 |
| Dobby looms . . . . . . . . . | — | — | — | — | 247 |
| Jacquard looms . . . . . . . . | — | — | — | — | 38 |
| Automatic looms . . . . . . . . | 12 | 103 | 68 | 183 | 12 |
| Plain looms . . . . . . . . . . | — | — | 10 | 10 | — |
| Check looms . . . . . . . . . | — | — | 24 | 24 | — |
| Dobby looms . . . . . . . . . | 12 | 103[a] | 29 | 144 | 12 |
| Jacquard looms . . . . . . . . | — | — | 5 | 5 | — |
| All looms . . . . . . . . . . . . | 41 | 103 | 68 | 212 | 490 |

*Source:* ECLA survey.

[a] Non-automatic looms converted into automatic looms.

TABLE VII. WOOL: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR RIO GRANDE DO SUL

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | Composition of future inventory: Existing machinery: To be reconditioned | Composition of future inventory: Machinery to be purchased | Total number of machines: Future | Total number of machines: Existing |
|---|---|---|---|---|---|
| Leviathan washers | 5 | — | 2 | 7 | 9 |
| Dryers | 5 | — | 1 | 6 | 11 |
| Single cards | — | — | — | — | — |
| Double cards | 10 | 16 | 4 | 30 | 38 |
| Waste cards | 7 | 3 | 8 | 18 | 36 |
| Pre-comber intersecting gill boxes | 11 | — | 36 | 47 | 51 |
| Combers | — | — | 40 | 40 | 94 |
| Post-comber intersecting gill boxes | 9 | — | 16 | 25 | 35 |
| Backwashers | 2 | 2 | 2 | 6 | 7 |
| Melange gill boxes | 17 | — | — | 17 | 18 |
| Preparation systems | — | — | 7 | 7 | 9 |
| Spindles | 20,117 | — | 1,988 | 22,105 | 43,403 |
| Doubling frames | 380 | — | 112 | 492 | 708 |
| Reeling machines | 340 | — | 37 | 377 | 500 |
| Cheese winders | 1,024 | — | 182 | 1,206 | 2,422 |
| Twisting frames | 6,392 | 3,370 | 20 | 9,782 | 12,032 |
| Pirn winders | 90 | — | 30 | 120 | 506 |
| Warping machines | 1 | 7 | 4 | 12 | 28 |
| Slasher sizers | 1 | — | — | 1 | 2 |
| Non-automatic looms | 29 | — | — | 29 | 478 |
| Plain looms | — | — | — | — | 35 |
| Check looms | 29 | — | — | 29 | 158 |
| Dobby looms | — | — | — | — | 247 |
| Jacquard looms | — | — | — | — | 38 |
| Automatic looms | 12 | 103 | 68 | 183 | 12 |
| Plain looms | — | — | 10 | 10 | — |
| Check looms | — | — | 24 | 24 | — |
| Dobby looms | 12 | 103[a] | 29 | 144 | 12 |
| Jacquard looms | — | — | 5 | 5 | — |
| All looms | 41 | 103 | 68 | 212 | 490 |

*Source:* ECLA survey.
[a] Non-automatic looms converted into automatic looms.

TABLE X. MAN-MADE FIBRES: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR MINAS GERAIS

| | *Composition of future inventory* | | | *Total number of machines* | |
|---|---|---|---|---|---|
| | *Existing machinery* | | | | |
| *Type of machine* | *Up-to-date* | *To be reconditioned* | *Machinery to be purchased* | *Future* | *Existing* |
| Reeling machines . . . . . . . . | — | — | 5 | 5 | 128 |
| Cheese winders . . . . . . . . . | — | — | 18 | 18 | 205 |
| Twisting frames . . . . . . . . . | 28 | 200 | 200 | 428 | 1,068 |
| Pirn winders . . . . . . . . . . . | 20 | — | 1 | 21 | 152 |
| Warping machines . . . . . . . . | 2 | — | 2 | 4 | 7 |
| Slasher sizers . . . . . . . . . . | — | 1 | — | 1 | 1 |
| Non-automatic looms . . . . . . | 30 | — | — | 30 | 106 |
| Plain looms . . . . . . . . . . | — | — | — | — | 8 |
| Check looms . . . . . . . . . | 30 | — | — | 30 | 60 |
| Dobby looms . . . . . . . . . | — | — | — | — | 36 |
| Jacquard looms . . . . . . . . | — | — | — | — | 2 |
| Automatic looms . . . . . . . . | — | 2[a] | 12 | 14 | — |
| Plain looms . . . . . . . . . . | — | — | 2 | 2 | — |
| Check looms . . . . . . . . . | — | — | — | — | — |
| Dobby looms . . . . . . . . . | — | 2[a] | 9 | 11 | — |
| Jacquard looms . . . . . . . . | — | — | 1 | 1 | — |
| All looms . . . . . . . . . . . . | 30 | 2 | 12 | 44 | 106 |

*Source:* ECLA survey.
[a] Non-automatic looms converted into automatic looms.

TABLE XI. MAN-MADE FIBRES: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR RIO GRANDE DO SUL

| | *Composition of future inventory* | | | *Total number of machines* | |
|---|---|---|---|---|---|
| | *Existing machinery* | | | | |
| *Type of machine* | *Up-to-date* | *To be reconditioned* | *Machinery to be purchased* | *Future* | *Existing* |
| Twisting frames . . . . . . . . . | — | 200 | — | 200 | 407 |
| Pirn winders . . . . . . . . . . . | 39 | — | 5 | 44 | 246 |
| Warping machines . . . . . . . . | — | 8 | — | 8 | 14 |
| Slasher sizers . . . . . . . . . . | 2 | 2 | 1 | 5 | 5 |
| Non-automatic looms . . . . . . | 8 | — | — | 8 | 235 |
| Plain looms . . . . . . . . . . | — | — | — | — | 1 |
| Check looms . . . . . . . . . | 8 | — | — | 8 | 183 |
| Dobby looms . . . . . . . . . | — | — | — | — | 45 |
| Jacquard looms . . . . . . . . | — | — | — | — | 6 |
| Automatic looms . . . . . . . . | 6 | 51[a] | 26 | 83 | 8 |
| Plain looms . . . . . . . . . . | 4 | 1[a] | — | 5 | 6 |
| Check looms . . . . . . . . . | 2 | 20[a] | 26 | 48 | 2 |
| Dobby looms . . . . . . . . . | — | 28[a] | — | 28 | — |
| Jacquard looms . . . . . . . . | — | 2[a] | — | 2 | — |
| All looms . . . . . . . . . . . . | 14 | 51 | 26 | 91 | 243 |

*Source:* ECLA survey.
[a] Non-automatic looms converted into automatic looms.

TABLE X. MAN-MADE FIBRES: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR MINAS GERAIS

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | Existing machinery: To be reconditioned | Machinery to be purchased | Total number of machines: Future | Total number of machines: Existing |
|---|---|---|---|---|---|
| Reeling machines | — | — | 5 | 5 | 128 |
| Cheese winders | — | — | 18 | 18 | 205 |
| Twisting frames | 28 | 200 | 200 | 428 | 1,068 |
| Pirn winders | 20 | — | 1 | 21 | 152 |
| Warping machines | 2 | — | 2 | 4 | 7 |
| Slasher sizers | — | 1 | — | 1 | 1 |
| Non-automatic looms | 30 | — | — | 30 | 106 |
| Plain looms | — | — | — | — | 8 |
| Check looms | 30 | — | — | 30 | 60 |
| Dobby looms | — | — | — | — | 36 |
| Jacquard looms | — | — | — | — | 2 |
| Automatic looms | — | 2[a] | 12 | 14 | — |
| Plain looms | — | — | 2 | 2 | — |
| Check looms | — | — | — | — | — |
| Dobby looms | — | 2[a] | 9 | 11 | — |
| Jacquard looms | — | — | 1 | 1 | — |
| All looms | 30 | 2 | 12 | 44 | 106 |

*Source:* ECLA survey.
[a] Non-automatic looms converted into automatic looms.

TABLE XI. MAN-MADE FIBRES: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR RIO GRANDE DO SUL

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | Existing machinery: To be reconditioned | Machinery to be purchased | Total number of machines: Future | Total number of machines: Existing |
|---|---|---|---|---|---|
| Twisting frames | — | 200 | — | 200 | 407 |
| Pirn winders | 39 | — | 5 | 44 | 246 |
| Warping machines | — | 8 | — | 8 | 14 |
| Slasher sizers | 2 | 2 | 1 | 5 | 5 |
| Non-automatic looms | 8 | — | — | 8 | 235 |
| Plain looms | — | — | — | — | 1 |
| Check looms | 8 | — | — | 8 | 183 |
| Dobby looms | — | — | — | — | 45 |
| Jacquard looms | — | — | — | — | 6 |
| Automatic looms | 6 | 51[a] | 26 | 83 | 8 |
| Plain looms | 4 | 1[a] | — | 5 | 6 |
| Check looms | 2 | 20[a] | 26 | 48 | 2 |
| Dobby looms | — | 28[a] | — | 28 | — |
| Jacquard looms | — | 2[a] | — | 2 | — |
| All looms | 14 | 51 | 26 | 91 | 243 |

*Source:* ECLA survey.
[a] Non-automatic looms converted into automatic looms.

TABLE XIV. JUTE: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR RIO GRANDE DO SUL

| | Composition of future inventory | | | Total number of machines | |
|---|---|---|---|---|---|
| | Existing machinery | | | | |
| *Type of machine* | *Up-to-date* | *To be reconditioned* | *Machinery to be purchased* | *Future* | *Existing* |
| Softeners | — | 2 | 2 | 4 | 4 |
| Breaker cards | — | — | 4 | 4 | 5 |
| Finisher cards | — | — | 5 | 5 | 8 |
| Combined cards | — | — | — | — | — |
| Waste cards | — | — | — | — | 1 |
| Drawing gill frames | — | — | 52 | 52 | 119 |
| Roving frames | — | — | — | — | 368 |
| Spindles | — | — | 1,693 | 1,693 | 3,942 |
| Spoolers | — | — | — | — | 260 |
| Reeling machines | — | — | — | — | 220 |
| Cheese winders | — | — | 28 | 28 | 140 |
| Twisting frames | — | — | 8 | 8 | 364 |
| Pirn winders | 18 | — | 83 | 101 | 660 |
| Warping machines | — | — | 5 | 5 | 7 |
| Warper/slasher sizers | — | — | 5 | 5 | 7 |
| Automatic looms | — | — | — | — | 379 |
| Shuttle-less looms | — | — | 114 | 114 | — |
| Circular looms | — | — | — | — | — |
| All looms | — | — | 114 | 114 | 379 |

*Source:* ECLA survey.

TABLE XV. JUTE: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR SÃO PAULO

| | Composition of future inventory | | | Total number of machines | |
|---|---|---|---|---|---|
| | Existing machinery | | | | |
| *Type of machine* | *Up-to-date* | *To be reconditioned* | *Machinery to be purchased* | *Future* | *Existing* |
| Softeners | 6 | 2 | 7 | 15 | 19 |
| Breaker cards | 7 | 3 | 17 | 27 | 41 |
| Finisher cards | 9 | 5 | 24 | 38 | 62 |
| Combined cards | — | — | — | — | 6 |
| Waste cards | 1 | — | — | 1 | 6 |
| Drawing gill frames | 12 | — | 392 | 404 | 1,092 |
| Roving frames | — | — | — | — | 3,214 |
| Spindles | 5,409 | — | 8,926 | 14,335 | 33,726 |
| Spoolers | — | — | — | — | — |
| Reeling machines | — | — | 121 | 121 | 822 |
| Cheese winders | 145 | — | 376 | 521 | 2,716 |
| Twisting frames | 143 | 48 | 198 | 389 | 1,060 |
| Pirn winders | 52 | — | 987 | 1,039 | 4,860 |
| Warping machines | 1 | — | 15 | 16 | 21 |
| Warper/slasher sizers | 2 | — | 14 | 16 | 53 |
| Automatic looms | — | — | — | — | 1,552 |
| Shuttle-less looms | 284 | — | 490 | 774 | 760 |
| Circular looms | 102 | — | — | 102 | 102 |
| All looms | 386 | — | 490 | 876 | 2,414 |

*Source:* ECLA survey.

TABLE XIV. JUTE: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR RIO GRANDE DO SUL

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | Composition of future inventory: Existing machinery: To be reconditioned | Composition of future inventory: Machinery to be purchased | Total number of machines: Future | Total number of machines: Existing |
|---|---|---|---|---|---|
| Softeners | — | 2 | 2 | 4 | 4 |
| Breaker cards | — | — | 4 | 4 | 5 |
| Finisher cards | — | — | 5 | 5 | 8 |
| Combined cards | — | — | — | — | — |
| Waste cards | — | — | — | — | 1 |
| Drawing gill frames | — | — | 52 | 52 | 119 |
| Roving frames | — | — | — | — | 368 |
| Spindles | — | — | 1,693 | 1,693 | 3,942 |
| Spoolers | — | — | — | — | 260 |
| Reeling machines | — | — | — | — | 220 |
| Cheese winders | — | — | 28 | 28 | 140 |
| Twisting frames | — | — | 8 | 8 | 364 |
| Pirn winders | 18 | — | 83 | 101 | 660 |
| Warping machines | — | — | 5 | 5 | 7 |
| Warper/slasher sizers | — | — | 5 | 5 | 7 |
| Automatic looms | — | — | — | — | 379 |
| Shuttle-less looms | — | — | 114 | 114 | — |
| Circular looms | — | — | — | — | — |
| All looms | — | — | 114 | 114 | 379 |

*Source:* ECLA survey.

TABLE XV. JUTE: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR SÃO PAULO

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | Composition of future inventory: Existing machinery: To be reconditioned | Composition of future inventory: Machinery to be purchased | Total number of machines: Future | Total number of machines: Existing |
|---|---|---|---|---|---|
| Softeners | 6 | 2 | 7 | 15 | 19 |
| Breaker cards | 7 | 3 | 17 | 27 | 41 |
| Finisher cards | 9 | 5 | 24 | 38 | 62 |
| Combined cards | — | — | — | — | 6 |
| Waste cards | 1 | — | — | 1 | 6 |
| Drawing gill frames | 12 | — | 392 | 404 | 1,092 |
| Roving frames | — | — | — | — | 3,214 |
| Spindles | 5,409 | — | 8,926 | 14,335 | 33,726 |
| Spoolers | — | — | — | — | — |
| Reeling machines | — | — | 121 | 121 | 822 |
| Cheese winders | 145 | — | 376 | 521 | 2,716 |
| Twisting frames | 143 | 48 | 198 | 389 | 1,060 |
| Pirn winders | 52 | — | 987 | 1,039 | 4,860 |
| Warping machines | 1 | — | 15 | 16 | 21 |
| Warper/slasher sizers | 2 | — | 14 | 16 | 53 |
| Automatic looms | — | — | — | — | 1,552 |
| Shuttle-less looms | 284 | — | 490 | 774 | 760 |
| Circular looms | 102 | — | — | 102 | 102 |
| All looms | 386 | — | 490 | 876 | 2,414 |

*Source:* ECLA survey.

TABLE XVIII. FLAX: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR SÃO PAULO

| | Composition of future inventory | | | Total number of machines | |
|---|---|---|---|---|---|
| | Existing machinery | | | | |
| Type of machine | Up-to-date | To be reconditioned | Machinery to be purchased | Future | Existing |
| Hackling machines | 5 | — | 1 | 6 | 9 |
| Drawing frames | 28 | — | 273 | 301 | 408 |
| Cards | 7 | — | 3 | 10 | 25 |
| Rectilinear combers | 4 | — | 34 | 38 | 72 |
| Roving frames | 1,315 | — | 726 | 2,041 | 2,190 |
| Spindles | 12,471 | — | 2,282 | 14,753 | 21,852 |
| Reeling machines | — | — | — | — | 30 |
| Cheese winders | 515 | — | 270 | 785 | 2,100 |
| Twisting frames | 36 | 900 | — | 936 | 1,558 |
| Pirn winders | 276 | — | 43 | 319 | 675 |
| Warping machines | 23 | — | 18 | 41 | 51 |
| Slasher sizers | 3 | 3 | 1 | 7 | 8 |
| Non-automatic looms | 7 | — | — | 7 | 735 |
| Plain looms | — | — | — | — | 425 |
| Check looms | 7 | — | — | 7 | 11 |
| Dobby looms | — | — | — | — | 262 |
| Jacquard looms | — | — | — | — | 37 |
| Automatic looms | 293 | 360 | 35 | 688 | 360 |
| Plain looms | 253 | 178[a] | 20 | 451 | 309 |
| Check looms | — | — | 1 | 1 | — |
| Dobby looms | 40 | 182[a] | 2 | 224 | 51 |
| Jacquard looms | — | — | 12 | 12 | — |
| All looms | 300 | 360 | 35 | 695 | 1,035 |

*Source:* ECLA survey.

[a] Non-automatic looms converted into automatic looms.

TABLE XIX. COTTON: DEGREE OF OBSOLESCENCE OF THE EXISTING PRODUCTION MACHINERY, BY STATE

| | Guanabara and Rio de Janeiro | Minas Gerais | Santa Catarina and Rio Grande do Sul | São Paulo | Total |
|---|---|---|---|---|---|
| | | | (a) *Absolute figures* | | |
| *Existing spindles* | *830,430* | *531,494* | *120,759* | *1,412,099* | *2,894,782* |
| Up-to-date | 166,724 | 78,498 | 40,042 | 317,604 | 602,868 |
| Suitable for reconditioning | 239,412 | 245,160 | 47,772 | 676,510 | 1,208,854 |
| Obsolete | 424,294 | 207,836 | 32,945 | 417,985 | 1,083,060 |
| *Existing looms* | *20,159* | *16,630* | *3,216* | *31,008* | *71,013* |
| Up-to-date | 4,835 | 4,171 | 792 | 12,575 | 22,373 |
| Suitable for reconditioning | 1,006 | 3,096 | 669 | 7,666 | 12,437 |
| Obsolete | 14,318 | 9,363 | 1,755 | 10,767 | 36,203 |
| | | | (b) *As a percentage of total* | | |
| *Existing spindles* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| Up-to-date | 20.1 | 14.8 | 33.2 | 22.5 | 20.8 |
| Suitable for reconditioning | 28.8 | 46.1 | 39.5 | 47.9 | 41.8 |
| Obsolete | 51.1 | 39.1 | 27.3 | 29.6 | 37.4 |
| *Existing looms* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| Up-to-date | 24.0 | 25.1 | 24.6 | 40.6 | 31.5 |
| Suitable for reconditioning | 5.0 | 18.6 | 20.8 | 24.7 | 17.5 |
| Obsolete | 71.0 | 56.3 | 54.6 | 34.7 | 51.0 |

*Source:* ECLA survey.

TABLE XVIII. FLAX: EXISTING MACHINERY AND FUTURE REQUIREMENTS FOR SÃO PAULO

| Type of machine | Composition of future inventory: Existing machinery: Up-to-date | Composition of future inventory: Existing machinery: To be reconditioned | Composition of future inventory: Machinery to be purchased | Total number of machines: Future | Total number of machines: Existing |
|---|---|---|---|---|---|
| Hackling machines | 5 | — | 1 | 6 | 9 |
| Drawing frames | 28 | — | 273 | 301 | 408 |
| Cards | 7 | — | 3 | 10 | 25 |
| Rectilinear combers | 4 | — | 34 | 38 | 72 |
| Roving frames | 1,315 | — | 726 | 2,041 | 2,190 |
| Spindles | 12,471 | — | 2,282 | 14,753 | 21,852 |
| Reeling machines | — | — | — | — | 30 |
| Cheese winders | 515 | — | 270 | 785 | 2,100 |
| Twisting frames | 36 | 900 | — | 936 | 1,558 |
| Pirn winders | 276 | — | 43 | 319 | 675 |
| Warping machines | 23 | — | 18 | 41 | 51 |
| Slasher sizers | 3 | 3 | 1 | 7 | 8 |
| Non-automatic looms | 7 | — | — | 7 | 735 |
| Plain looms | — | — | — | — | 425 |
| Check looms | 7 | — | — | 7 | 11 |
| Dobby looms | — | — | — | — | 262 |
| Jacquard looms | — | — | — | — | 37 |
| Automatic looms | 293 | 360 | 35 | 688 | 360 |
| Plain looms | 253 | 178[a] | 20 | 451 | 309 |
| Check looms | — | — | 1 | 1 | — |
| Dobby looms | 40 | 182[a] | 2 | 224 | 51 |
| Jacquard looms | — | — | 12 | 12 | — |
| All looms | 300 | 360 | 35 | 695 | 1,035 |

*Source:* ECLA survey.

[a] Non-automatic looms converted into automatic looms.

TABLE XIX. COTTON: DEGREE OF OBSOLESCENCE OF THE EXISTING PRODUCTION MACHINERY, BY STATE

| | Guanabara and Rio de Janeiro | Minas Gerais | Santa Catarina and Rio Grande do Sul | São Paulo | Total |
|---|---|---|---|---|---|
| | | | (a) *Absolute figures* | | |
| *Existing spindles* | *830,430* | *531,494* | *120,759* | *1,412,099* | *2,894,782* |
| Up-to-date | 166,724 | 78,498 | 40,042 | 317,604 | 602,868 |
| Suitable for reconditioning | 239,412 | 245,160 | 47,772 | 676,510 | 1,208,854 |
| Obsolete | 424,294 | 207,836 | 32,945 | 417,985 | 1,083,060 |
| *Existing looms* | *20,159* | *16,630* | *3,216* | *31,008* | *71,013* |
| Up-to-date | 4,835 | 4,171 | 792 | 12,575 | 22,373 |
| Suitable for reconditioning | 1,006 | 3,096 | 669 | 7,666 | 12,437 |
| Obsolete | 14,318 | 9,363 | 1,755 | 10,767 | 36,203 |
| | | | (b) *As a percentage of total* | | |
| *Existing spindles* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| Up-to-date | 20.1 | 14.8 | 33.2 | 22.5 | 20.8 |
| Suitable for reconditioning | 28.8 | 46.1 | 39.5 | 47.9 | 41.8 |
| Obsolete | 51.1 | 39.1 | 27.3 | 29.6 | 37.4 |
| *Existing looms* | *100.0* | *100.0* | *100.0* | *100.0* | *100.0* |
| Up-to-date | 24.0 | 25.1 | 24.6 | 40.6 | 31.5 |
| Suitable for reconditioning | 5.0 | 18.6 | 20.8 | 24.7 | 17.5 |
| Obsolete | 71.0 | 56.3 | 54.6 | 34.7 | 51.0 |

*Source:* ECLA survey.

TABLE XXII. JUTE: DEGREE OF OBSOLESCENCE OF THE EXISTING PRODUCTION MACHINERY, BY STATE

| | Guanabara and Rio de Janeiro | Minas Gerais | Santa Catarina and Rio Grande do Sul | São Paulo | Total |
|---|---|---|---|---|---|
| | | | (a) *Absolute figures* | | |
| *Existing spindles* | *5,300* | — | *3,942* | *33,726* | *42,968* |
| Up-to-date | — | — | — | 7,580 | 7,580 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 5,300 | — | 3,942 | 26,146 | 35,388 |
| *Existing looms* | *691* | — | *379* | *2,414* | *3,484* |
| Up-to-date | 40 | — | — | 384 | 424 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 651 | — | 379 | 2,030 | 3,060 |
| | | | (b) *As a percentage of total* | | |
| *Existing spindles* | *100.0* | — | *100.0* | *100.0* | *100.0* |
| Up-to-date | — | — | — | 22.5 | 17.6 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 100.0 | — | 100.0 | 77.5 | 82.4 |
| *Existing looms* | *100.0* | — | *100.0* | *100.0* | *100.0* |
| Up-to-date | 5.8 | — | — | 15.9 | 12.2 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 94.2 | — | 100.0 | 84.1 | 87.8 |

*Source:* ECLA survey.

TABLE XXIII. FLAX: DEGREE OF OBSOLESCENCE OF THE EXISTING PRODUCTION MACHINERY, BY STATE

| | Guanabara and Rio de Janeiro | Minas Gerais | Santa Catarina and Rio Grande do Sul | São Paulo | Total |
|---|---|---|---|---|---|
| | | | (a) *Absolute figures* | | |
| *Existing spindles* | *2,482* | — | *2,280* | *21,852* | *26,614* |
| Up-to-date | 1,200 | — | — | 13,128 | 14,328 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 1,282 | — | 2,280 | 8,724 | 12,286 |
| *Existing looms* | *214* | — | *26* | *1,095* | *1,335* |
| Up-to-date | 108 | — | 12 | 370 | 490 |
| Suitable for reconditioning | 100 | — | — | 663 | 763 |
| Obsolete | 6 | — | 14 | 62 | 82 |
| | | | (b) *As a percentage of total* | | |
| *Existing spindles* | *100.0* | — | *100.0* | *100.0* | *100.0* |
| Up-to-date | 48.3 | — | — | 60.1 | 53.8 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 51.7 | — | 100.0 | 39.9 | 46.2 |
| *Existing looms* | *100.0* | — | *100.0* | *100.0* | *100.0* |
| Up-to-date | 50.5 | — | 46.2 | 33.8 | 36.7 |
| Suitable for reconditioning | 46.7 | — | — | 60.5 | 57.2 |
| Obsolete | 2.8 | — | 53.8 | 5.7 | 6.1 |

*Source:* ECLA survey.

TABLE XXII. JUTE: DEGREE OF OBSOLESCENCE OF THE EXISTING PRODUCTION MACHINERY, BY STATE

| | Guanabara and Rio de Janeiro | Minas Gerais | Santa Catarina and Rio Grande do Sul | São Paulo | Total |
|---|---|---|---|---|---|
| | | | (a) *Absolute figures* | | |
| *Existing spindles* | *5,300* | — | *3,942* | *33,726* | *42,968* |
| Up-to-date | — | — | — | 7,580 | 7,580 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 5,300 | — | 3,942 | 26,146 | 35,388 |
| *Existing looms* | *691* | — | *379* | *2,414* | *3,484* |
| Up-to-date | 40 | — | — | 384 | 424 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 651 | — | 379 | 2,030 | 3,060 |
| | | | (b) *As a percentage of total* | | |
| *Existing spindles* | *100.0* | — | *100.0* | *100.0* | *100.0* |
| Up-to-date | — | — | — | 22.5 | 17.6 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 100.0 | — | 100.0 | 77.5 | 82.4 |
| *Existing looms* | *100.0* | — | *100.0* | *100.0* | *100.0* |
| Up-to-date | 5.8 | — | — | 15.9 | 12.2 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 94.2 | — | 100.0 | 84.1 | 87.8 |

*Source:* ECLA survey.

TABLE XXIII. FLAX: DEGREE OF OBSOLESCENCE OF THE EXISTING PRODUCTION MACHINERY, BY STATE

| | Guanabara and Rio de Janeiro | Minas Gerais | Santa Catarina and Rio Grande do Sul | São Paulo | Total |
|---|---|---|---|---|---|
| | | | (a) *Absolute figures* | | |
| *Existing spindles* | *2,482* | — | *2,280* | *21,852* | *26,614* |
| Up-to-date | 1,200 | — | — | 13,128 | 14,328 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 1,282 | — | 2,280 | 8,724 | 12,286 |
| *Existing looms* | *214* | — | *26* | *1,095* | *1,335* |
| Up-to-date | 108 | — | 12 | 370 | 490 |
| Suitable for reconditioning | 100 | — | — | 663 | 763 |
| Obsolete | 6 | — | 14 | 62 | 82 |
| | | | (b) *As a percentage of total* | | |
| *Existing spindles* | *100.0* | — | *100.0* | *100.0* | *100.0* |
| Up-to-date | 48.3 | — | — | 60.1 | 53.8 |
| Suitable for reconditioning | — | — | — | — | — |
| Obsolete | 51.7 | — | 100.0 | 39.9 | 46.2 |
| *Existing looms* | *100.0* | — | *100.0* | *100.0* | *100.0* |
| Up-to-date | 50.5 | — | 46.2 | 33.8 | 36.7 |
| Suitable for reconditioning | 46.7 | — | — | 60.5 | 57.2 |
| Obsolete | 2.8 | — | 53.8 | 5.7 | 6.1 |

*Source:* ECLA survey.