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Santiago, Chile, 14 to 25 March 1966

INDUSTRIES PROCESSING AGRICULTURAL PRODUCTS OTHER THAN FOOD

Submitted by the Food and Agriculture Organization of the United Nations (FAO)

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P A P E R NO. IV

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The FAO Contribution to this Symposium includes in addition to the one mentioned above five other papers entitled:

I:	ST/ECLA/CONF.23/L.19	"The Economic Significance and Contribution of Industries based on Renewable Natural Resources and the Policies and Institutions Required for their Development"
II:	ST/ECLA/CONF.23/L.20	"Some Essential Requisites for Industrial Development of Renewable Natural Resources"
III:	ST/ECLA/CONF.23/L.21	"Food and Food Products Industries"
V:	ST/ECLA/CONF.23/L.23	"Fisheries Industries"
VI:	TE: ECLA/SID/66/VI	"FAO's Relations with Industry through the Freedom from Hunger Campaign"

In addition, FAO has collaborated with ECLA in the preparation of all the papers relating to the joint ECLA/FAO Interim Review Consultation on Pulp and Paper Development in Latin America, which is scheduled to form a part of the Symposium.

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INDUSTRIES PROCESSING AGRICULTURAL PRODUCTS OTHER THAN FOOD

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INDUSTRIES PROCESSING AGRICULTURAL PRODUCTS OTHER THAN FOOD

INTRODUCTION

1. Agricultural products other than food (excluding forestry and fishery products) include the beverages and raw materials used in various industries manufacturing a wide range of mainly consumer goods. The farmer himself rarely consumes much of such produce in the raw state, but rather sells it for cash. Since in developing regions such as parts of Latin America, industries are relatively few, the sale is mainly for export. Yet requirements of the manufactured consumer goods in such regions are considerable, and are liable to increase relatively rapidly as economic development leads to higher standards of living. With the raw materials at hand, this naturally leads to consideration of their local manufacture, which should however take into account industrial and technological developments in other parts of the globe.

The raw products can be roughly divided into five main groups, viz:

I. Natural Fibers, vegetable as well as animal fibers;

II. Hides, Skins, Leather, including also animal by-products and tannin extracts;

III. Saps and Secretions, such as rubber, lac, resins, etc.;

IV. Technical and Essential Oils, including drying oils;

V. Condiments, such as tea, coffee, cocoa, tobacco and spices;

VI. Various Products, such as industrial starch, insecticides, medicaments and dye-stuffs.

In general, the agricultural raw materials all require some degree of processing to put them in a form suitable for commercial marketing - cotton has to be ginned, wool scoured, hides tanned, rubber milled, while the processing of other agricultural raw materials is even more complicated. This initial processing is largely performed in the producing countries, and most developing countries have processing units which may be quite small, or in the case of plantation crops, such as hard fibers, organized (for decortication) on industrial lines. By a series of further strictly industrial processes, the raw materials are transformed into finished goods, such as textiles, footwear, tyres, etc.

2. As a result of technical developments in this century, and mainly in the last few decades, man is no longer so dependent on the agricultural raw materials as formerly when clothes, footwear, tyres, paints, perfumes, etc., were exclusively made from "natural" materials. Only the products of group V, condiments are not as yet greatly threatened by synthetic substitutes. In groups I to IV; artificial products or synthetics are increasingly taking the place of the agricultural products, as production growth rates in the following table indicate. Apart from the fact that synthetics can be "tailored" to use, they have advantages in the relative stability of their quality and price, and in technological developments in

processing, which makes relatively efficient and profitable use of them:

Table A — Production of Natural and Synthetic Fibers and Rubber

	World					Developing Countries				
	1961	1962	1963	1964	1964 Quantity m.n.tons	1961	1962	1963	1964	1964 Quantity m.n.tons
	Indices 1957-60 - 100					Indices 1957-60 - 100				
Fibers - Natural	109	110	114	115	17.89	121	121	123	124	8.82
Man-made -										
Cellulosic	110	117	125	134	3.27	120	126	135	165	.23
Synthetics	173	224	276	348	1.68	295	464	536	950	.03
Rubber - Natural	107	109	106	113	2.24	107	109	106	113	2.24
Synthetics	124	142	160	185	3.75	-	-	-	-	.05

While the development of synthetic substitutes for agricultural raw materials has taken place mainly outside the developing countries, it is a question of economic analysis and policy whether some countries rich in mineral oil, make more of their agricultural raw materials by extending processing industries or make more of their oil in petrochemical products, such as synthetics, which compete throughout the world if not always for the same industrial processing capacity, for the same end uses as the agricultural raw materials.

Notwithstanding the rising tide of the synthetics, production of many agricultural raw materials will no doubt continue to expand, especially in many developing countries in the Latin Americas and other less developed regions. Such production is likely to continue to be the mainstay of their processing industries for some time to come, and provided costs of producing and processing these materials can be lowered, they should be able to meet competition from synthetics in markets of developed countries also.

3. The establishment and expansion of domestic industries processing local agricultural raw materials is a field of economic development often favoured by developing countries because it can contribute to the maintenance and increase in standards of living, while effecting savings in foreign exchange expenditures on consumer goods in favour of expenditures on import of capital and other goods more essential for economic development; or because the value added in manufacture increases the foreign exchange earned where the product can be exported in place of the raw material. It can also by processing a larger domestic market for raw materials largely exported, help stabilise prices to the producer.

Latin America shares with other developing regions of the globe a substantial interest in the production of a number of agricultural raw materials and in the potentialities for their local manufacture. Some developing countries are further advanced than others in exploiting these potentialities. In the further development of local manufacture of certain raw materials as, for example, cotton, developing countries not only within Latin America, but in other regions, will no doubt want to take into account each others plans, to ensure the highest economic benefit from investments made in this field.

I. FIBERS

Review of Natural Fibers

1. Natural fibers may be distinguished between animal and vegetable fibers; both groups are different in chemical composition, and consequently in certain typical properties like reaction to dyes. There are many types of natural fibers*, more than 2,000 species of fiber-yielding plants in various parts of the worldbeing known, of which, however, less than fifty are processed in any significant quantity, and only about ten or twelve are of outstanding commercial importance. The following scheme gives a review of the more important fibers.

Animal Fibers

A. Silk

a. True silk, produced by the silkworm Bombyx mori;
b. "Wild" silks, Tussore silks, produced by various insects, such as Antherea spp.

B. Epidermal Hairs

a. Wool, the epidermal protective covering of sheep;
b. Mohair, the hairs of the Angora goat, the llama, alpaca and vacuña;
c. Various animal hairs, such as camel and rabbit hairs used for felt, pig bristle, yak hair, etc.;
d. Horse hair.

Vegetable Fibers

A. Seed and Fruit Hair Fibers

a. Seed hairs such as cotton: Gossypium spp.;
b. Pod fibers, such as
   Kapok (Indonesia, Thailand): Ceiba pentandra;
   Bombax (India): Bombax malabaricum;
   Vegetable silks: Calotropis gigantea and others;
c. Husk or hull fibers, such as Coir (Ceylon, India, etc.):
   Cocos nucifera.

B. Leaf fibers

a. Agave fibers, such as:
   Sisal (Africa, Brazil, Venezuela, Indonesia, Taiwan): Agave sisalana;
   Henequen (Mexico, Cuba): A. fourcroydes;

*Details of their origins can be supplied as required.

Cantala (Philippines): A. cantala;
Lecheguilla: A. lecheguilla;
Mexican henequen: A. lurida;
Letona (El Salvador, Guatemala, Honduras): A. letona;

b. Phormium tenax or Formio, known variously as:
New Zealand Flax (New Zealand);
Formio chileno (Chile);
Maolan (Japan)

c. Furcraea fibers, such as:
Fiqué (Colombia): Furcraea macrophylla;
Mauritius fiber (Mauritius and Reunion): Furcraea gigantea;

d. Sanseviera, Bowstring-Hemp (Africa): Sanseviera spp.

e. Pineapple fibers, such as:
Ananas fiber (Philippines, South America, Mozambique): Bromelia ananas L.;
Pita floja (Central and South America): Aechmea magdalenae;

f. Various fibers, such as:
Palma istlé (Mexico): Samuela carnerosana;
Caroa (Brazil): Neoglazovia variegata;

C. <u>Leaf-stem Fibers</u>

a. Musa fibers, such as:
Abaca or Manila hemp (Philippines): Musa textilis;
Banana fibers: (Musa paradisica var.);

b. Palm fibers, such as:
Dum palm fiber (Ethiopia, East Africa): Hyphaene spp.
Vegetable brush fibers, derived from various palms.

D. <u>Bast Fibers</u>

a. Flax and hemp fibers, such as:
Flax (Europe, U.S.S.R., U.A.R., Japan, Turkey): Linum usitatissimum;
Hemp (Europe, Turkey): Cannabis sativa;
Sunn hemp (India, Pakistan): Crotalaria juncea;

b. Jute and allied fibers, such as:
True jute (India, Pakistan): Corchorus spp.;
Kenaf or Mesta (India, Pakistan, Thailand): Hibiscus cannabinus;
Roselle (Indonesia, South Africa): Hibiscus Sabdariffa;
Congo jute (Africa): Urena lobata, Cephalonia polyandrum);
Abutilon (China): Abutilon Avicennae and A. indicum;

c. Ramie: Boehmeria nivea

Whatever their origins, the uses to which the various fibers are ultimately put, are determined primarily by their physical properties as modified in processing. In this connection it is useful to consider the fibers and industries processing them under the following headings:*

1. [x]<u>Textile fibers</u>, including cotton, wool, silk, flax, ramie, hemp.

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*Paper-making fibers are dealt with in the paper on Forest Industries.

[x]The most important, cotton and wool, are often classified along with cellulosic and synthetic fibers as "apparel fibers" although, in fact, their uses are much wider.

2. Sacking fibers, mainly the soft fibers, jute, kenaf, and allied fibers.

3. Cordage fibers, mainly the hard fibers, sisal and henequen, abaca.

4. Bristle, brush or mat fibers, including coir, piassava, palmyra

5. Stuffing fibers, including kapok and vegetable silks.

Following pre-industrial processing to put them in marketable form, the fibers in categories 1 through 3 move into industries where preparatory processes such as carding and spinning convert them into yarn. These processes and the equipment involved are adapted to each particular fiber. And in subsequent processes of doubling, weaving, etc., the several natural fibers in yarn form are relatively rarely processed together, although the man-made cellulosic and synthetic fibers are sufficiently adaptable to be processed on equipment designed to process particular natural fibers. It follows therefore that the names of particular natural fibers enter into the designation of the industries processing them, e.g. cotton textile industries, woollen and worsted industries, jute manufacturing industries, etc.

Major Textile Fibers

Cotton

2. While it is large identified with apparel, and in Africa cotton is highly favoured for this use, cotton has in fact a very wide range of household and industrial uses also. Since it is a general purpose fiber, with many uses in manufactured form, requirements tend to expand relatively rapidly with economic development, especially in regions where the initial level of development is generally low*.

In terms of tonnage produced, cotton is the most important fiber. Its production is quite widely spread throughout the globe, and its processing even more so. A considerable number of countries in Central and South America are in fact very well adapted to the production of cotton of different varieties. The output on the continent which shows diverse trends, in total is more than 1,700,000 tons, which is about 15 per cent of world output of cotton.

The pre-marketing process of ginning, that is separating the lint from the cotton seed which yields valuable oil as a by-product, is done on roller gins in the case of extra-long staples produced by U.A.R. and Sudan, while for shorter staples, saw gins are used. In this connection FAO is rendering assistance under U.N. Special Fund Cotton Research Project to U.A.R. in introducing the most modern ginning and testing methods with the object of improving the quality and marketability of the crop.

*See Statistical Annex

Table B — Cotton in Latin America — ooo metric tons

	1948/49-1952/53	1961/62	1962/63	1963/64
Total Latin America	862	1537	1781	1704
Central America				
Mexico	222	437	540	465
Nicaragua	8	57	74	91
El Salvador	8	59	72	75
Guatemala	2	26	52	65
Honduras	-	4	5	7
Haiti	2	1	1	1
Dominican Republic	-	1	2	...
Total Central America	242	585	746	704
South America				
Brazil	395	609	640	652
Peru	76	134	152	...
Argentina	118	108	133	99
Colombia	10	78	82	73
Paraguay	14	11	13	12
Venezuela	4	8	11	10
Ecuador	3	4	3	5
Uruguay	-	-	1	1
Total South America	620	952	1035	1000

Almost two-thirds of this output are attributable to Brazil and Mexico. The bulk of the output is consumed in the region, whilst about 40 per cent of the production is exported. The Latin American countries most dependent on cotton, and the percentages of exports of raw cotton in their total exports in 1959/61 were Nicaragua 23 and Mexico 22. Latin America finds its main market in Western Europe and Japan, as the following trade-figures show:

Table C — Trade in Raw Cotton in Latin America - Average 1959-61 — ooo metric tons

	Exports to	from
Latin America	32.7	32.7
USA and Canada	19.1	19.0
West and South Europe	336.8	-
Australia, New Zealand, South Africa	9.6	-
Japan	207.1	-
Middle East	1.7	0.8
Asia and Far East	22.6	-
Africa and n.e.s. countries	4.8	-
U.S.S.R. and Eastern Europe	18.1	6.3
China (Mainland)	0.9	-
Unallocable residuals	25.4	-
Total ...	678.8	58.8

Cotton Textile Industrialization

3. Cotton textile industrialization represents an attractive line of development to many developing countries. Until the Second World War, cotton-producing developing countries had to rely almost completely on imports of cotton manufactures. The only exception was India, where a textile industry was already firmly established before the War. During the post-war period, however, cotton manufacture spread to a large number of developing countries, and textile mills grew rapidly, mainly in Asia and the Far East, and the Middle East, but also in Latin American countries, such as Cuba and El Salvador. The existence of a local supply of raw material and the presence of a labour force suitable for training, encouraged the setting-up of mills. Capital was often provided by foreign firms or governments, either in the form of private investment, loans, or inter-government aid. Expansion was favoured by rising demand in domestic markets, most of which were heavily protected, and by government policies designed to promote industrialization. The main obstacle lay in a scarcity of managerial and technical skills, and in a lack of adequate transport facilities, distribution channels and sources of power.

Cotton mills tend to be less capital-intensive, and to use less fuel and power per worker, than the average manufacturing plant in developing countries; the value which processing adds to raw cotton, however, is also smaller than the value added to raw materials in other industries. This is illustrated by the following data for India and Pakistan.

	Fixed Assets	Fuel and Electricity consumed	Value Added
	Value per person employed as percentage of the value for manufacturing industry as a whole		
India	60	72	78
Pakistan	79	86	80

The low capital and power intensity, and the relatively low wage rates, give developing countries a comparative advantage in the manufacture of all staple types of cotton goods, including hosiery and knitted underwear. Raw cotton accounts for a high proportion of total manufacturing costs, and transportation costs are negligible in those countries which process their own cotton crop. Gross value added by manufacturing tends to be of the same magnitude as the cost of raw fibre. The import contents of the finished textiles consist chiefly of the cost of capital, fuel, chemicals and dyes; it rarely exceeds 25 per cent of the gross value of output.

Prospects for further growth in cotton manufacturing appear favourable in a large number of developing countries. In the majority of cases, the supply of raw material presents few problems, increased area and improved techniques pointing to larger crops. Domestic demand for clothing and textiles is also rising with population trends and higher levels of national income. An adequate labour force is available in most developing regions, and capital for expanding capacity may be obtained through foreign credit or aid. Finally, more efficient use of machinery, which is a prime requisite for a viable cotton industry, can be achieved through the training of both labour and management. The great majority of new textile industries enjoy some form of government assistance and protective legislation. Continued growth therefore seems assured for such recently established industries as those of Mexico and Brazil in the Latin American region, and, at a somewhat slower pace, for those of Argentina and of Central American cotton-producing countries.

Wool

4. Wool is predominently an apparel fiber, but has also important household uses into which the carpet wools of sheep indigenous to the region enter. Production of wool in Latin America is fairly substantial in certain areas, especially in Argentina and Uruguay, but also in Brazil, Chile and Peru. It is in total averaging in recent years some 190,000 metric tons on a clean basis, and accounting for some 13 per cent of world output. There is, however, a certain trend to discourage pastoral production in favour of agriculture and the manufacturing industry.

Table D — Wool in Latin America — 000 metric tons

	1948/52	1961	1962	1963
Total Latin America	188.0	193.5	189.8	197.0
Argentina	106.0	103.7	100.3	105.4
Uruguay	51.3	...	...	49.8
Brazil	12.2	15.5	15.9	16.7
Chile	9.9	11.1	11.1	11.1
Peru	4.4	5.0	5.0	5.2
Mexico	...	3.5	2.8	...
Bolivia	2.2	...	...	...
Falkland Islands	1.4	1.5	...	...
Colombia	0.8	...	...	...

There is practically no export of Latin American wool to other regions, all the wool being converted within the region into finished goods in the woollen and worsted industries of Argentina, Uruguay, Brazil and other Latin American countries. The region is even an importer of wool, imports in 1959-61 from other regions (Australia, New Zealand, South Africa) reaching 7,100 metric tons.

The attempt in Latin America to export wool in the form of semi-manufactures, mainly tops, met with little success. The West European market, which absorbed important quantities just after the War, shrank with economic recovery, whilst Japan developed its own combing sector. The experience in Latin America, and even in developed countries such as Australia and New Zealand, has shown that it is difficult to produce wool textiles economically in countries without a solid industrial basis.

High protective tariffs, and government assistance to mills, enabled most wool-producing countries in Latin America to expand their wool/textile capacity, and some degree of import substitution took place. Owing to the high cost of imported machinery and other materials, and to the scarcity of skilled labour, however, processing proved relatively expensive, and domestic wool textiles had to be marketed at prices which discouraged consumption. The following statistics* show mill consumption during the 'fifties in Argentina, Uruguay and Brazil, a decline in Argentina being offset by increases in the other countries.

*Also see Statistical Appendix

	Argentina	Uruguay	Brazil
	thousand metric tons, clean basis		
1953-55 average	30.5	16.8	12.9
1959-61 average	23.4	18.5	15.7

Sacking (Soft) Fibers

5. The fibers used primarily in the manufacture of sacks and other containers, are jute- kenaf and allied fibers. They are also used in substantial quantities in the manufacturing of floor coverings. The latter, however, enter into the economic life of mainly the developed countries. On the other hand, developing countries in Latin America and elsewhere, with expanding outputs of agricultural commodities such as cocoa, coffee, sugar, cotton, wool, etc. have increasing requirements of containers; and only in special circumstances are they likely to introduce the bulk handling methods which have become widespread in developed countries.

The great bulk of jute and allied fibers is produced in the Far East where agronomic conditions for its production are specially favourable. Latin America is producing less than 50,000 metric tons of jute, mainly in Brazil. Endeavours after the last war, strongly encouraged by the U.S.A., to introduce kenaf on a large scale into the Western Hemisphere as a jute substitute, had no permanent success. The Latin American home consumption of jute goods of about 230 thousand metric tons requires further imports into the region of about 180,000 metric tons.

As for other fibers, initial processing from the plant into the baled fiber takes place in the growing area. The usual way of initial processing for jute and all other bast fibers, is retting for 10-15 days in stagnant or slow-moving water. During retting, the outer bast layer separates from the stem by bacterial action and can afterwards easily be stripped off by hand. By energetic washing of the retted bast, clean fibers are obtained.

While this way of processing is still predominantly used in India, Pakistan and Thailand, it is less practical for other countries, where either water is not so abundant, or labour not so plentiful and cheap. Attempts have therefore been made, and are still being made to extract kenaf and similar fibers without sisal. While certain decorticators have been developed for this purpose, they are by no means an ideal solution because bast or soft fibers are really too fine for mechanical decortication, with the result that either the fiber losses in decorticators are too high, or the fibers are not opened up sufficiently. A satisfactory solution is a two-stage process: the stems are first treated in a "ribboner" (a kind of rather crude decorticator) which delivers the bast in the form of small ribbons or fiber bundles. These are then retted, either in the rather primitive traditional way, or in a more efficient modernised way, like canal-retting, sprinkler retting, application of warm water, etc.

The further processing of jute and allied fibers by spinning and weaving into finished goods - twines, fabrics and sacks - is carried on mainly in the principal fiber-producing countries, India and Pakistan.

In Latin America the local jute production is processed in Brazil, with the result that imports of raw jute into the region have declined drastically.

Jute Manufacturing Industries

6. While the problems of raw jute and allied fiber supply and price remain acute, the proliferation of jute manufacturing industries in many developing countries has to be approached with caution, the more so because it also raises problems of international adjustment, and questions of the economic benefits of investment in such industry. In this connection, the FAO Study Group on Jute, Kenaf and Allied Fibers at its September 1964 session considered that it would be useful to collect and exchange information on investment plans in the various countries and also gave attention to data on investment requirements for setting up new jute industries in developing countries, some details of which are given below. The Group will again be considering these matters at its next session in September 1966.

The cost of the raw material is by far the most important item in costs of production of jute or kenaf sacks. Therefore, if a sack factory is to be established in a certain country, and if the fiber is to be produced locally, the fiber price to the factory must be competitive with the cost of jute produced in India; otherwise the factory will have to rely on Government assistance to keep it going.

In the hypothetical case of a country having an annual demand of six million bags a year, the investment required would be approximately as follows:

	Total	Of which imported
Machinery, furnishings, spare parts, electric motors, excluding the power house	US $ 1,260,000	US $ 1,260,000
Buildings	630,000	313,600
	US $ 1,890,000	US $ 1,573,600

The length of time involved from the date of the placing of the order of machinery and plant will be about 2½ years; if a fiber is to be grown locally, starting from scratch, before establishing a factory, a period of at least five years would probably be required.

About 50 to 60 per cent of the cost of the finished bag would be the raw material cost, including batching oil. Required raw material is 7,000 tons for 6,000 tons of bags. Assuming that the raw material costs $160 per ton and the bags $270 per ton, the gross value added by manufacture would be $770,000. If the fiber was all produced locally, the saving per annum in foreign exchange would be $1,620,000, if the fiber was imported the savings of foreign exchange compared with the import of the sacks would still be about $500,000.

If a soft fiber is to be grown locally to supply the sack factory, a labour force of around 12,500 will be needed for cultivation, harvesting, retting and drying, during a period of, say, four months during the year.

Cordage (Hard) Fibers

7. The principal products of the hard fibers - abaca, sisal and henequen - are ropes for marine and industrial use and binder and baler twines used in mechanized agriculture, while subsidiary uses of these fibers are in carpets, upholstery and paper manufacture. All such products are mainly in demand in the more highly developed countries where there is an increasing application of synthetic fibers.

Hard fiber plants grow in tropical and subtropical regions and production of the fibers is quite widespread among developing countries in Latin America, as well as in Africa and the Far East. The processing of agaves originated in Mexico, when also the first method of mechanical decortication was developed. Initial "on the spot" processing consists in extracting the fiber from the leaf by means of hand stripping or scraping in a power-driven decorticator, either a handfed raspador or an automatic continuously working decorticator. A by-product of decorticators is sisal-waste ("flume tow"), which after retting and/or mechanical cleaning, can be used for upholstery or sack manufacture. Automatic decorticators are huge stationary machines with high capacity, often requiring mechanised transport for the leaves. They involve considerable capital investment by big plantations which employ them. While production in most countries is largely on these lines, there is now an increasing demand for smaller, transportable decorticators which are within reach of groups of smallholders.

Production of hard fibers in Latin America is concentrated in the agave fibers such as sisal and nenequen. An attempt during the last war to produce abaca in Central America was later abandoned again. While Mexico, the homeland of sisal from which country it was introduced to Florida first and from there to East Africa, is now producing mainly henequen, sisal has after the war been introduced in Brazil, where a sisal industry has been built up in rather a spectacular way.

Sisal and henequen enjoy an increasing share of the world demand for hard fibers partly because the main outlet is in the expanding markets for agricultural twines, and partly because improvements in manufacturing sisal have enabled it to capture larger markets for ropes and other goods. Of the total agave fiber output, Latin America accounts for more than 60 percent of world production, Mexico and Brazil being the main producers, while also Haiti, Venezuela and Cuba produce substantial amounts.

The emergence of Brazil as the world's second largest sisal producer in the postwar period reflected an expansion in the domestic market for sisal, while in Mexico henequen output expanded with the development of a large domestic market for henequen for Yucutan's cordage mills.

Table E - Hard Fibers in Latin America 000 metric tons

	Type of fibre	1948/52	1961	1962	1963
Agaves					
Total Latin America		210	374	398	406
Brazil	Sisal	43.6	170.4	194.3	199.3
Mexico	Henequen	110.0	156.0	156.4	157.5
Haiti	Sisal	28.3	23.4	21.3	20.3
Venezuela	Sisal	6.0	8.4	8.5	11.6
Cuba	Henequen	14.7	10.2	10.2	10.2
El Salvador	Letona	3.0	3.5	3.0	2.7
Dominican Rep.	Sisal	-	1.5	0.7	-
Guatemala	Letona	0.9	-	-	-
Jamaica	Sisal	0.2	0.4	0.4	0.4
Bahama	Sisal	0.2	-	-	-
Honduras	Letona	0.1	0.1	0.1	0.1

	Type of fiber	1948/52	1961	1962	1963
Other Hard Fibers					
Total Latin America		20	30	35	35
Colombia	Fiqué	11.7	23.0	24.5	-
Mexico	Palma Istlé	13.9	13.2	14.2	13.2
Argentina	Formio	4.2	3.8	4.5	4.5
Brazil	Caroa	5.6	3.9	4.3	3.4
Chile	Formio	0.3	0.3	0.4	0.4

Hard Fibre Processing Industries

8. Conditions in developing countries which grow the raw material lend themselves quite well to the manufacture of cordage and other products from hard fibers. The industry need be neither power nor capital-intensive, technology is or can be simple, and economies of scale are not large. Raw material cost accounts for a considerable part of total costs of production, and since spinning mills can be located near plantations, transportation cost is small. The gross value added by manufacture varies between one-half and two-thirds of the value of raw fiber. The import content of the finished product consists mainly of depreciation and fuel costs and probably does not exceed 10 per cent of the gross value of output.

Since the last war, the manufacture of cordage and other hard fiber products has been expanding rapidly in Latin America, particularly in Mexico and Cuba, and more recently in Haiti, the Dominican Republic and Brazil. More than half the volume of sisal and henequen exported from this region is now in processed form. Despite a shortage of modern machinery, the abundance of cheap fiber and the low cost of labor make Latin America's cordage mills competitive with those of North America, whither most exports are directed. Since 1960, cordage shipments from Cuba have been sent chiefly to centrally planned countries, especially the U.S.S.R.

The postwar success story of the Mexican cordage industry may serve as an example of potential opportunities elsewhere. Though old established, the industry has suffered a decline early in the century, and did not begin to expand until the end of the second world war. During the fifties, its consumption of henequen doubled, while its exports of cordage almost trebled. Mexican mills employ about 100 workers each and produce an average of about 1,500 tons of henequen manufactures a year. Average capital investment amounts to $200,000 per mill, or some $2,000 per worker. The value of output is about $375,000 per mill and thus 3,750 per man employed. As the following table shows, processing adds some two-thirds to the value of raw fiber, and domestic factors of production alone add about 50 percent. Thus for every dollar's worth of fiber exported in the manufactured rather than in the raw stage Mexico earns an additional 50 cents in foreign exchange.

<u>Composition of Gross Value of Output and Import Content in Hard Fiber Manufacturing in Mexico, 1955</u>

Percentages

Items	Total			Import Content	
Raw fiber	60			0.5	
Fuel and power	2			1.0	
Other net inputs	6			2.0	
Total inputs			68		3.5
Labor	11			-	
Profit (estimate)	10			-	
Net value added		21			
Capital depreciation (estimate)		11			5.5
Gross value added			32		
Gross value of output			100		9.0

Source: Censo Industrial 1956 (Información Censal 1955), Resumen General, Secretaría de Industria y Comercio, Dirección General de Estadística, México, 1959.

Judging by the experience of Mexico, there is little difficulty in setting up cordage mills where there is a plentiful supply of raw fiber and an abundant labor force. Training workers seems to create few problems, and the low level of wages obviates the need for the latest machinery. Further rapid growth can therefore be expected in Brazil which, like Mexico, may develop a considerable export surplus of hard fiber products. Assuming that these developments will take place, sisal and henequen from Latin America could be exported mainly in the form of cordage. This would raise Latin American exports of cordage to 200.000 - 250.000 tons by 1970.

There has also been a considerable expansion in the manufacture of sisal and henequen bags and sacks in Latin America for packaging export crops such as coffee and sugar, and even paper manufacture from sisal started in Latin America. In developed countries, more hard fibers are used for padding, and new uses are evolved in the building, mining, plastics and pharmaceutical industries.

A broader approach to the development of sisal manufacture in developing countries is however advisable. In particular it has to be recalled that hard fiber products are consumed mainly in developed countries, where technological advances affecting their manufacture and usage are liable to take place relatively rapidly. Insofaras competition from synthetics has to be met, recently polypropolene agricultural twines are reportedly being developed. The long-term demand prospects for hard fiber products or products into which hard fibers may enter, have therefore to be assessed. There is also need to promote not only more efficient production, but more efficient marketing and greater stability in sisal prices. The Government of Tanzania and other governments concerned have recognized that this problem of assessing long term prospects, and of making approaches to stabilization of sisal prices can best be taken up at international level. In November 1965 the FAO Committee on Commodity Problems recommended that an ad hoc meeting on hard fiber producing and consuming countries be held next March to go into these questions with a view to recommending suitable measures.

Coir Fiber

General

9. Coir, or coconut fiber, is obtained from the husk of the coconut. It is therefore a by-product of copra manufacture. The name coir is derived from the Malay word for cord, kayar.

On an average, about 25 - 30 per cent of the weight of husks can be obtained as fibres of which one-quarter to one-third are long, and the rest short fibers. The quality of the fiber depends on the variety of the coconut husks used, on the degree of ripeness of the nuts, and on the freshness of the husks. The finest and longest varieties of coir fiber are used for making cordage and floor coverings. A coarser variety is used in manufacturing brushes and brooms, and a short variety is employed for filling mattresses, or as a substitute for horse hair in upholstery. Rubberized coir is used in furniture, aeroplace and automobile upholstery, and coir dust is useful for acoustics, insulation and air-conditioning filters.

Fiber Quality

10. Coir has natural resilience, durability, resistance to dampness and elasticity, and stands up well to mechanical wear and abrasion. Coir rope is said to be unique in not rotting in salt water. On the other hand, the texture of coir rope and mats is rough, and the appearance not highly aesthetic. Coir does not have as light a colour as sisal and cannot be spun to the same fineness. Coir rope being rougher is less easy to handle than sisal rope, and is also stiffer and more brittle. Because of these limitations and because it is a by-product of coconut production, coir is one of the cheapest natural fibers. The unit values of annual imports of coir into the United Kingdom in the years 1959 to 1962 ranged from 40 to 55 per cent of the unit value of the imports of sisal. The average prices paid by manufacturers in the Netherlands for coir yarn in the years 1952-1956 were reported as ranging from half to three-quarters of the average prices paid for sisal yarn.

Economic Importance

11. World production of coir is estimated at about 250,000 metric tons in recent years, therefore about double that of abaca and not far short of half that of sisal. About 95 per cent of the world supply of coir is produced in India and Ceylon where the concentration of coir production in Western coastal areas make it vital to the economies of these regions. Coir production is one of the biggest cottage industries of India, and is a means of supplementing the low earnings of small coconut growers and fishermen, and of providing employment for the otherwise unutilized female labour of the densely populated coastal areas.

Attempts to produce coir are also made in other countries. In the Philippines, for example, there are plans to start producing coir fiber on a large scale. Coir production in Zanzibar is being increased under the direction of its Copra Board, and the export potential of East African countries is put at 10,000 metric tons annually. In Thailand, until 1961 only small amounts of coir fiber were produced by hand for fishing nets and local cordage, but production with modern machinery has recently been introduced.

As about five-sixths of the world's coconut husks are still burnt as fuel, used as manure or (mostly) wasted, the potential production in all coconut producing countries is very high. To assess the possible maximum coir production, it can safely be assumed that 1,000 coconuts yield about 100 kgs. of coir and about 200 kgs. of copra. For each kilogram of copra, therefore, half a kilogram of coir could be produced.

For the world production of about 3,200,000 metric tons of copra, the theoretically possible coir production would be 1,600,000 metric tons compared with an actual production of 250,000 metric tons.

For Latin America, with a production of about 250,000 metric tons of copra, the potential coir production would be 125,000 metric tons. Biggest potential producer would be Mexico, which produces 183,000 tons of copra, therefore the bulk of the whole region. Other substantial producers of copra are Venezuela, Jamaica and Trinidad/Tobago. However, also the smaller producers of coconuts have recently shown a lively interest in the production of coir and the manufacture of articles from coir, such as ropes and twines, brooms and brushes, mats, etc. For these countries, coir processing can be encouraged as a rural or cottage industry, increasing the standard of living of the rural population. FAO is giving technical assistance in this respect to the Dominican Republic and to Dominica, while the same assistance is considered for Trinidad and Tobago.

The future rate of growth of the world coir industry will depend mainly on the price at which good quality coir can be supplied, because coir output is a small proportion of the world supply of industrial fibres, and close substitutes exist in all end-uses.

Coir Substitutes

12. The closest substitute of coir is sisal and decreases in the import of coir in Western European countries since the second World War have been ascribed to lower purchases by manufacturers of mats and matting who have turned to sisal. The threat of substitutes is serious for coir yarn as the process of substitution involves no capital costs the same machine being able to process sisal yarn.

In the industrialized countries, tacked carpets covering the whole floor of the living room have become more popular, and consequently coir carpets are used less. Coir matting is usually covered by a carpet of other materials. The increased use of synthetic floor coverings, such as cocovinyl tiles in corridors, entrance halls, kitchens, etc., has also made the customary carpets and mats superfluous. In low-income countries like India, the market for coir floor coverings will depend on price rather than quality. Among wealthier consumers in India, coir faces competition from jute mattings.

Processing

13. Initial processing is the extraction of the fiber from the husks which can be done either by hand or by machine. The manual processing is highly labour-intensive, involves a long retting period, and is the traditional method used in India, Thailand and Indonesia. Husks, cut into two or three sections, have to be soaked in sea or brackish water for five to nine months before fiber separation can be done by vigorous beating of the soaked husks with mallets. The fibrous material is then washed, dried and opened up into fibers five to ten inches long, ready for spinning.

Spinning of coir fiber into yarn is a cottage industry performed almost entirely by women and children, and is done by hand or by means of simple hand-driven machines. The yarns are made into hanks of up to twenty yards' length and sold to buyers, often against payment in kind. The hanks are then transported to the commercial centres where the yarn is graded and baled for export or for the coir mills. At present, almost all the world's supplies of coir yarn are produced in India. The estimated value added per head per day is more than Rs. 2, probably the highest of all the cottage industries of India.

In mechanical processing of coir, the husks are crushed between fluted rollers and conveyed mechanically to retting pits. The retted pieces are fed into breaker drums where short and long fibers suitable for different purposes are separated. The fiber is then washed, sun-dried, combed and bundled with coir twine, and pressed into bales for export. This technique of processing reduces the length of the retting period to three to six weeks, and the labour requirements per machine are very low. By the use of strong crushing and hackling machines, this retting period can be further reduced and consists sometimes only in a few days' soaking in water.

To eliminate retting altogether, a dry processing method has been developed in the United Kingdom, consisting of heavily beating the husks in a "husk-bursting mill", followed by treatment in a "sifter" for further opening and screening, and eventually in a "turbo-screen" for the final separation of the remaining waste and dust. This type of equipment is built for high outputs, but requires also high capital investment.

Cheaper processing equipment for smaller capacities, making use of the wet method with soaking, is obtainable from Japan. A set of machines for the processing of 1,000 husks a day, producing about 100 kgs. of coir, requires an investment of less than 2,000 US dollars, and includes crushing machine, combing machine and baling press. Labour requirement for such a unit would be six men.

Also the twisting and spinning of fibres to yarns is already done in some countries (Ceylon) by mechanical equipment consisting of automatic spinning frames. By wet spinning, drying and untwisting, curled fiber can be obtained, as used for various purposes.

<u>End-uses</u>

14. The major end-uses of coir are mats and matting, carpets and rugs, mattresses and upholstery, cordage and brushes and brooms. Except in the case of cordage, the consumption is overwhelmingly in the industrialized countries. When cordage is included, the industrialized countries account for about three-fifths of total consumption. Over one-third of the world output of coir is used as floor coverings in the form of coir mats, mattings, rugs or carpets, and about 90 per cent of these are consumed in the industrialized countries of the world, the United Kingdom being the biggest single market. Somewhat under one-third of world consumption of coir is in mattresses and upholstery, 95 per cent of this in the industrialized countries, and 80 per cent in E.E.C., the United Kingdom and Japan. The same applies to coir brushes and brooms the consumption of which is also concentrated in the high income countries.

An exception to the general consumption pattern of coir products is that of cordage, the third most important outlet of coir. Unlike coir floor coverings and mattress fiber, coir cordage is mainly used in less-developed countries, the leading consumers being India and Ceylon.

<u>Coir Industries in Developing Countries</u>

15. Coir products are increasingly produced in developing countries, especially cordage. The biggest coir industry is in India where coir carpets and rugs are manufactured and exported.

Coir is an excellent raw material for the establishment of small industries in developing countries, especially the manufacture of cordage, mats, brooms and brushes. Such industries require only relatively small investment for the necessary machinery and can be managed by farmers' co-operatives, by small entrepreneurs or groups (families) at village level, contributing to the industrialization of rural districts by what is now called "intermediate technology". A few examples from recent FAO projects in Latin America will show how much capital and labour is required:

A small brush manufacturing workshop can be constructed for about US $ 1,300 using simple Japanese machinery, viz. a wooden-holder making machine, a bristle filling machine, a shaving machine, etc., for the daily production of 350 kitchen brushes by six workers.

Also Japanese equipment for the making of cordage on a small scale is rather cheap, e.g., a two-ply twine-making machine with treadle drive for a capacity of about 120 meter/hour costs US $ 110 f.o.b., whilst a three-ply machine driven by a ¼ h.p. motor, and for a capacity of about 150 metres per hour can be obtained for US $ 175. The price for a small, treadle-operated floor mat loom is US $ 453.

For various end-uses, coir is required as a "refined" fiber; refining consists of chemical treatment ("boiling") to remove remnants of pulp and to make the fibers more supple, followed by a treatment with oils, soaps, paraffins, sulphurized castor oil and similar agents to make the fiber more lustrous, resembling horse hair. The fiber is then dyed black, if required, spun, steamed and dried. There is no reason why this refining could not be done in developing countries, manufacturing a variety of high-priced export products suitable for every purpose.

Another product that could be made in developing countries, especially in countries which are also rubber producers, is rubberized coconut fiber, a popular upholstery material that can be used in a similar way as foam rubber, but is much cheaper. The manufacturing process starts with spinning the wet fibers, drying and untwisting, forming ("needling") the now curled fibers in a mat-making machine into a continuous sheet of pre-set density and dimensions. This sheet with even surface and squared edges is then sprayed with specially prepared latex, and at the same time dried in a special oven, then cut to the lengths required and vulcanized in an autoclave.

There are other by-products of coconut processing that could be used as industrial raw materials, such as coconut shells for charcoal, and as a filler for plastics and similar purposes. Whether or not the manufacture of such by-products is economic depends on local circumstances and on market outlet; before engaging in such an enterprise, a careful marketing survey should take place

II. HIDES, SKINS, LEATHER AND ANIMAL BY-PRODUCTS

Hides and Skins

Economic Significance

1. Cash crops, such as sisal and coffee, are immediately apparent when one looks at the export figures. Animal products, because of their intrinsic role in the life of the people, the walking bank balance or general provider, do not receive the attention that they deserve.

Frequently only 50% or less of the hides and skins produced reach the markets. The rest are left to rot near the place where the animals are slaughtered. Those products that do reach the markets are too frequently not of the highest quality. At the present time there is over demand for medium weight hides and skins and the bigger suppliers can demand quality prices for mixed bales of clean and ticky hides.

With the perfection of synthetic soling materials, the heavy hides trade is suffering a set-back which would appear to be irreversible. To offset these conditions some producers are selling the lighter, looser-grained belly and the thick back separately.

Further Outlook

2. What does the future hold for the hide, skin and leather industry ? Suedes, gloving leathers, upper leather for the footwear industry generally and leather for fancy goods which up to the present have generally been able to maintain their position, are likely to be faced with increased competition from new types of synthetic leather and the heavy leathers previously used for travel goods and sole leather are not expected to make up the ground lost to synthetics. These heavy leathers produced from heavy cattle hides will, however, find a place in the internal markets of the countries of origin where these are also developing countries with a rapidly growing footwear consciousness. For these countries in particular it is well that the applied research, development and training programmes necessary for the establishment of local industries to meet these demands be started in plenty of time. Local raw materials need to be surveyed, not only as to the supply of the raw hides and skins, but also the available ancillary materials, indigenous tannin materials, salt and lime.

Processing of Hides

3. Apart from the use of the air-dried hides as a roofing material by some nomadic tribes, cured hides must be regarded as the raw material for the leather industry. The value of a hide is determined at any one time by the demand for the leather or types of leather for which the hides can be used, this being a reflection of the weight and quality of the cured hide.

Processing of the green hides invariably takes place in the country of origin. The method employed depends to a large extent on the quantity of hides to be processed in unit time, the distance from the market and consumer, climatic conditions and the availability of labour and raw materials (curing salt and building materials). In highly developed countries, where the abbatoir is frequently adjacent to the tanneries and large numbers of cattle are slaughtered daily, and where flaying is carried out under supervision or mechanically, then it is found that the processors adopt the wet-salted method of curing. The quality of the product is good and there is a minimum of labour involved. In some of the less-developed countries they have a well-developed meat industry, and handle large numbers of stock-slaughtering at a central factory. In this latter case the hides are salted and piled immediately after cleaning. They are later suspension-dried, folded, baled and exported in the dry-salted condition. These hides soak back well in the tanneries and provided they were folded before they were completely flint dry, there is normally little damage, if any, to the grain of the hide. Dry salting is preferred in cases where long distances between producer and consumer are concerned, because of the saving in transport costs and ease of handling a dry, baled product. The bulk of the world supply of hides comes from the small producer, particularly in the remote parts of the tropical and sub-tropical region. Through the activities of Governments and international agencies a marked improvement in the quality of products has been accomplished, more hides now reach the markets and fewer are left to putrify. More and more of these hides are produced by the suspension air drying method. In places where the climatic conditions are not so favourable for parts of the year, drying sheds are being erected for individual or communal use. In Asian countries, with a long tradition of vegetable tanning processes, and also in some Near Eastern countries, there has grown up a tradition of rough tanned leather production. In this latter process, the hides are de-haired, and vegetable tanned before drying. These are folded and exported in the bale. The advent of cheap plastic bags has made it possible to transport moist rough chrome tanned pelts treated with disinfectant over large distances, taking this into account together with the difficulty in finding wet-house workers in the European and North American tanneries, this process has become economic, and there is a growing demand for rough chrome tanned products.

Processing of Skins

4. The practice for handling skins follows very closely the pattern indicated above for cattle hides. There are two practices which apply particularly to the skin trade. The first is connected with the method of flaying. In order to minimise the damage to the skin, a practice known as casing is frequently used. This method minimises the use of the knife in the whole operation and uses air under pressure to initially separate the connective tissue which holds the skin. The second practice is the pickling of sheepskins in an acid/salt mixture. The skins are transported in the wet condition in bundles in plastic bags. The outer hessian sack protects the plastic and makes handling easier.

Grading

5. The value of the raw or cured hide and skin production can be greatly enhanced by careful adherence to grading practices. The buyer prefers to pay a higher price for products whose grading is consistent. This has been very noticeable in the export side of the business. The domination of the world markets in the 1930's by clean quality hides from South America is but one example. In this export business there is always the danger of complacency, particularly at the time when demand exceeds supply. The quality falls, as has happened in the case of the South American hides with ticky "northern hides". Consumers are, therefore, turning more to hides of North American origin and rough chrome tanned hides from Asia. It is time too, that the process of grading is taken up on the internal markets so that the producer receives a share of the higher return. On a national basis this will increase the circulation of money within the country; a stimulus to the development of commercial economy.

Leather Manufacture

Economic Significance

6. It is a sobering thought that in many rapidly developing countries the amount of the national income spent on importing footwear and leather goods is double the money earned from the export of hides and skins. This disparity between leather production and demand may be reduced by increased investments in mechanised tanneries and the liquidation of the impoverished rural tanneries, where these exist, as these latter tanneries cannot produce quality leathers, nor can they stimulate better raw stock production as can the mechanised tanneries. The best that can be done for non-mechanized rural tanneries is to turn them into the wethouses which would produce the pelts for the mechanised tanneries. In this way it would be possible to cut down transport costs in many instances, while at the same time it would give the rural worker a guaranteed outlet for his production.

The potential production of hides, skins or leather of many of the developing countries is very great, as they are frequently the main centres of cattle population. Conditions appear to be favourable for investment in the leather industry in these countries as labour costs are relatively lower, raw materials including indigenous tannin bearing materials are abundant and there is a rapidly growing footwear consciousness. The importance of training programmes for prospective staff in advance of major capital investment cannot be over-emphasized.

Mechanized Tanneries

7. Where no traditional tanning industry exists, it is as well to start right at the point of installing a mechanised tannery geared to the immediate needs of the country or to take the surplus raw stock over and above external trade commitments. The advantages of mechanised tanneries are threefold. Firstly, it is easier to inject the technical know-how into a centralised unit or units. Secondly, a mechanised tannery produces larger quantities of a more uniform product. Thirdly, a mechanised tannery can produce more types of leather. For example, the same group of rural tanners previously working 50 - 100 hides and skins daily, would for an investment of some $ 35,000 be able to handle 500 hides daily in a semi-mechanised co-operative. A fully mechanised tannery costing some $ 100,000 - 250,000 would have an even greater production and be able to manufacture finished leathers outside the scope of the semi-mechanized tannery. With full mechanisation it is possible to transform a hide of varying thickness into an almost uniform piece of leather and this improves the efficiency of utilisation. Sheepskins can be split layerwise, producing one chamois and one lining leather piece.

Tanning Processes

8. In the last thirty years much progress has been made in the improvement of tanning processes. There has been a change from the vegetable tannin materials to mineral tans. The mineral tans have a number of advantages. The material is of consistent analysis. The mineral tannage can be controlled scientifically, whereas the control of vegetable tannage is an art. Only one-tenth to one-twentieth of the quantity is required to tan a unit amount of stock. Therefore,where transport costs are involved the mineral tan is prefered. Mineral tannage is prefered in most instances for shoe upper leather because of its finer properties, in particular its property of holding its colour, and the ease with which the finishing processes can be carried out.

With the exception of grain correction techniques, which are economically restricted to fully mechanised tanneries, many recent developments in leather finishing techniques are suitable for the semi-mechanized as well as fully mechanized tanneries. The production of truly fast surface finishes, which can be applied in synthetic resin emulsion, can be used with a minimum of equipment.

Animal By-Products

9. Many Governments have embarked on plans to increase the availability of protein. They have in some cases suggested the introduction of vegetable protein-rich plants, while every year thousands of tons of more valuable animal protein goes to waste. Meat is exported and the protein-rich by-products go down the drain, or are thrown on the waste heap for the stray dogs and vultures to clean up.

It is not only the waste of protein that has to be considered, but also the waste of valuable raw materials for glue, fertilizer, tallow, pharmaceutical products, surgical ligatures, etc. It is in the interests of disease control to process the inedible offals. The availability of material for processing depends on local custom, as under certain conditions even the hide of an animal may be eaten by the human population, whereas in other parts, even the cheaper cuts of meat are included with the offal to be rendered for fat and meat meal. The size of the operations and the selectivity of the final products depend on the quantitative availability of raw material, the availability of markets for the products and availability of capital for the initial investment. The equipment required to start the small plant for producing a simple protein meal should not be beyond the reach of any butcher or abbatoir. Naturally, the larger the scale of production the greater can be the diversification of the final products.

The main by-products of animal origin are discussed in FAO Agricultural Development Paper No. 70, "Processing and Utilisation of Animal By-products".

Development of Indigenous Tannin Bearing Products

10. Although as a general rule vegetable tannage is diminishing, it is well to investigate locally available tannin bearing materials, as one or more of these materials might be available in sufficient quantity and have desirable characteristics to enable the local industry to develop a trade in local leather, boots, sandals and belts, etc., and also for pre- or rough tannage processes for the export stock that will be sold on the export market to more developed countries to finish for fashion leathers. In the Sudan, for instance, it has been found that a granular substance containing over 50% tannins is recoverable from mechanically disintegrated and separated pods of the Acacia nilotica. This powder is the only recorded naturally occurring substance which contains a mixture of condensed and hydrolysable tannins. It is, therefore, not essential to blend with other vegetable tannin materials to obtain a tannage with good penetration while still producing a light coloured mellow leather. The sugar content of the liquor is very low, it does not ferment readily nor will the finished leather darken with oxydation to the extent found with other vegetable tanning materials. Extract production is hardly warranted with a material of over 50% tannins.

III. RUBBER

1. Of the group Saps and Secretions, comprising Rubber, Lac, Resins, Waxes, etc., only Rubber will be dealt with here, it being the most important. World consumption of natural rubber is now more than 2,200,000 tons and almost the same amount is consumed of synthetic rubbers. Rubber is therefore experiencing closer competition from synthetics than is any other natural product.

Production of Natural Rubber

2. The following table shows world production, Latin American production and most important producing countries, based on the 1963 figures, all in metric tons:

Production	Tons
World	2,090,000
Latin America	25,000
Important producers in Central America	
Brazil	20,600
Bolivia	1,600
Important producers outside Africa:	
Indonesia	582,300
Malaysia	799,300
Thailand	188,300
Ceylon	104,800

Natural rubber is grown only in tropical countries, and more than nine-tenths of it in South East Asia where crude rubber exports are major contributors to the foreign exchange earnings of the leading rubber exporters, Malaysia and Indonesia (43 and 45 per cent, respectively, in 1959-61). Compared with these major producers, the significance of Latin America as a rubber producer is rather small, larger quantities being only produced in Brazil, the original home country of the rubber tree Hevea brasiliensis.

Processing

3. Liquid rubber latex is obtained from the stem of Hevea brasiliensis by tapping or making excisions of the bark. Latex exudes slowly as a thin fluid, a usually white and milk-like colloid emulsion. Without the addition of preservatives this soon becomes putrid and partly solidifies, i.e., coagulates. For preservation, usually a 3 per cent solution of concentrated aqueous ammonia is used. The dry rubber content of latex is normally about 35 per cent.

Initial processing of rubber consists of coagulation of the latex, milling of the coagulum to sheets, and smoking of these sheets for drying and preservation. Coagulation is done in flat dishes or partitioned troughs by adding an about 1 per cent solution of a coagulant (acetic acid, formic acid or sodium silicofluoride), after the latex has first been diluted and cleaned by sieving, settling and skimming. The slabs of coagulated latex are washed with water and milled through four or more pairs of rollers into sheets of about 4 ft. long, 18 inches wide and one-eigth inch thick, weighing about half a pound. The sheets are washed in water, cut in half and dried for 4 to 7 days in the smokehouse.

Besides in the form of smoked sheets, rubber is also prepared as crepe which is milled very thin in creping machines and not smoked. For Pale Crepe, an aqueous solution of sodium bisulphite is added; Sole Crepe is made by lamination from sufficient layers of thin pale crepe.

Other forms in which natural rubber can be delivered are concentrated latex, sprayed rubber and rubber powders. Concentrated latex is made from latex either by creaming, centrifugation, evaporation or filtration. For the production of sprayed rubber and rubber powders, various processes are used, such as spray drying, precipitation from latex and mechanical disintegration.

Processing by Smallholders

4. The relatively simple process of making rubber sheets by coagulation and milling lends itself to the application by smallholders. With a small hand-milling roller as the only piece of equipment, very good quality sheet can be prepared. In contrast to some other agricultural raw materials which require a large plant and considerable capital investment for processing, initial rubber processing requires therefore only little capital. This is the main reason why next to large modern rubber estates rubber produced by smallholders has gained such an importance. In 1963, for example, production by estates and smallholders in Malaysia and Indonesia was, in metric tons:

	Malaysia	Indonesia
Estates	463,000	208,000
Smallholders	335,000	375,000
Total	798,000	583,000

In Thailand practically all the rubber is produced by smallholders.

Rubber Manufacturing

5. Manufacture of products from the crude rubber shipped from the rubber producing countries to the industrialized countries requires rather complicated processes of which only the following are shortly mentioned:

Mastification is the process of softening or "breaking down" the rubber in special mills or mixing machines;

Compounding is the mixing of rubber with certain ingredients by further mechanical working; the formula of compounding depends on the article to be manufactured; usual additives are: reclaimed rubber, vulcanizing agents, accelerators of vulcanization, accelerator activators and retarders, antioxydants, rubber substitutes, plasticizers and softeners, stiffeners and antisofteners, odorants, fillers and pigments;

Sheeting and extruding by "frictioning" in a calender or running through an "extruder";

Impregnation and dipping to apply rubber to fabrics and forms;

Assembly of processed parts, as e.g. in the case of tyre manufacture;

Vulcanization of the newly formed rubber article by the application of heat, time and, in most cases, pressure.

There are also many special processes, such as the production of foam rubber from latex, the manufacture of rubber thread from latex, the manufacture of hard rubber, etc.

Rubber Industries in Developing Countries

6. Rubber is grown in tropical countries, but is consumed almost exclusively elsewhere. In 1959-61, less than 5 per cent of the total output was consumed in countries where rubber is grown, 73 per cent was exported to developed and 21 per cent to centrally planned countries.

However, a high percentage of the manufactures produced in industrialized countries from imported rubber are re-exported to developing countries, which, therefore, are buying back part of their exported rubber in processed form. The developing countries' net imports of rubber manufactures from developed countries may be estimated at about $ 300 million. This means that of some $ 1,000 million foreign exchange earnings from crude rubber exports to developed countries, developing countries spend about 30 per cent on importing goods made wholly or partly of the same product or its synthetic substitute. The largest single item, in most cases, is tyres and tubes which sometimes account for as much as 80-90 per cent of total imports, both in major rubber producing countries like Ceylon, Indonesia and Thailand, and in non-producing countries like Madagascar and Ecuador.

This looks therefore like a prima facie case for large-scale import substitution, but unfortunately in the case of the major rubber product, tyres and tubes, the cost of rubber is only a relatively small part of the total cost as the following figures show:

BREAKDOWN OF RAW MATERIALS CONTENT AND COST OF TYRES PRODUCTION IN INDIA

	Percentages of	
	Weight	Value
Rubber (natural and/or synthetic)	50	27.5
Fabric (rayon cord)	17	38.5
Carbon black	18	4.5
Bead-wire, etc.	15	10.9
Total raw materials	100	81.4
Labour		1.6
Overheads, depreciation, bonus, etc.		17.0
Total		100.0

On this calculation, the largest cost item is fabric. Rubber accounts for a little over a quarter of total cost, and labour for a very small percentage. As for fabric the superior high tenacity rayon and nylon should be used, the import content of tyres produced even in rubber-growing countries appears to be high and the labour content low. But notwithstanding these drawbacks, as a long-term proposition the domestic production of tyres for the strongly expanding markets of developing countries does promise a saving of foreign exchange, especially if other ingredients are produced domestically. Market expansion is so vigorous, in fact, that in spite of the large minimum size of tyre factories many developing countries can, even now, provide sufficient outlets for at least one factory.

Another branch of rubber manufacture which holds out more immediate prospects of foreign exchange gains is the production of rubber footwear. The technology used in this case need not be complex, and natural rubber is the main component. Several developing countries already produce rubber footwear for their own consumption and, in some cases, even for export.

The Impact of Synthetics on Rubber Consumption

7. Production of synthetic rubber has increased throughout the post-war period and is now slightly larger than that of natural rubber where growth has been very much slower. While in 1952 synthetic rubber was only 38 per cent of total world consumption of 2,353,000 long tons of rubber (natural and synthetic), the same percentage was in 1962 already 50 per cent. However, as world consumption of rubbers in the same time almost doubled to 4,358,000 tons, consumption of natural rubber, measured in tons instead of per cent, could increase, although not so vigorously as consumption of the synthetic product.

Synthetic rubber is by no means a homogeneous product, but over the years many different types have been developed having widely different characteristics and tailored to meet the specific requirements of individual end-uses. This is one of the advantages of synthetics. Another is the stability of prices compared with the wide fluctuations experienced in natural rubber. Some types of synthetics, such as Polybutadiene, cannot be regarded as a complete replacement of natural rubber, but are processed in mixtures with natural rubber.

Projections made by FAO indicate that world elastomer consumption in 1970 is likely to range between 7.2 million and 8.5 million metric tons, while production of natural rubber is projected to increase only to within a range of 2.7 million to about 3 million tons. The gap remaining to be filled by synthetic rubber would therefore be of the order of 4.5 - 5.5 million tons.

IV. TECHNICAL AND ESSENTIAL OILS

1. The distinction between technical and edible oils is not quite sharp. There are indeed some vegetable oils like tung oil or castor oil which are used exclusively for technical purposes, but most oils have significance for human nutrition as well as for technical applications. For all practical purposes, the technical oils can be divided into three main groups, viz. oils for soap, drying oils, and others, the last group comprising oils for cosmetic and medical purposes as well as oils used for lubricants, textile oils, etc.

Oils Used for Soap

Types of vegetable soap oils

2. Theoretically, each vegetable oil can be used for soapmaking. After all, fats and oils are chemically a combination ("ester") of fatty acids and glycerol, while soaps are the salts of the fatty acids. By splitting the ester into fatty acid and glycerol by simply boiling it with alkali the alkali combines with the fatty acids to soap. In practice, not every vegetable oil is suitable, some oils giving soft soaps that are easily oxidized (getting rancid), or sticky soaps producing a "greasy" lather. The vegetable oils are usually used in mixtures with animal fats like tallow and hardened whale oil, and with other vegetable oils, the right mixture of the "fat charge" being the secret of a special type of soap.

While therefore the same oil may be used for food purposes as well as for soap, the quality will not be the same. It is obvious that for soap not the same high quality of oil is required as for food. Taking palmoil, for example, only oil with low content of f.f.a. (free fatty acids) is used for food purposes, while "hard" oil with high f.f.a.-content, such as the oil produced by smallholders with primitive equipment, is only used for soap and other technical purposes. Also the "soapstock" obtained by alkali refining of certain edible oils is a favoured raw material for soapmaking.

Of special significance for soap are the lauric-acid oils: coconut oil, palm kernel oil and babassu oil, because they can easily be saponified (even cold), give hard soaps which are very white and extremely resistant to oxidation and therefore especially suitable for toilet soaps. In the U.S.A., coconut oil is the main raw material for soap, next to inedible tallow and greases. In Great Britain, the vegetable oils consist chiefly of palm oil and palm kernel oil, but in other European countries there is also a considerable consumption of soft vegetable oil.

Processing

3. Soapmaking is essentially a rather simple process which can (and is) performed all over the world in plants of all sizes, from small cottage industries and medium sized rural industries, up to huge modern and more-or-less automatic factories. In its simplest form of a cottage industry, the only equipment required is a vessel for preparing the caustic soda lye, a soap pan for stirring lye and oil together and boiling it, and a frame or box for cooling the soap. Additional equipment can be added as required, such as a scale for weighing oil and caustic soda, a device for cutting the soap into bars, and a stamping machine.

In modern plants, the boiling of soap is carried out in large cylindrical or square kettles with cone bottoms, equipped with steam coils, provided with delivery pipes for fat, water, lye, brine and niger (soapstock). In the larger plants, soap kettles have a total water capacity of several hundreds of thousands of pounds. After boiling the charge, which is composed according to a special formula depending on the type of soap desired, the soap is "grained out" by the addition of salt or brine and washed. The neat soap from the kettle might then be blended with builders or other material in vessels, with agitators called crutchers. The hot liquid soap is converted to a solid form suitable for forming into bars by "framing" in portable frames. If soap chips are to be produced solidification of soap takes place on a slowly revolving chilling roll from which the chips are removed by a scraper blade. Soap in finely divided quickly dissolving form is manufactured by the spray-drying process in tall spray towers. For the manufacture of high-grade toilet soap bars, soap chips are dried, milled in a series of rolls, compressed into a continuous bar in a plodder, cut by a wire cutter into blanks which are stamped into finished soap bars and automatically wrapped.

In huge modern plants, saponification might be done continuously on a very large scale making use of high-speed centrifugal separators for rapidly accomplishing the various steps of conventional soap making.

Soap Manufacture in Developing Countries

4. In developing countries, the scope for rapid increases in the consumption of both toilet soap and bar household soap is considerable. Per caput consumption in most of these countries is still very low and responds significantly to changes of income. The prospects for soapmaking in developing countries and for expanding existing soap manufacture are therefore quite good, the more so as also the processing of vegetable oilseeds in developing countries is steadily expanding. Competition of synthetic detergents might be less in developing countries than in industrialized countries, but is also increasingly felt, especially in the field of household soap.

Impact of Synthetics

5. Since about 1930, when usable synthetic detergent materials first became available in Germany, a large number of materials have been developed which differ in chemical composition while possessing much the same detergent characteristics. Some of these are produced from natural vegetable or animal oils and fats, while others are derived from a petroleum base.

In most industrialized countries, the growth of synthetic detergents has been largely at the expense of soap. In the U.S.A., synthetic detergent production outpaced that of soap as early as 1953, and had almost trebled by 1960. In 1962 soap accounted for only 24 per cent of total detergent sales, as against 92 per cent in 1946. Per caput consumption of soap declined over the same period from 21 pounds to 6 pounds, while consumption of synthetic detergents increased from 2 pounds to 21 pounds. In other industrialized countries, the impact of synthetic detergents on soap consumption is less spectacular than in the U.S.A., but is also considerable. Looking to the future, it is to be expected that synthetics will further increase their share of the detergent market, especially in industrialized countries.

Drying Oils

Types of Drying Oils

6. Drying oils are vegetable oils which on exposure to air form hard films and which for this reason may be used as vehicles in paints and varnishes. The "drying" process is not caused by evaporation of water or volatile solvents, but by oxidation and polymerization of the oils which are "unsaturated" in contrast to the (more or less) saturated non-drying oils. The degree of unsaturation is measured by the "iodine value."

One distinguishes between:

Drying oils, such as linseed, tung, oiticica, perilla, hemp and dehydrated castor oil, with iodine values between about 140 and 200 or more.

Semi-drying oils, such as soybean, sunflower, safflower, poppy seed, rubberseed, and walnut oil, with iodine values between about 110 and 140.

Non-drying oils, such as palm, palmkernel, coconut, olive and groundnut oils, etc., with still lower iodine values; cottonseed, sesame and rapeseed oil are with iodine values between about 100 and 110 just at the verge of semi-drying oils and have therefore some weak drying properties.

Besides the vegetable drying oils, there are also some animal oils with drying properties, especially fish oils (menhaden, sardine, pilchard).

Production of drying oils

7. World production of the most important drying oils: linseed, castor, tung and oiticica oils was 1.4 million tons in 1963 and during the past few years has remained fairly constant at this level. (Castor oil is not a drying oil in itself, but can be converted by catalytic dehydration into dehydrated castor oil with excellent drying properties.

The most important drying oil is linseed oil. Of a world production of linseed of 3.5 million tons, about 2.5 million tons are produced in four countries, i.e., Argentina, U.S.A., India and Canada. Total Latin American production was 876,000 metric tons (1963/64), of which Argentina produced 771,000 tons, Uruguay 62,000 tons, Brazil 20,000 tons and Mexico 16,000 tons.

Tung oil

Tung oil is processed from Aleurites Fordii and Aleuritis montana while the Japanese tung oil is derived from the seeds of Aleurites cordata. Main producer used to be China which before the last war exported about 100,000 tons. Aleurites Fordii was introduced in the U.S.A. (Florida) in 1905, it has been cultivated on a commercial scale since 1952, and expanded after the second world war. The U.S.A. are now producing about 20,000 tons which is almost sufficient for the internal market. Aleurites has been introduced since the second world war, with more or less success, into many other countries, such as Argentina (Misiones), Australia, New Zealand, Brazil, Ceylon, Thailand, West Indies, also into Russia (Trans-Caucasia) and Yugoslavia (Dalmatia).

Oiticica oil is extracted from the seeds of Licania rigida, in Brazil, from a high tree up to 20 m, while a similar oil (Cacahuanache oil, also called Mexican Oiticica oil) is produced in Mexico and Central America from Licania arborea. World production is about 10-12,000 tons.

Perilla oil is derived from Perilla ocymoides, an annual of the Labiatae to which family also belong Lallemantia iberica yielding the Lallemantia oil and Salvia hispanica, the source of the Chia oil, both also excellent drying oils, but still of little commercial importance. Perilla is a native of Manchuria, but is now cultivated in Japan, Korea, Northern India, and the U.S.A. The seeds of the perilla plant shatter and hence it is less suited for combine harvesting. World production is about 6,000 tons.

There are other plants producing drying oils which are not yet commercially utilized, such as various species of the genus Parinarium. Some have got local significance. Parinarium annamense, for example, is a tree growing wild in Thailand, the seeds of which contain an excellent drying oil, similar to tung oil; this oil is now increasingly used in Thailand for local varnish and paint production. This example shows that research in this field might pay also for other developing countries.

The semi-drying oils are more significant as edible oils and need not be treated here in detail. Most important in mixtures with drying oils are soybean and sunflower oils while also small amounts of corn oil, rapeseed oil and others are used for this purpose.

It will be noted that many drying oils are produced outside the tropics, or in mountainous districts. The drying properties of the oils grown in cooler climates, indicated by a higher iodine value, are usually better. This does not mean, however, that there are not excellent prospects for certain types of plants yielding drying oils to be grown in developing countries.

Processing

8. Initial processing of the seeds yielding drying oils is about the same as the processing of oilseeds for edible oils, therefore first cracking or shelling of the nuts as far as necessary. Tung nuts (or rather dry tung fruits), for example, are hulled in Florida with disc hullers, but are not shelled, being fed into expellers after hulling complete with shell. The pre-processed nuts or seeds, after cleaning, are extracted either mechanically by hydraulic presses or expellers, or "chemically" by means of solvent extraction. Most common and very practical for smaller and medium plants are expellers; these can be obtained in all sizes.

For use in the paint industry, the extracted oil usually undergoes some pre-treatment (with the exception of tung and oiticica oil, which are chemically different and require special treatment), such as the heating with small amounts of lye or sulphuric acid to precipitate chlorophyll and phosphatides, further "prebodying" by heating alone or with "driers", or blowing with air. The oils are then either processed to varnishes by partially polymerizing them at high temperatures with resins and "driers" (catalysts), afterwards thinning the resulting product to a usable consistency with a volatile solvent. Or they are used for the manufacture of paints which are mixtures of drying oils, resins, pigments, thinners or solvents, dryers and various other ingredients depending on the special use.

Next to all kinds of paints and varnishes, drying oils are also used for the manufacture of other products, such as linoleum, oiled fabrics, putty, rubber-like materials (factices and others), core oils (binding agents for the sand cores of hollow metal castings) and tanning oils.

Impact of Synthetics

9. Just as other agricultural raw materials, also drying oils and oil products are encountering competition from synthetic substitutes. In the paint industry, technological changes have resulted in a shift from a drying-oil type of ingredient to synthetic resins, and the use of aqueous dispersions of polymerizates as binding agents. Instead of organic solvents which are inflammable and often detrimental to health, the latter contain water as the volatile substance. They can be easily used by the "handyman" and therefore under present circumstances find a large market, especially in the United States where this type now constitutes half of the house paint produced. In the linoleum industry, linoleum has been displaced to some extent by synthetic rubber, vinyl plastics, and other types of floor coverings.

However, world production of drying oils shows no reduction, even increased from the 1950-54 average of 1.2 million tons to 1.4 million tons in 1959 and has since remained rather stable at this level. Impact of synthetics has therefore been compensated by the growth of the overall market.

Some drying oils have even received a new importance by being combined with synthetics (co-polymerization), the resulting product having better properties than its components. The same scientific knowledge which lead to the development of synthetic products has also enabled important improvements of the natural products. There are now quite a number of special treatments in drying oils leading to special types of products, such as polymerization, segregation into fractions with special properties by differential solubility, fractional distillation of fatty acids and re-esterification of these, treatment with maleic anhydride (Diels-Adler reaction) and others.

Significance for Industrialization of Developing Countries

10. Drying oil products, especially paints and varnishes, are now increasingly manufactured in developing countries, especially in countries which produce the raw materials or anyhow part of the raw materials. With increasing prosperity the demand for paint will increase considerably in these countries. There is usually great need for a cheap house paint made mainly from local raw materials which can substitute the expensive sophisticated paints imported now at the expense of foreign exchange.

Other Technical Oils

11. There are many other technical applications of fatty oils, vegetable oils as well as animal and marine oils. The most important vegetable oils for technical purposes are castor and rapeseed oil while also "hard" palm oil from West Africa with high f.f.a.-content plays a certain role.

Production

Castor oil is extracted from the seeds of Ricinus communis which is cultivated in many tropical and sub-tropical countries either as annual or as a tree-like perennial. Main producers are India and Brazil, but also in many other countries castor beans are increasingly cultivated, such as Europe (France and Italy), U.S.A. (California),Brazil, Ecuador, Paraguay, Mexico, Thailand, etc. The producing countries of castor beans are more and more crushing the beans in the country exporting only the oil. In Latin America, e.g., Brazil was till about 1958 a big exporter of castor beans, but has since developed into a big exporter of castor oil. Beans are still exported from Ecuador, Paraguay and to a lower extent from Peru. World production is about 200,000 tons (average 1953-1957), but still increasing. The U.S.A. alone needs some 110,000 tons per year, and the oil is considered to be in short supply.

Rapeseed oil is derived from the seeds of Brassica spp. and is in the first instance an edible oil. This fact explains the rather high world production of 4,200,000 tons (1962/63). It is produced in many European countries (total European production 1,110,000 tons), in Canada (190,000 tons in 1963/64), and in Asia where India is the main producer (1.3 million tons); other Asian producers are China (Mainland), Pakistan, and Japan. In Latin America, Chile is producing 49,000 tons and Mexico about 7,000 tons.

Processing

Initial processing is the same as for other vegetable oils, therefore extraction by hydraulic presses or expellers or solvents (or by a combination of two of these units) after crushing and cooking.

For castor beans, mechanical harvesting and hulling has been a certain problem, but in the last few years special castor bean harvesters and huller-cleaners were developed in the U.S.A. There are now non-scattering low varieties, annuals, which are much easier to be harvested mechanically than the former tree-like perennials.

Industrial Products

The various industrial products manufactured from technical oils are only mentioned shortly. Lubricating oils are now usually mineral oils, but fatty oils and sulphurized fatty oils, like castor oil, are still used for special purposes. "Blown" rapeseed oil is used in blended oils together with mineral oils. Also in the manufacture of lubricating greases (made from lubricating oil and soap), rapeseed oil still plays a part, next to animal tallow and greases. Cutting oils for the lubrication of tools for the cutting of metals are prepared by compounding a sulfurized fatty oil with mineral oil. Fatty oils and sulphonated fatty oils are also used in the textile industry as textile lubricants and in leather treatment, although in the latter case animal oils are preferred.

As burning oils for illumination, fatty oils have been replaced by petroleum products, except for special applications, as for example, the oil for the lamps in churches, which is a specially refined rapeseed oil. In candles, a certain amount of stearic acid (prepared from vegetable oils) or highly hydrogenated oil is still used as a hardening agent. Oils, fats and fatty acids are still important materials in the cosmetics and pharmaceutical industry, although here, too, petroleum fractions have taken over many of the traditional functions of fatty oils. Castor oil, olive oil, almond oil, palm oil and others play a considerable role.

Considerable amounts of crude palm oil are used as tinning oils in the manufacture of tin plate and cold-reduced sheet steel. Castor oil is extensively used as a base for fluids for hydraulic systems, therefore as a hydraulic oil. An interesting application of castor oil is for a certain type of plastic material. Also widely used for plastics and many other technical purposes is the Cashew Nut Shell Liquid ("C.N.S.L."), which is a by-product of the production of cashew nuts. These few examples may suffice to show the wide application of vegetable oils and fatty oils in general for all kinds of industrial purposes.

Essential Oils

12. Quite different in properties and chemical composition from the vegetable fatty oils are the essential oils, also called ethereal or volatile oils. One can describe them as volatile odoriferous bodies of an oily character obtained almost exclusively from vegetable sources.

Sources

Essential oils are present in the plants in very small amounts, often in special cells, in flowers, but also in leaves, bark, roots, or fruits. The number of essential oils is quite considerable, and only the most important ones, originating from tropical countries can be mentioned here.

Several essential oils are found in various parts of the plant body of Citrus plants, such as Lime Oil from the fruit of Citrus aurantifolia (West Indies, Florida, Mexico, Central America, parts of South America, West coast of Africa, etc.), Sweet Orange Oil from the fruits of Citrus sinensis (Brazil, the West Indies, U.S.A., Japan, Southern Europe), Bergamot Oil from the fruits of Citrus aurantium (Italy), Lemon Oil from the peel of the fruit of Citrus limon (Italy, California, to a lesser extent Brazil, Jamaica and various other countries) and Neroli Oil from the flowers of bitter and sweet oranges (Southern Europe and Northern Africa).

Geranium oil is derived from Pelargonium spp. cultivated in East Africa, Ceylon and partly in the southern States of the U.S.A.; Camphor and Camphor Oil is the general term for various essential oils containing camphor, obtained from different plants, such as Cinnamomum camphora, the camphor tree, in Japan and Formosa, and Ocimum kilimandscharicum, a member of the Labiatae, in East Africa.

Special significance for Africa have Ylang-Ylang and Cananga Oil distilled from the flowers of Cananga odorata, a tree from southern Asia. This tree has been introduced to various parts of Africa, with the result that at present about 90 per cent of all Ylang-Ylang oil is produced in Nossi Bé and the Comores, small islands between Madagascar and the East African coast. The tree grows also in the West Indies.

The young shoots of Pogostemum cablin yield the famous Patchouli Oil; the plants are grown in Malaysia and Indonesia, but have been introduced in the Seychelles, Madagascar and parts of Africa, also in Brazil.

Mainly grown in the West Indies and parts of Central America is the small Bay tree, Pimenta acris, from the leaves of which Bay Oil can be distilled, well-known for its use in the preparation of Bay Rum. The leaves are partially dried, baled and exported to distilleries in the U.S.A., but some oil is also distilled in producing countries.

Basil Oil is extracted from Ocimum basilicum and various other species of Ocium; O. basilicum is cultivated in Reunion and Morocco and is a common weed of the Sudan Gezira. Other Ocimum spp. are known as the fever plants of West Africa. Ajowan oil is mainly produced in India from the seeds of Trachyspermum copticum (Carum copticum) which is also found in Persia and Egypt.

Out of the dried and powdered rhizomes of Acorus calamus, the sweet flag, collected in India and Ceylon, is steam-distilled the yellow, patchouli-like calamus oil.

A native of tropical America, growing wild in Mexico, but also cultivated, is the tree Burseva delpechiana, from the bark of which Linaloe oil is distilled in Mexico and the U.S.A., used in the preparation of perfumes.

Another native of tropical America and the West Indies is Acacia farnesiana, from the flowers of which Cassic oil is extracted by maceration with cold fat (enfleurage), mainly in the South of France.

Essential oils of some commercial importance are also produced from a number of grasses, all belonging to the genus Cymbopogon, viz. West Indian and East Indian Lemon Grass Oil from C. citratus and C. flexuosus, respectively, Citronella Oil from C. nardus, and Palmarosa Oil and Gingergrass Oil from two varieties (Motia and Sofa) of C. martini. These grasses are cultivated in many tropical countries, mainly in East Asia and Ceylon, but partly also in Africa, parts of the West Indies and of Central America (Guatemala, Honduras).

As last of this by no means complete list Vetiver or Khus-Khus Oil may be mentioned, a valuable oil distilled from the roots of the grass Vetiveria zizanioides which is cultivated also in the West Indies (besides in Java, Indonesia, Reunion and southern U.S.A.), and which in East and West Africa is commonly used as an anti-erosion plant on contours.

Processing Methods

13. The various methods used for processing essential oils are:

(1) steam distillation for the more stable oils, such as Citronella and other grass oils, Cananga oil, Patchouli oil, etc.;

(2) expression, either by hand ("écuelle" and "éponge") or by machinery, used almost entirely for the production of oils contained in the peels of fruit, like various oils from citrus plants;

(3) extraction by some type of solvent, i.e.,

  (a) by volatile solvents such as petroleum ether, alcohol, etc.;

  (b) "enfleurage" by cold neutral fats, used for the expensive essential oils of certain flowers;

  (c) "maceration" by hot oils or fats.

Of these extraction methods, the solvent extraction has become more and more popular.

Processing in Developing Countries

14. Much processing, especially the rather simple steam distillation, is done in developing countries. As the amounts of essential oils are relatively small, but have a considerable value, manufacture of such oils lends itself especially to introduction as an "intermediate industry". The equipment is small and simple and

can easily be made locally, so no great capital investment is required; it is a rural industry suitable for farmers' co-operatives or small entrepreneurs and should be encouraged as such.

Essential oils are not always extracted in the producing country; the fruits of the bay tree, e.g., are exported as such to the large distilleries in the U.S.A., also the young leaves of Pogostemon are partly exported to Britain and the U.S.A. for the distillation of the best quality patchouli oil.

Industrial use of essential oils is in the first instance for perfumes, toilet preparations, soaps, etc. In developing countries, there is usually a large demand for such products, a demand which will further increase with the rising standard of living. There is already a flourishing industry for perfumes and toilet preparations in many developing countries manufacturing cheaper preparations adapted to the taste and to the buying power of the local customers. It may be expected that this industry will further expand and that local production will be increased and improved in quantity and quality.

Other essential oils are used in the food industry, for flavouring aerated beverages, etc., and for these uses will also find a quickly expanding market in developing countries.

Impact of Synthetics

15. Also in the field of essential oils, modern chemical science and industry have found quite a number of synthetic substitutes. They can roughly be grouped into two classes, viz. the isolates or artificial oils, and the synthetic oils, synthetized either from the isolates or from other chemical raw materials, such as coal-tar derivatives.

The isolates are not in themselves a threat to the natural product, but have often even stimulated the production of these products which are used as a raw material. For example, safrole which is a fraction of camphor oil is used for the production of heliotropin; menthol is isolated by freezing from peppermint oil, and cineol in the same way from eucalyptus oil; enormous quantities of sassafras and lemongrass are now cultivated solely for the recovery of the isolates safrole and citral. So notwithstanding the fact that certain perfumes are now manufactured synthetically, and partly as a result of this scientific development, the cultivation of plants for essential oil production has become a large industry and further expansion may be expected.

V. STIMULANTS AND CONDIMENTS

Tea

1. Tea is prepared from the leaves of Camellia sinensis which are rolled, fermented and dried, and is used for one of the most popular non-alcoholic beverages which is perhaps consumed by half the world's population, especially in Europe, Asia and the Far East. The word "tea" comes from the Chinese (Amoy dialect) "tay" while the Cantonese word is "chah". Hence the word chah or chai for tea in many countries like Russia, Japan, India, Persia and even East Africa (Kiswaheli).

Production

2. Tea is almost entirely produced in the developing countries which contribute more than 90 per cent to world exports. The total annual value of tea exports from developing countries in 1959-61 averaged $578 million, making tea one of the largest earners of export income.

World production in 1964 was 1,087,000 metric tons (estimate) compared with only 640,000 metric tons in 1948-52, it has therefore risen quite considerably. Main production countries are in Asia, especially India, with 373,000 metric tons, Ceylon with 218,000 metric tons, Mainland China with 160,000 metric tons, Japan with 83,000 metric tons, and Russia with 47,000 metric tons. Production in Africa is about 63,000 tons in total, but is is remarkable that almost a dozen African countries are producing tea. Tea production of Latin America is only 17,000 metric tons, of which the bulk is produced in Argentina, and the rest in Peru and Brazil. There is certainly scope for further expansion, especially in the highlands, although "lowland" tea, too, can be grown at lower altitudes of 800-1,000 feet. Highland tea yields higher prices, having better taste and flavour, but less "strength" and colour, while production per acre in the lowlands is much higher and tea can be produced more cheaply there.

Processing

3. The tea plant, which would develop into a medium-sized tree if left alone, is cut down to a bush of just the right height to be easily plucked. Plucking is restricted to the young shoots, viz. the tip with the first or the first two leaves. The tip (bud) gives the best quality tea and quality is getting lower and lower the farther the leaves are away from the bud. The third leaf (counted from the tip), which in plucking is often kept separate, gives only a second quality tea, and the fourth leaf, which, however, is not always plucked, yields only an inferior tea.

The plucked leaves and shoots are brought to the tea factory and left there about a day to wither. For this purpose, small manufacturers spread the leaves on bamboo trays in the sun while bigger factories spread them on wire or bamboo netting, or hessian, placed in racks or frames in shelves (called "tats") one above the other in the withering "lofts". Usually air is blown or sucked through these withering lofts; in the case of quick withering is about 8 hours, this air is heated to about 30°Centigrade. Other quick withering methods which sometimes reduce withering time to as low as 5 hours make use of revolving drums, tunnels or troughs. Of these later methods, trough withering is of growing importance, especially for new producers.

The next stage is rolling the leaf, either in a rather primitive way by hand in small-scale processing, or by mechanically driven "rollers" in modern factories. The object of rolling is to break the leaf cells, and liberate the juices and enzymes sealed within. Rolling is also responsible for the typical form of processed tea, viz. the small balls of leaf called "souchong" (from Chinese, meaning raisin) or the long thin sausages called "pekoe" (from Chinese, meaning hair).

After rolling, or also during intervals of rolling (depending on the rolling scheme) the rolled leaf is "broken" and "sifted", usually on a special type of shaking screen; the rolled wet tea might also be separated on such screens with various mesh into fractions.

The next stage of processing is fermentation from one to about four hours, by just leaving the rolled mass to itself on glass shelves, in baskets or on cement in the coolest room of the factory, often in a cellar. During fermentation colour as well as aroma of the tea are developed: the greenish rolled tea becomes dark red-brown while the typical tea aroma is developing. Therefore for the preparation of "green" tea, fermentation has to be prevented, killing the ferments by steaming.

After fermentation the tea is dried or "fired" in special tea driers blowing hot air through the tea at about 112°Centigrade. The "factory tea" comes off the driers black and brittle with only about three per cent moisture.

The dry factory tea is then cut in a cutting machine and grade-sifted by a rather complicated system of shaking screens and screens making a rotary horizontal motion. Grading is done according to a scheme varying from factory to factory, but usually the following types are prepared:

Pekoe, the long, sausage-like rolled pieces;

Souchong, the thick, round, raisin-like pieces;

Pekoe-Souchong, a mixture of both,

various types of "Brokens", containing smaller pieces, like Broken Pekoe (B.P.), Broken Orange Pekoe (B.O.P.) and "Broken tea",

various types of "Fannings", very small pieces, often obtained by separation in a "Wan" in an air-stream,

Dust, the finest product.

The valuable bud of the leaf, the "tip" during processing often gets a light colour by dried tea juice and these small pieces of very high quality (called "orange" or "golden" or "white") determine partly the value of the grade. Hence special grades called e.g. "orange pekoe", or "broken orange pekoe" or "golden fannings", etc.

Next to the orthodox way of tea processing, as described here, there are also various unorthodox methods of tea manufacture, which are of growing importance in North East India and East Africa. To these unorthodox teas belong the Legg-cut teas and the C.T.C. teas. Legg-cut tea is made from unwithered leaf, cut with a blunt knife similar to the cutting of tobacco, followed by a light roll and relatively short fermentation. The output consists of about 70% fannings and 30% dust. World production of Legg-cut teas was estimated in 1963 at more than 30,000 tons.

More important is the C.T.C. process (Crushing, Tearing, Curling) with a special type of metal rollers; world production of C.T.C. teas was estimated at 140,000 tons (1963). Over two-thirds of the tea output of Assam consists of C.T.C. Besides about 50% Fannings, and 20% Dust, C.T.C. includes also some 30% B.P. Another unorthodox procedure is based on the Rotorvane, which can be used in combination with Legg-cut or C.T.C. for continuous processing without conventional rollers.

Besides the common "black tea" which is the most popular type in Europe and many other countries, other special types of tea are the "green" tea, processed without fermentation and consumed mainly in China and Japan, and the semi-fermented "oolong" tea, manufactured in Formosa and Foochow in China.

Equipment used for tea processing has been described in an FAO Development Paper (No.12 of November 1951); however this is now outdated and it is hoped to publish a new paper on tea processing taking into account recent developments.

Blending

4. After the tea manufacturer has taken much trouble to separate the various fractions of tea, the blender mixes fractions (and also products from various sources) again according to some formula of his own, to special "blends". Blending is usually done in Europe, Australia or other main consumer countries, and the blenders are re-exporting part of their products. However for consumption in developing countries, blending is also done more and more in these countries.

Industrial Products from Tea

5. Although tea is used for the manufacture of tea seed oil in China and for a dye in the USSR, the only processing of interest in the Western World is that for instant tea. There is a great deal of secrecy about the techniques and scale of production, but two methods are reported - one from manufactured black leaf and another from the fresh leaf. Manufacturing from green leaf has been developed in producing countries Uganda and Ceylon and more recently in India; Brooke Bond in conjunction with the USA firm of Tenco have also set up a research centre in Kenya. The process is not labour-intensive; it is a technical process and does not require insistance on fine plucking in the field. The Indian Budget Enquiry Committee of 1964 pointed out its possibilities in utilizing waste tea.

The advantage to an exporting country lies in the additional markets that may be opened up, though these are largely supplied by the domestic industry manufacturing from imported black teas. In the United Kingdom instant tea got off to a bad start in the retail market as a result of the poor product originally marketed. The retail market is still small but the automatic vending industry believes that with the domestic development of acceptable brands in recent years there is likely to be an expansion in the catering trade. Instant tea sales, however, are estimated to account for little more than 2 per cent of the UK tea market. In the United States per caput consumption of tea is still small and consumers are not so firmly wedded to orthodox tea; the increase in consumption in the last few years is attributable to the growing use of instant tea, especially for iced tea. Instant tea consumption rose from 5.6 per cent of the total in 1960 to 18.7 per cent in 1964. There are a number of firms in the United States producing instant tea from imported black tea - indeed one of the reasons advanced for the firmness of the market for plain tea in 1964 was the demand from this industry in the USA.

The domestic industry is a sophisticated one doing research into the chemical properties of the missing tea aroma and pre-packing lemon flavouring. If tea producing countries wish to develop markets for instant tea in these two countries, they will have to produce a product that can compete with the domestic product. In European countries the emphasis on tea promotion is being given to marketing of quality teas as an attractive competitor to coffee; where soluble tea would fit in requires market research. Tea consumption has risen rapidly in some of the developing countries (including producers such as India and Pakistan). The possibility of marketing instant tea as a "convenience" drink here would depend on the comparative cost of production.

References to the production and consumption of instant tea were included in the documentation of the Ad Hoc Meeting on Tea held at Nuwara Eliya (Ceylon) in May 1965. The statistics are meagre, however, and FAO was requested by the meeting to collect data on instant tea.

Coffee

6. The word coffee is probably derived from the original Arabic qahwah, but some connect it with the town of Kaffa in Ethiopia, reputedly the birthplace of coffee. In any case, the word coffee sounds similar in most languages of the world. Quite generally, the discovery of coffee is accredited to Africa where it has grown in a wild state until fairly modern times. According to others it was first cultivated in Southern Arabia and the habit of coffee drinking has spread from Arabian Mohammedans to other people. The plant from the seeds of which about 80 per cent of the coffee of commerce is derived is called Coffea arabica while other commercially known species are C. liberica, C. stenophylla and C. robusta.

Production and significance

7. World production of coffee is 4.03 million metric tons (1963/64), four times as much as world tea production. Almost 70 per cent of this amount is produced in Latin America, viz. 2.78 million metric tons, especially in Brazil (1.56 million metric tons) and Colombia, (468,000 metric tons). Africa occupies the second place with 1 million metric tons produced in 23 African countries. The most important producers in Latin America are (1963/64)

Brazil	1,560,000	metric tons
Colombia	468,000	" "
Mexico	129,500	" "
El Salvador	113,400	" "
Guatemala	105,000	" "
Costa Rica	66,000	" "
Venezuela	52,300	" "
Peru	48,000	" "
Ecuador	42,800	" "
Haïti	39,000	" "
Dominican Republic	36,100	" "
Honduras	28,600	" "
Cuba	28,500	" "
Nicaragua	27,000	" "
Porto Rico	13,800	" "
Paraguay	7,200	" "
Panama	4,500	" "
Trinidad and Tobago	4,100	" "
Jamaica	2,600	" "

Since 1950 the world coffee economy has passed through two phases. The first, from 1950-1955 was characterised by rapidly increasing demand and high and stable prices. The second period, from 1955, saw a sharp increase in world supplies far above demand, with the result of declining prices and serious adverse economic effects on the producing countries. Efforts to halt the decline in coffee prices date back to 1957, leading eventually in 1962 to a five-year International Coffee Agreement with participation by consuming as well as producing countries.

Early FAO projections for the UN Development Decade indicated further growth in world output, and also in world consumption, the latter at 3 - 3.5 per cent p.a. compared with 2 per cent in the past. Attempts are being made by I.C.A. to reduce production and encourage consumption. In the coffee producing countries, especially in Latin America, domestic consumption is likely to rise very considerably by 1970, as a result of the rapid population growth. Considerable scope for raising domestic consumption exists, especially in African producing countries.

Primary Processing

8. Processing of green coffee has to be done in the country of production, and the steps involved in the cultivation and processing differ somewhat from country to country.

One can distinguish between a "dry" processing method and a "wet" or "wash" process. With the dry method (also called "unwashed" or "natural" processing method), the ripe cherry is dried first. Drying can be done in the sun, on a floor of beaten earth, on cement, on trays, or on exposed drying platforms, as in Brazil. Artificial or "machine drying" is done either with simple static driers, consisting essentially of a perforated galvanised sheet-iron flooring above a bank of fire tubes, or with various types of rotary drier.

The main feature of the wet method is that the cherries are pulped and either fermented, mechanically hulled or treated with chemicals, then washed and graded. They are then dried in the same way as described for the dry method.

The dry cherry of the dry method, or the "parchment" coffee of the wet method, has to be shelled and hulled, which can be done by the planters themselves, or by the buyers who have the necessary equipment. One can distinguish between hulling for the dry cherries prepared by the dry method, and peeling for the wet processed parchment coffee. There are various machines available for this purpose.

Eventually the coffee has to be graded into standard sizes by means of either rotary cylinder graders, oscillating screens, peaberry separators with inclined travelling band, and large, long and short bean separators with indents or pockets on the inside surface of the cylinder. Bulk sorting is usually followed by pneumatic grading to remove any remaining dust or pieces of shell, as well as light, defected or insect-damaged beans. Top grade coffee will also be handpicked, or separated with an electronic separator, which only recently has been adapted to coffee.

This initial processing can also be done by small farmers with relatively simple and cheap equipment. The only piece of equipment which might be out of reach of the smallholders is the pulper, but pulping plants can be established at central points by farmer cooperatives, or government. Coffee processing, not requiring big capital investment, is therefore an important rural industry, and belongs to the group of "intermediate" industries, so important to the development of rural districts and developing countries in general.

Further processing and utilization

9. Whilst initial processing is always done in producing countries, the following processing operations are often carried out in the country of consumption. The first operation is - similarly to the case of tea - the blending, after carefully tasting the various types. Coffees grown in the various countries differ by types and by kinds as well as by grades. One distinguishes between "mild" and "Brazil" coffees among Latin American coffee. Further distinctions are made as to "hardness", "softness", "high-grown", and "washed", etc.

The typical flavour of coffee developes only after roasting, which is done in special machinery. After roasting, the coffee is either sold as such, or in ground form.

For the details of coffee processing, reference is made to Informal Working Bulletin No.20 on "Coffee Processing", published by the Agricultural Engineering Branch of FAO, as an unpriced document, available to interested parties, in English, French and Spanish.

Industrial Products made from Coffee

10. Apart from the production of an essence, the only industrial processing of the coffee bean of significance is the preparation of instant (soluble) coffee. This was developed in North America and Europe, largely using robusta coffee from Africa. Subsequent developments included the wider use of arabica coffees (partly to improve the blend, but also because Latin American coffees were at times competitive in price), and the development of instant coffee production in arabica-growing countries Mexico, Guatemala, Nicaragua and Brazil itself (where the industry is being expanded). Processing in African coffee producing countries is more recent - a factory has been set up at Abidjan in the Ivory Coast and Tanzania is building a factory to absorb 2,000 tons of beans annually.

Production of instant coffee offers to countries, faced with the problem of restricting exports, a means of using surplus coffee and saving a certain amount of warehousing space; "soluble coffee" is however included in the definition of coffee in the International Coffee Agreement, and counts against export quotas.

Statistics of instant coffee production and consumption are incomplete, but it is estimated that in the United States instant coffee represents about 20 per cent of all coffee consumed (in bean equivalent). Imports represent only about 4 per cent of total availability of intant coffee, and the country is, in fact, a net exporter of the product; instant coffee has shared in the general decline in coffee consumption since 1962. In Canada instants account for about two-fifths of total coffee consumption, but also appear to have shared in the fall in coffee consumption in 1964; only about one-eighth of the instant coffee available is imported.

The great increase in coffee consumption in the United Kingdom over the last decade has been largely in the form of instants which now account for over three-quarters of total coffee consumption. Consumption of instants is believed to have increased in 1964, despite the fall in coffee consumption as a whole. Imported supplies, however, still account for only about one-ninth of available supplies of instant coffee.

Cocoa

11. Cocoa is derived from the seeds or beans of a small tree, Theobroma cacao, and some related spp., originating in the tropical rain forests on the east side of the South American Andes. Cocoa (or cacao) was not introduced into Europe until the sixteenth century, and its cultivation in other parts of the tropics started only two centuries later. Today, West Africa supplies about two-thirds of the world demand.

Production

12. World production (1963/4) is 1,220,000 metric tons, of which almost three-quarters, viz. 900,000 metric tons are produced in Africa. The second largest producer is Latin America, with 290,000 metric tons. Compared with these two regions, the production in other regions is insignificant, viz. 22,000 metric tons in Oceania, and 7,000 metric tons in Asia (Ceylon, Philippines, Indonesia). In the last decade, the production in South America has been at about the same level, while the production of Central America has risen about 30,000 tons, mainly in Mexico. In the same period, the production of Africa has risen from 500,000 to 900,000 metric tons.

Outside Africa, the main producers are Brazil, Ecuador, the Dominican Republic, Mexico, Colombia and Venezuela. The most important Latin American producers had the following productions in 1963/64:

Brazil	143,500	metric	tons
Dominican Republic	38,000	"	"
Mexico	30,000	"	"
Ecuador	30,000	"	"
Colombia	17,000	"	"
Venezuela	16,700	"	"
Costa Rica	12,000	"	"
Trinidad and Tobago	5,500	"	"
Peru	4,200	"	"
Grenada	2,500	"	"
Haïti	2,400	"	"
Bolivia	2,000	"	"
Cuba	1,700	"	"
Jamaica	1,600	"	"
Panama	1,000	"	"

Whilst cocoa is grown exclusively in development regions, over 90 per cent is exported to industrialized countries, mainly as beans, but also in the primary processed form (cocoa butter, powder or paste). Cocoa beans cannot be stored easily and cheaply under tropical conditions, and domestic consumption of cocoa products in the producing countries is small.

The long-term outlook for cocoa is not without promise. Future growth will depend mainly on consumption in new areas, particularly in low-income countries. Much will depend also on measures taken by the low-income countries to develop local chocolate industries for domestic consumption. The greatest possibilities for expanding consumption exist in the U.S.S.R. and in the Eastern European centrally planned economies.

Primary Processing

13. The initial processing has to take place in the country of production near the farm, where the pods are grown. Most of the world's cocoa is produced by smallholders with only a few acres. Not more than about 10 per cent of the African production is from larger plantations, often operated co-operatively by farmers. The relatively simple way of processing is certainly a factor in the favour of the small farmer.

Processing comprises the following stages: Pod breaking of the ripe pods either by means of a cutlass or machete, or with a wooden billet. Recently, pod breaking machines have been constructed in South America, but are up to now still without practical significance. After the breaking of the pod, the placenta is usually removed, although on some Ghana farms the beans are fermented together with the placenta.

The next processing stage is fermentation. There are essentially four methods used today for the fermenting of raw cocoa:

1. Curing on the drying platform
2. Fermenting in baskets
3. Fermenting in heaps on the ground, and
4. Fermenting in systems of boxes

Fermentation takes 3 to 12 days, during which the germ in the seed is killed by the developed heat ("sweating"), which can reach temperatures up to 115°F (46°C). The character and flavour of the bean are changed by fermentation. To obtain an even fermentation, the beans have to be mixed and stirred, while the exuded juices or "sweatings" have to be drained.

After fermentation, when the moisture content of the whole bean is about 60 per cent, the beans are dried to reduce moisture to less than 8 per cent. Drying can be natural in the sun, or artificial. Sometimes the beans are washed before drying, but unwashed, sun-dried beans seem to be preferred. A common method of natural drying is to spread the beans on mats or split bamboo canes, which are raised from the ground; this system has been refined in numerous cocoa-growing areas by the introduction of either a fixed-roof with sliding trays, or a moving roof with a fixed drying floor, in order to be able to protect the beans during sudden showers, or at night.

The fermented and dried beans are placed in open-weave jute sacks and stored thus in warehouses for periods of up to 9 to 12 months in the tropics. Eventually the beans are sorted and graded. Recommendations in quality standards and grading practice for cocoa beans were made by the Working Party on Cocoa Grading of the Food and Agriculture Organization (See Report of the Second Session, Paris, 2-6 July 1963).

For the details of cocoa processing, reference is made to FAO Agricultural Study No.60 "Processing of Raw Cocoa for the Market".

Manufacture of Intermediate Products and Chocolate

14. For the manufacture of intermediate products such as cocoa butter and cocoa powder, and chocolate, the cocoa beans are first cleaned to remove stones, dirt and other foreign matter, and then roasted. During roasting the kernel or nib loosens from the shell, whilst flavour and colour are developed. Shelling after roasting is therefore easier, but there are also processes known which shell the unroasted nuts. In any case, the shell has to be removed completely before further processing of the beans.

Shelling is done by first breaking the beans, either between fluted rollers or in disc mills, or by means of specially designed centrifugal crackers. After breaking, nibs and shells are separated. This separation is done by a system of shaking screens and by "aspiration", a kind of winnowing process, removing the lighter shells from the nibs.

Cocoa nibs contain about 40% of cocoa butter, a valuable fat with typical melting properties. Cocoa butter can be extracted by means of expellers in the same way as oil seeds are extracted. The press cake is then processed to cocoa powder by milling and sifting, the finer fractions being separated in a cyclone.

For the manufacture of chocolate, the roasted nibs, after separation from shells, are ground by special roller mills, similar to the Anglo-American crushing rolls used for the crushing of oil seeds. By the heat of friction during this grinding process, the cocoa butter within the kernels is melted, with the result that the ground product becomes liquid, and is therefore called "chocolate liquor".

The chocolate liquor is mixed with sugar and other additives, depending on the end-product desired in the "melangeur", a roller-mill/mixer of the old "edge-runner" type or in a modern kneading and mixing machine. The ready mixture has to undergo a second grinding process in special crushing rolls, such as five-high crushing rolls. The last refining of the chocolate mass takes place by a long rubbing process in a special machine, called conge.

Processing Industries in Developing Countries

15. There has been a sharp increase, in recent years, in the quantity of cocoa beans processed industrially in the country of origin, part of this exported to developed countries in the form of intermediate products - cocoa butter, paste or powder.

However, as an increase in the primary processing of cocoa beans into intermediate products could make only a very small contribution to foreign exchange earnings *per se* it is of limited economic value. One advantage lies in that it enables the utilization of cocoa beans which would be unfit for export otherwise.

The establishment of complete chocolate industries is of greater economic significance, as this would greatly stimulate the demand for cocoa and chocolate. At present, home consumption in many producing countries is very low, owing to the high price and a lack of tradition of cocoa eating, which is linked with the climatic conditions. In the immediate future, establishment of a complete chocolate industry in many developing countries could be hampered by the lack of the other primary materials required, as well as of ancillary industries and skilled labour. If the domestic market is to expand, there will be a need to develop types of products suited to consumption under tropical conditions, e.g. chocolate with a lower proportion of cocoa-butter (or with slightly hydrogenated cocoa butter), and which will sell at a price within the reach of the local population. In any event government subsidies or other forms of aid would be necessary at the outset.

Tobacco

Production

16. World production of tobacco (1963/64) is 4.18 million metric tons. Main production is in North and South America, producing together 1.65 million metric tons, and Asia (without mainland China) with 1.10 million metric tons. Largest producer is the U.S.A. (more than a million tons), then India, Brazil, Japan, Turkey, Greece, Pakistan and Bulgaria. Greece produced in 1963/64 125,600 metric tons from the 600,000 metric tons produced in the whole of Europe, and Bulgaria 105,200 metric tons. The production of other countries does not reach the 100,000 ton mark.

The more important producers in Latin America are (1963/64):

Brazil	206,800	metric	tons
Mexico	70,600	"	"
Cuba	47,900	"	"
Argentina	45,000	"	"
Colombia	42,900	"	"

Dominican Republic	34,000	metric	tons
Porto Rico	14,600	"	"
Paraguay	9,300	"	"
Venezuela	8,800	"	"
Chile	6,500	"	"
Honduras	4,200	"	"
Peru	3,000	"	"
Ecuador	1,900	"	"
Guatemala	1,300	"	"
El Salvador	1,200	"	"
Jamaica	1,200	"	"
Haïti	1,100	"	"
Bolivia	1,000	"	"

In most Latin American countries production is expanding rapidly.

Trade in tobacco and its products involves almost every country, and its total value is estimated at about $1,000 million. Before the war, there was a distinct geographical specialization in the production of the different kinds of tobacco, but after the war this traditional pattern has changed. There has been a shift from dark and strong tobacco towards cigarettes, expecially in developing countries. On present indications, tobacco consumption is expected to grow both in developed and developing countries, and the emphasis of future requirements of raw tobacco might be on light cigarette leaf. But in the long run, the relation between tobacco consumption and the incidence of diseases, especially cancer, will be a very important factor.

Processing

17. Initial processing of tobacco has to take place on the farm or plantation, therefore in the country of production. After harvesting, the leaves are cured by subjecting them to varying temperatures and degrees of humidity for some time. The three common methods of curing are by air, fire and flue. The four essential steps of curing are: wilting, yellowing, colouring and drying, during which processes certain physical and chemical changes take place.

Air-curing takes place in buildings equipped with ventilators, and often heated artificially, and lasts one to two months. The fire-curing process is similar, but makes use of wood fires, allowing the smoke to come in contact with the leaf. Flue-curing makes use of small and tightly constructed barns, provided with suitable ventilators and metal pipes, or flues, extending from furnaces around the floor of the barn.

After curing, the leaf can only be handled without breakage in special moistening cellars, or during humid periods. Leaf is graded according to colour, size and other recognizable element properties, tied into "hands" or bundles, and is then ready for the market.

Manufacture of Tobacco Products

18. Only a few short remarks on the manufacture of tobacco products can be made here.

After curing, the tobacco leaves are fermented between 4 and 6 weeks, depending on the end-use. A kind of fermentation takes place also during the "ageing" period, which might be from one to three years. In most cases the stems, or midribs, are first removed from the leaf.

After ageing and "processing", manufacture usually starts with blending of grades of different years, and from different sections and type of leaf. Most types and grades have rather specific uses, such as using the upper leaves for chewing and the lower leaves for smoking. Some types of tobacco are used principally for cigarettes, others for cigars, or for pipe tobaccos. Pipe tobacco mixtures contain, usually, some flavouring constituents and some glycerine as a conditioner. The details of certain processes of manufacture are trade secrets.

Cigarette manufacture has been widely mechanized, with machinery turning out cigarettes in astronomical figures, while packing is also done automatically. Cigars were made by hand, and the more expensive types are still hand-made, but for the cheaper types machinery is also used.

Tobacco Manufacturing Industries in South America *)

19. The manufacture of cigarettes is a billion-dollar industry in South America, and has a tremendous potential for expansion. Cigarette factories in Brazil and Venezuela are very modern and equipped with the newest machines. New cigarette factories have grown up near Caracas, Sao Paulo, and other cities across South America. Manufacturers are increasing their cigarette output considerably faster than the world average rate of 5 percent annually, although South America is still a much larger market for imported cigarettes than for imported leaf. In 1962, Brazil alone produced about 80 billion cigarettes, more than half the total for all South America. Factories in Venezuela, Chile and Uruguay are also rapidly expanding their cigarette output.

Per capita consumption of tobacco products varies widely in South America. It is about 4 pounds per person in Brazil, and around 3 pounds - the world average - in Argentina, Colombia, Uruguay and Venezuela. In Peru, Bolivia, Ecuador, and Paraguay where there is a large rural Indian population the per capita consumption is very low.

Except for Uruguay and the Guianas, South America has become self-sufficient in tobacco production. Uruguay is the destination for over half the U.S. leaf exports to the continent since all of its cigarettes are made from imported leaf. A small quantity of U.S. leaf is imported for blending in cigarettes by all South American countries except Brazil.

Of all the tobacco produced in South America, over half the total is used in cigarettes and about a quarter is exported. The remaining quarter of the total production is mainly used by cottage industries for the preparation of "twist" tobacco, while smaller amounts are used in cigars and in cut and smoking tobacco.

Spices

20. Few agricultural products have a more fascinating history than spices. The search for spices led to the discovery of the New World, and of the sea-route round the Cape to India; wars were waged for the possession of spice-growing islands, and overgrown marmor palaces in the jungles of islands in the Moluccas (Indonesia) still tell the tale of the riches of spice growers.

One of the advantages of spices, similar to essential oils, is that they can be produced by small farmers, so to say in their backyards, because the amounts are small compared with other agricultural products, and the prices are relatively high. Primary processing is usually rather simple, although it needs experience, and required capital investment is very small. There is little secondary processing.

Spices are less threatened by competition from synthetics than many other non-food products.

*)See USDA, Foreign Agricultural Service, FAS - M - 139, August 1962.

It is not possible to mention here all the spices, the number of which is quite considerable, and therefore only selected spices will be dealt with. As the processing of spices differs for each product, processing will be discussed for every spice separately. The spices are arranged alphabetically.

Allspice

21. Allspice consists of the dried unripe fruits of Pimenta officinalis; it is also called Jamaica pepper or pimento. The tree is a relative of the clove tree, and is a native of the West Indies and tropical Central America. The bulk of the world's supply comes from Jamaica where the hot and fairly dry climate is ideal for the growth of the plant. Processing is very simple: the fruits are picked in the green state before they are fully ripe, and dried for some days, until the seeds rattle inside them. The finished product is then a small, wrinkled, purplish-black little berry.

Betel

22. There are two spices (or maybe they should be called drugs) known as betel, the betel nut and the betel vine. Both are chewed, usually together, by mixing pieces of betel nuts with some tobacco and slaked lime, rolling the whole mixture in a fresh leaf of the betel vine to make a pellet. The chewed mixture seems to have a stimulating and mildly narcotic effect, but it spoils the teeth and results in spitting out a red juice. Betel chewing has been a habit for two thousand years or more in many tropical countries, especially in India, Ceylon and Indonesia but is somewhat losing ground in modern times.

The betel nut is the seed of the Areca palm, Areca catechu, whilst the betel vine leaves are plucked from Piper betel, closely related to the pepper plant, Piper nigrum.

Cardamoms

23. Cardamoms are the dried fruits of Elettaria cardamomum, a perennial herb and a relative of ginger, to which the plant bears a resemblance. It is a popular spice in Asian countries, being used especially for curry powders, also for mixing with coffee in some markets. The world supply (being mainly consumed within the country of production) comes from India and Ceylon, but the plant has been introduced into other countries.

The fully-grown fruits are harvested when the green colour is changing into yellow, and when they are not yet fully ripe; it requires considerable experience to know which fruits should be cut off, and which not. Harvesting is done with a pair of special scissors. The fruits are then dried slowly in the sun, e.g. only three hours in the morning and two hours in the afternoon. Sometimes artificial drying is applied, but this process has also to be carried out rather slowly. The dried product should be light yellow, with a minimum of split fruits. To improve the colour further, the product is bleached with sulphurous vapour. The finished product is sorted and graded according to size and colour.

Chillies

24. Chillies are the most popular spices in all tropical countries, but are also widely used in Southern Europe, and are slowly gaining more and more ground in colder regions. They are the fruits of the annual plant Capsicum annum, and the perennial Capsicum frutescens, natives of the tropical areas of Central America and the West Indies. Both exist in a multitude of varieties and forms, and are known and grown in hot countries all over the world. C. annum yields the less pungent fruits, paprika and sweet peppers, whilst the fruits of C. frutescens are very sharp ("hot") and are known in powdered form as Cayenne pepper.

Chillies are usually consumed fresh, either as such or ground to a kind of paste under the addition of some ingredients such as oil, vinegar, salt, sugar, according to taste and habit. They are also dried and ground to a powder, or pickled or canned (known in cookery as pimiento).

Cinnamon

25. True cinnamon is prepared from the bark of Cinnamomum zeylanicum, a tree native to Ceylon, which is still the main producer of cinnamon. In Africa, it is produced in the Seychelles. There are other Cinnamon spp. from which a type of cinnamon is prepared, e.g. Cinnamon Cassia, the Chinese cinnamon, and C. Burmani, from which cinnamon is prepared in Indonesia. A near relative is Cinnamomum Camphore, the camphor tree, while also the avocado pear belongs to the same family.

In order to prepare cinnamon, the outer, corky layer of the bark of the tree is scraped off, and the bark is then carefully removed by cutting into two long strips, of about 1 meter long and 10 centimeters broad. These strips are slowly dried, during which process they become rolled into "quills".

Cloves

26. Cloves are the unexpanded flower buds of Eugenia aromatica (or Eugenia caryophylla), a small evergreen symmetrically shaped tree. They belong to the oldest spices known, already recorded in China in the third century B.C., and well known to the Romans. In the Middle Ages, cloves were the high-priced and much coveted product of the Moluccas (Indonesia), and they are still today one of the most important of the commercial spices. About 90 per cent of the world's clove supply are produced in Zanzibar and Pemba, where environmental conditions are favourable for the rather exacting growth requirements of the tree. They are also grown in parts of the West Indies, Madagascar and Indonesia.

Processing consists in hand-picking and drying the flower buds, which are harvested when they are still dull green in colour, or are just becoming a dull red. The trees are therefore not allowed to flower, except, of course, for seed production. During drying, the flower buds shrivel up to the dark brown cloves of commerce, which are either used as such or after grinding to a powder. By distilling the flower buds or the stems and fruits of the clove tree, the essential clove oil is obtained from which synthetic vanilline is made.

Fenugreek

27. Fenugreek, the "Greek hay", is the seed of Trigonella foenum-graecum, an annual that has been grown for centuries in India and North Africa, e.g. U.A.R., Sudan, Morocco. Considerable quantities are exported from India and also from Morocco, but local consumption is probably much larger. The plant itself is also used as a fodder plant.

The seeds are greenish-brown, with deep grooves across one corner, giving the seeds a hooked appearance. They are contained in very long narrow pods. The seeds are highly aromatic, their flavour being due to the presence of an essential oil containing coumarin. They are used for various purposes, even as a source of yellow dye, and as local drugs, but mainly as a spice. They are a constituent of curry powders.

Ginger

28. Ginger is processed from the rhizomes of Zingiber officinale, a reed-like plant which is successfuly cultivated in India, Ceylon, Malaya, China, West Africa, Thailand and in the West Indies, especially Jamaica. Jamaica-ginger is world famous and is considered to be the best type of Ginger known in world trade. Ginger is marketed in various forms, the two most important of which are the black and the white ginger.

Black or grey ginger is unpeeled ginger, consisting of the dried rhizomes without special treatment; it is the form which is usually produced in Africa. The rhizomes are cleaned and washed, then immersed for 10 - 15 minutes in boiling water, and dried in the sun. White, uncoated or scraped ginger is made by skinning or peeling the rhizomes first with a special knife, followed immediately by thorough washing and careful drying in the sun. This is the most popular form of ginger for culinary purposes. To preserve ginger, tender and succulent roots are washed, scraped and sliced, the slices being treated in a special way with syrup.

Kola

29. Kola-nuts are the seeds of Cola acuminata, a 30-40 ft. high tree of Western Tropical Africa. It bears stout, warty green pods, 5-7 in. long, containing 6-10 large white or pink seeds, which become dark brown on drying. Kola nuts contain about 2 per cent caffein, and have become popular as a stimulating agent. The importance for West Africa ranks next to that of the oil palm. The production is estimated at about 50,000 tons per year. The Cola-tree has been naturalised in the West Indies where it is cultivated as a minor crop.

Nutmeg and Mace

30. These spices are derived from Myristica fragrans, a big tree originating in the Moluccas, but introduced into many other tropical countries, including West Indies. The fruits of this tree are light yellow, resembling an apricot, splitting up when ripe and disclosing the glossy, dark-brown nut, which is surrounded by a scarlet aril or wrapper in the form of a net. This aril is the important spice mace, valued on the brightness of its colour and one of the most delicately flavoured of all spices. The nut, which the mace surrounds, consists of a rather brittle shell and a hard, brown ovoid kernel, about an inch in length, representing the nutmeg of commerce.

Processing is very simple. The fruits are either picked or allowed to drop on the ground, where they are collected. The mace is carefully removed from the nut, flattened either by hand or by pressure between boards, and then allowed to dry. Also the seeds are dried in the sun, usually after removing the shell. The bulk of the world's supply comes from the Moluccas, from Penang, Celebes and parts of the West Indies.

Pepper

31. Pepper, one of the oldest and most common spices, is obtained from the fruits and seeds of Piper nigrum, a creeping perennial vine native to South West India, but introduced in many other tropical countries. An important exporter in Latin America is Brazil, with exports of almost 2,400 tons in 1963. "Black" and "White" peppers of commerce are derived from the same plant, the difference being merely one of processing.

For the production of black pepper, the berries ("pepper corns") are harvested when they start yellowing, therefore not yet fully ripe. They are put in heaps for some days for fermentation, during which process they turn black. Fermenting is sometimes replaced by plunging the fruits into hot water. After fermenting and drying in the sun, the pepper corns are threshed by treading, then winnowed and screened.

In order to produce white pepper, the berries are only harvested when they are fully ripe and red. They are put in bags in streaming water for one or two weeks. After this treatment, the skin of the fruits can easily be peeled by hand or feet rubbing. The white kernels are thereafter washed carefully, and dried as soon as possible. The correct dryness is marked by the fact that white pepper when properly dried do not split in two, but into many small pieces. Of 100 lbs. of fresh fruits, 36 lbs. of black pepper and only 24 lbs. of white pepper are obtained. The price of white pepper should therefore be at least 50 per cent more than that of black pepper for profit of extra work done.

Turmeric

32. Turmeric is similar to ginger, being obtained from the underground rhizomes of Curcuma longa, related to the ginger plant Zingiber. As a spice, it is used for curry powders, and also as an adulterant for other spices, like mustard, because of its cheapness. It is also used as dyestuff, notwithstanding that it is neither colour-fast nor fade-proof. Further applications are for locally made medicines, for cosmetics and also for religious purposes in the Far East. However, the types used for spices and for technical purposes are not exactly the same. The roots of the technical turmeric are bigger and harder, and contain more colouring matter.

For processing, the rhizomes are first sorted according to size, washed and cleaned carefully, then boiled 2-3 hours in water, the big pieces being boiled longer than the small pieces. The roots are then dried in the sun, turning them round two or three times a day. Every day in the evening, the roots are rubbed by hand to make them clean and smooth. Turmeric is produced in the West Indies, further in India, China, Ceylon and other countries of Asia and the Far East.

Vanilla

33. Vanilla is obtained from a climbing orchid, Vanilla Planifolia, a perennial vine-like plant, growing in tropical rain forests. Vanilla is a native of Central America and Mexico, but up to about 60 per cent of the world export of vanilla is now supplied by Madagascar; another important African producer is the Comoro Islands. Vanilla is also produced in the West Indies and Mexico, further in various South Sea islands.

The fruits are collected from the vines before they are ripe, i.e., when they are just beginning to change from green to yellow. The capsules, or vanilla beans, as they are termed, after collection have none of the aroma and flavour of the finished product, which only develops during the curing process. Various methods are used in different countries to process the fruits, all involving a partial drying of the fruits in the sun, followed by a sweating process, during which the characteristic flavour and smell develop. Treatment of the fruits with nearly boiling water before sweating (in air-tight boxes) might help to accelerate the process, which is repeated until the fruits become coffee-coloured, and the aroma of vanilla develops.

Aniseed

34. Of the large group of Umbelliferous spices, only Aniseed will be mentioned, derived from Pimpinella anisum, and well-known for flavouring liqueurs, confectionery and sweets. The plant is a native of the Mediterranean islands and Egypt. It is cultivated in many countries, including India, China and parts of Europe. In Latin America, Chile and Mexico are producers of aniseed.

VI. VARIOUS PRODUCTS

Technical Starch Products

1. Some roots or tubers have, as well as their significance for food purposes, importance as the raw material for technical starch production. An important source of such technical starch products is cassava (Manihot utilissima). Cassava starch is known in the trade as tapioca flour, and is used for many technical purposes, such as the manufacture of Dextrine, glucose, for the sizing of textiles, in the paper industry, etc. The main purchaser of tapioca starch is the U.S.A. Tapioca flour can be processed on a small scale, with very simple, and even hand-made equipment, by grating the washed and peeled roots, diluting the pulp obtained with water, and screening it through a cloth supported by a bamboo basket. The fibres remain within the cloth, whilst the starch forms a "milk" with the water, and can be separated and purified by settling in tanks. Small and medium-sized tapioca plants follow essentially the same method, but mechanized. The grating is done in this case by means of rotating raspers, and the screening on rotating screens or shaking screens. Large modern tapioca factories make use of centrifugal separators, artificial driers, and other modern equipment. Details of the processing of cassava are given in the FAO Development Paper No.54.

Main producers of tapioca flour are Indonesia and Thailand, but there is no reason why tapioca flour could not be prepared on a bigger scale in Latin America too, where cassava, after all, is very common.

In a rather simple process cassava roots can also be transformed into dry chips and "meal" which can be used for animal feed, and can as such be exported. There is a demand for these products in Europe, especially in West Germany.

Insecticides

2. Various plants are poisonous to insects and can therefore be used as insecticides, like the leaves of tobacco or of the "wild" tobacco Lobelia nicotianaefolia, the "Tuba-roots" of Derris elliptica and the Calamus-root of Acorus Calamus, the "Bitter-wood" (Quassia-chips) of Picraena excelsa, and the flower heads of Pyrethrum roseum.

Because of the great number of modern chemical insecticides, these natural insecticides have greatly lost significance, but some are still used, partly in combination with DDT or Lindane, such as the Pyrethrum powder prepared from the dried and finely ground flower-heads of Pyrethrum roseum (Chrysanthemum cinerariaefolium) and other Pyrethrum spp. The Pyrethrum industry originates from Persia, Dalmatia and Southern Russia (hence the names Persian-powder or Dalmatian-powder), but also plays a role in Africa, especially in Kenya and the Congo at higher altitudes (above about 1,800 meters altitude).

Another natural insecticide consists of the dried and powdered roots of Derris elliptica, D. malaccensis and similar plants, which contain mainly rotenon, and have been used for centuries in the Far East (Malaysia, Indonesia, Philippines) as fish-poisons.

Medicaments

3. A very great number of plants belong to the group "Medicinal Plants" because of their use as medicine. Many of them have nowadays only local significance, because their active agent is produced synthetically, or because the chemical industry has developed more effective synthetic substitutes. But some of these medicinal plants

still play a part in modern medicine, either as such, or as raw materials for synthetic products. Still well-known as laxatives are castor oil (from Ricinus communis), croton oil (from Croton Tiglium), senna leaves (from Cassia spp.), aloës (from Aloë spp.) and others. Opium, prepared from the unripe fruit capsules of Papaver somniferum, is an important raw material for valuable alkaloids, such as morphine and codeine, and numerous derivatives. Quinine, derived from the bark of Cinchona spp., was for centuries the only medicament against malaria, but has in modern times found effective synthetic medicaments as competitors. Also well-known are the numerous modern medicaments derived from plants, such as digitalis-preparations for heart diseases, rauwolfia preparations against high blood pressure, medicaments containing strychnine, brucine and derivatives for the treatment of nervous diseases and many others.

Production and processing of medicinal plants, similar to that of essential oils and spices, lends itself to small enterprises at the farmers and rural level.

Dyes

4. Vegetable dyes were once very important, with as a famous example indigo, and almost entirely lost their significance after the invention of synthetic dye-stuffs from coal-tar. However, some have recently regained their importance for the food industry, because of the cancerogene properties of some coal-tar dyes. To this group belongs Anatto Seed, derived from Bixa Orellana, which is, or can be, cultivated in numerous tropical countries and which can be exported as such, or as an extracted rough dye-powder.

VII. CONCLUDING REMARKS

It is clear from the above review that there is ample scope in the developing countries for the establishment of industries processing agricultural raw materials other than food. The same proposition is, of course, also valid for food too, including the establishment of industries based on fisheries and animal husbandry.

These products processing industries, if launched and operated efficiently, make a substantial contribution to the economic development and prosperity, stimulate demand for local agricultural products, and can, in many instances be suitably located, without necessarily becoming less economic near the source of raw material, thus providing work for the increasing numbers of the rural population.

In many developing countries there is the problem of rural unemployment and poverty, leading to undesirable urbanization, and products processing industries can therefore be very beneficial for the development of rural area.

Of further importance is the fact that many such industries are sufficiently flexible from a technological point of view as to permit of a gradual initiation of rural workers into the processes of industry as the scale and scope of a successful pilot plant are expanded.

A more detailed examination of the economic problems arising from the erection of such products processing industries is, however, required for each particular case.

The domestic market may often be restricted, especially in countries with a relatively small population, and even more modest purchasing power. Inter-regional arrangements are therefore indicated, in order to avoid the proliferation of uneconomic plants in the same branch in a number of neighbouring countries. Viewed in a wider perspective, the problem is complicated by the barriers often erected against such products by developed countries, and by the threat of competition from synthetics, especially in the case of certain fibres and of rubber. In developing countries the trend towards the rapid increase in the consumption of the corresponding natural products has not so far been at all so marked, but it may well be that this trend will set in after a period of time. The switch to the consumption of synthetic products will presumably be somewhat slower in those developing countries which themselves produce the natural products, but even there it is doubtful if the tendency for synthetic articles to gain predominance for certain uses can be resisted indefinitely to any great degree. However, the main difficulty, with particular reference to large scale operations, will be the basic one of finding the necessary skills and possibly also capital to get such industries going on an efficient and competitive basis.

FAO has constantly attached the greatest importance to the establishment of these industries. It has, at the analytical level, produced projections for a number of non-food agricultural products, and is now engaged in the World Indicative Plan for Agricultural Development, which will provide a comprehensive frame of reference for developing countries, by working out projections and targets in respect of the production, consumption and trade in agricultural products in 1985, with intermediate figures for 1975. These projections and targets should be of great assistance to developing countries in gauging certain basic aspects relevant to decisions to set up new industries of the type in question. At technical, technological and operational stages, FAO has also given, and is increasingly giving, assistance designed to improve, modernize and extend these industries. It is convinced that it is thereby assisting developing countries in Africa and elsewhere to develop their economy and attain the standard of living to which they are entitled.

APPENDIX

APPAREL FIBER CONSUMPTION IN LATIN AMERICA

1961 to 1963

Extracted from: World Apparel Fiber Consumption
1961 to 1963 - FAO August 1965.

ARTICULO / PAIS O REGION	ARGENTINA 1961	ARGENTINA 1962	ARGENTINA 1963	BOLIVIA 1961	BOLIVIA 1962	BOLIVIA 1963	BRASIL 1961	BRASIL 1962	BRASIL 1963
	(................			Miles de toneladas métricas					................)
ALGODON									
Consumo industrial	111.1	89.0	85.6	1.9	2.0	2.2	275.6	275.6	271.0
Comercio exterior									
Exportaciones: Hilados	-	-	0.3	-	-	-	0.3	0.1	-
Tejidos	-	-	0.1	-	-	-	0.5	0.4	1.4
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	0.4	-	-	-	0.8	0.5	1.4
Importaciones: Hilados	0.3	0.4	0.3	0.2	...	...	-	-	-
Tejidos	0.4	0.4	0.1	0.4	...	...	-	-	-
Otras manufacturas	0.1	0.1	0.1	0.1	...	...	-	-	0.1
Total	0.8	0.9	0.5	0.7	0.7	0.8	-	-	0.1
Balance del comercio exterior	+ 0.8	+ 0.9	+ 0.1	+ 0.7	+ 0.7	+ 0.8	- 0.8	- 0.5	- 1.3
Disponible para el consumo interior	111.9	89.9	85.7	2.6	2.7	3.0	274.8	275.1	269.7
LANA									
Consumo industrial de lana virgen (base limpia)	24.5	15.9	13.8	-	-	-	14.7	15.2	14.1
Comercio exterior									
Exportaciones: Peinados	1.4	2.2	4.7	-	-	-	-	0.1	0.1
Blusas y desperdicios	3.5	4.0	2.4	-	-	-	0.4	0.3	-
Hilados	-	0.1	0.7	-	-	-	-	-	-
Tejidos	-	-	0.2	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	4.9	6.3	8.0	-	-	-	0.4	0.4	0.1
Importaciones: Peinados	-	-	-	-	-	-	-	0.1	0.4
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	0.1	*0.1	*0.1	-	-	-
Tejidos	0.1	0.1	-	0.1	*0.1	*0.1	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	0.1	0.1	-	0.2	0.2	0.2	-	0.1	0.4
Balance del comercio exterior	- 4.8	- 6.2	- 8.0	+ 0.2	+ 0.2	+ 0.2	- 0.4	- 0.3	+ 0.3
Disponible para el consumo interior	19.7	9.7	5.8	0.2	0.2	0.2	14.3	14.9	14.4
FIBRAS ARTIFICIALES (CELULOSICAS)									
Producción:									
Fibra cortada	4.3	2.4	3.2	-	-	-	11.3	11.3	11.3
Fibra continua	12.6	9.4	7.5	-	-	-	30.8	30.4	29.0
Total	16.9	11.8	10.7	-	-	-	42.1	41.7	40.3
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	-	-	0.2	-	-	-	-	-	-
Hilos e hilados	2.5	2.6	0.8	0.2	0.2	...	-	-	-
Tejidos	1.9	1.8	0.8	0.6	0.6	...	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	4.4	4.4	1.8	0.8	0.8	0.8	-	-	-
Balance del comercio exterior	+ 4.4	+ 4.4	+ 1.8	+ 0.8	+ 0.8	+ 0.8	-	-	-
Disponible para el consumo interior	21.3	16.2	12.5	0.8	0.8	0.8	42.1	41.7	40.3
FIBRAS SINTETICAS (NO CELULOSICAS)									
Producción:									
Fibra cortada	-	-	0.32	-	-	-	0.68	1.91	2.81
Fibra continua	1.81	2.27	4.26	-	-	-	4.99	6.80	7.62
Total	1.81	2.27	4.58	-	-	-	5.67	8.71	10.43
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	0.06	0.06	...
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	0.06	0.06	0.06
Importaciones: Fibra cortada	0.45	0.14	0.77	-	-	-	0.37	0.10	0.20
Hilos e hilados	2.64	2.07	1.36	-	-	-	-	-	0.10
Tejidos	0.50	0.62	0.50	-	-	-	-	-	0.10
Otras manufacturas	0.04	0.06	-	-	-	-	-	-	-
Total	3.63	2.89	2.63	-	-	-	0.37	0.10	0.40
Balance del comercio exterior	+ 3.63	+ 2.89	+ 2.63	-	-	-	+ 0.31	+ 0.16	+ 0.34
Disponible para el consumo interior	5.44	5.16	7.21	-	-	-	5.96	8.87	10.77
TODA CLASE DE FIBRAS: Disponibilidades para el consumo interior	158.3	121.0	111.2	3.6	3.7	4.0	337.2	340.6	335.2
POBLACION (millones)	21.08	21.42	21.72	3.50	3.55	3.60	73.09	75.27	76.16
DISPONIBILIDADES POR HABITANTE (kg.)									
Toda clase de fibras	7.5	5.7	5.2	1.0	1.0	1.0	4.7	4.6	4.4
Algodón	5.3	4.2	4.0	0.7	0.8	0.8	3.8	3.7	3.5
Lana	0.9	0.5	0.3	0.1	-	-	0.2	0.2	0.2
Fibras artificiales (celulósicas)	1.0	0.8	0.6	0.2	0.2	0.2	0.6	0.6	0.5
Fibras sintéticas (no celulósicas)	0.26	0.24	0.33	-	-	-	0.08	0.12	0.14

ARTICULO / PAIS O REGION	CHILE 1961	CHILE 1962	CHILE 1963	COLOMBIA 1961	COLOMBIA 1962	COLOMBIA 1963	COSTA RICA 1961	COSTA RICA 1962	COSTA RICA 1963
	(...	...	...	Miles de toneladas métricas	...	...	...	...	...)
ALGODON									
Consumo industrial	23.2	23.9	25.4	50.8	55.1	57.0	1.0	1.3	1.6
Comercio exterior									
Exportaciones: Hilados	-	-	-	0.6	1.5	1.0	-	-	-
Tejidos	-	-	-	0.1	0.8	1.2	-	-	-
Otras manufacturas	-	-	-	0.1	-	-	-	-	-
Total	-	-	-	0.8	2.3	2.2	-	-	-
Importaciones: Hilados	-	-	-	-	-	-	0.2	0.3	0.3
Tejidos	0.2	0.2	...	-	-	-	1.6	1.7	1.7
Otras manufacturas	0.1	0.3	...	-	-	-	0.2	0.2	0.4
Total	0.3	0.5	0.5	-	-	-	2.0	2.2	2.4
Balance del comercio exterior	+ 0.3	+ 0.5	+ 0.5	- 0.8	- 2.3	- 2.2	+ 2.0	+ 2.2	+ 2.4
Disponible para el consumo interior	23.5	24.4	25.9	50.0	52.8	54.8	3.0	3.5	4.0
LANA									
Consumo industrial de lana virgen (base limpia)	7.2	8.7	7.8	*2.1	*1.7	*1.9	-	-	-
Comercio exterior									
Exportaciones: Peinados	-	-	-	-	-	-	-	-	-
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Peinados	0.2	0.5	...	3.2	0.9	0.4	-	-	-
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	0.1	0.1	0.1
Tejidos	0.1	-	-	-	-	-	0.2	0.1	0.2
Otras manufacturas	-	-	-	-	-	-	-	0.1	0.1
Total	0.3	0.5	0.5	3.2	0.9	0.4	0.3	0.3	0.4
Balance del comercio exterior	+ 0.2	+ 0.5	+ 0.5	+ 3.2	+ 0.9	+ 0.4	+ 0.3	+ 0.3	+ 0.4
Disponible para el consumo interior	7.5	9.2	8.3	5.3	2.6	2.3	0.3	0.3	0.4
FIBRAS ARTIFICIALES (CELULOSICAS)									
Producción:									
Fibra cortada	1.6	2.0	2.5	3.8	5.1	5.8	-	-	-
Fibra continua	1.5	1.5	1.8	4.3	3.9	4.5	-	-	-
Total	3.1	3.5	4.3	8.1	9.0	10.3	-	-	-
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	0.8	1.7	2.1	-	-	-
Hilos e hilados	-	-	-	0.6	0.3	0.5	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	1.4	2.0	2.6	-	-	-
Importaciones: Fibra cortada	0.2	0.2	*0.4	0.1	-	0.1	-	-	-
Hilos e hilados	0.1	0.2	*0.7	1.2	1.5	0.8	0.2	0.3	0.2
Tejidos	0.4	0.1	*0.1	-	-	-	0.5	0.6	0.9
Otras manufacturas	0.1	0.3	*0.2	-	-	-	0.1	0.1	0.1
Total	0.8	0.8	1.4	1.3	1.5	0.9	0.8	1.0	1.2
Balance del comercio exterior	+ 0.8	+ 0.8	+ 1.4	- 0.1	- 0.5	- 1.7	+ 0.8	+ 1.0	+ 1.2
Disponible para el consumo interior	3.9	4.3	5.7	8.0	8.5	8.6	0.8	1.0	1.2
FIBRAS SINTETICAS (NO CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	-	-	-
Fibra continua	0.36	0.45	0.45	0.37	0.64	0.68	-	-	-
Total	0.36	0.45	0.45	0.37	0.64	0.68	-	-	-
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	-	-	*0.44	0.25	0.27	0.45	-	-	-
Hilos e hilados	0.42	0.41	*0.68	0.38	0.64	0.73	0.25	0.26	0.38
Tejidos	-	-	-	-	-	-	0.03	0.05	0.07
Otras manufacturas	-	-	-	-	-	-	0.01	0.01	0.01
Total	0.42	0.41	1.12	0.63	0.91	1.18	0.29	0.32	0.46
Balance del comercio exterior	+ 0.42	+ 0.41	+ 1.12	+ 0.63	+ 0.91	+ 1.18	+ 0.29	+ 0.32	+ 0.46
Disponible para el consumo interior	0.78	0.86	1.57	1.00	1.55	1.86	0.29	0.32	0.46
TODA CLASE DE FIBRAS: Disponibilidades para el consumo interior	35.7	38.8	41.5	64.3	65.5	67.6	4.4	5.1	6.1
POBLACION (millones)	7.83	8.00	8.22	14.44	14.77	15.10	1.23	1.28	1.34
DISPONIBILIDADES POR HABITANTE (kg.)									
Toda clase de fibras	4.6	4.9	5.1	4.5	4.5	4.5	3.6	4.0	4.6
Algodón	3.0	3.1	3.2	3.5	3.6	3.6	2.4	2.7	3.0
Lana	1.0	1.2	1.0	0.4	0.2	0.2	0.2	0.2	0.3
Fibras artificiales (celulósicas)	0.5	0.5	0.7	0.5	0.6	0.6	0.7	0.8	0.9
Fibras sintéticas (no celulósicas)	0.20	0.21	0.19	0.07	0.10	0.12	0.24	0.25	0.34

PAIS O REGION / ARTICULO	CUBA 1961	CUBA 1962	CUBA 1963	REPUBLICA DOMINICANA 1961	REPUBLICA DOMINICANA 1962	REPUBLICA DOMINICANA 1963	ECUADOR 1961	ECUADOR 1962	ECUADOR 1963
	(................................ Miles de toneladas métricas								................................)
ALGODON									
Consumo industrial	12.6	13.6	14.7	0.4	0.4	0.4	4.0	4.2	4.3
Comercio exterior									
Exportaciones: Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Hilados	0.7	0.1	...	0.4	0.6	0.6	0.2	0.1	0.1
Tejidos	1.0	1.0	...	2.2	5.6	3.7	0.6	0.6	0.7
Otras manufacturas	-	-	-	0.1	2.4	2.2	-	-	-
Total	1.7	1.1	1.1	2.7	8.6	6.5	0.8	0.7	0.8
Balance del comercio exterior	+ 1.7	+ 1.1	+ 1.1	+ 2.7	+ 8.6	+ 6.5	+ 0.8	+ 0.7	+ 0.8
Disponible para el consumo interior	14.3	14.7	15.8	3.1	9.0	6.9	4.8	4.9	5.1
LANA									
Consumo industrial de lana virgen (base limpia)	-	-	-	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Peinados	-	-	-	-	-	-	-	-	-
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Peinados	-	0.1	...	-	-	-	0.1	0.1	0.1
Blusas y desperdicios	-	-	-	-	-	-	-	0.1	0.1
Hilados	-	0.1	...	-	-	-	-	-	-
Tejidos	0.4	0.3	...	-	-	-	0.2	0.2	0.2
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	0.4	0.5	0.5	-	-	-	0.3	0.4	0.4
Balance del comercio exterior	+ 0.4	+ 0.5	+ 0.5	-	-	-	+ 0.3	+ 0.4	+ 0.4
Disponible para el consumo interior	0.4	0.5	0.5	-	-	-	0.3	0.4	0.4
FIBRAS ARTIFICIALES (CELULOSICAS)									
Producción:									
Fibra cortada	2.3	1.8	0.9	-	-	-	-	-	-
Fibra continua	1.8	1.4	0.9	-	-	-	-	-	-
Total	4.1	3.2	1.8	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Fibra cortada	*0.9	*0.5	*0.2	-	-	-	-	-	-
Hilos e hilados	*0.2	*0.5	*0.2	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	1.1	1.0	0.4	-	-	-	-	-	-
Importaciones: Fibra cortada	0.2	*0.2	-	-	-	-	0.6	1.0	1.8
Hilos e hilados	2.6	1.5	*0.7	-	-	-	0.2	0.4	0.8
Tejidos	0.1	0.5	*0.5	0.1	0.5	0.4	0.1	0.1	0.2
Otras manufacturas	0.6	...	...	-	0.6	0.5	-	-	-
Total	3.5	2.8	1.7	0.1	1.1	0.9	0.9	1.5	2.8
Balance del comercio exterior	+ 2.1	+ 1.8	+ 1.3	+ 0.1	+ 1.1	+ 0.9	+ 0.9	+ 1.5	+ 2.8
Disponible para el consumo interior	6.2	5.0	3.1	0.1	1.1	0.9	0.9	1.5	2.8
FIBRAS SINTETICAS (NO CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	-	-	-
Fibra continua	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	0.02	0.04	*0.04	-	-	-	0.13	0.32	0.22
Hilos e hilados	0.59	0.14	*0.22	-	-	-	-	0.29	0.24
Tejidos	0.02	0.02	...	-	-	-	-	-	-
Otras manufacturas	0.04	...	...	-	-	-	-	-	-
Total	0.67	0.23	0.30	-	-	-	0.13	0.61	0.46
Balance del comercio exterior	+ 0.67	+ 0.23	+ 0.30	-	-	-	+ 0.13	+ 0.61	+ 0.46
Disponible para el consumo interior	0.67	0.23	0.30	-	-	-	0.13	0.61	0.46
TODA CLASE DE FIBRAS: Disponibilidades para el consumo interior	21.6	20.4	19.7	3.2	10.1	7.8	6.1	7.4	8.8
POBLACION (millones)	6.93	7.07	7.20	3.11	3.22	3.33	4.46	4.60	4.73
DISPONIBILIDADES POR HABITANTE (kg.)									
Toda clase de fibras	3.1	2.8	2.7	1.0	3.1	2.4	1.4	1.6	1.9
Algodón	2.1	2.1	2.2	1.0	2.8	2.1	1.1	1.1	1.1
Lana	-	-	-	-	-	-	0.1	0.1	0.1
Fibras artificiales(celulósicas)	0.9	0.7	0.4	-	0.3	0.3	0.2	0.3	0.6
Fibras sintéticas (no celulósicas)	0.10	0.03	0.04	-	-	-	0.03	0.13	0.10

AMERICA LATINA (continuación)

ARTICULO / PAIS O REGION	EL SALVADOR 1961	EL SALVADOR 1962	EL SALVADOR 1963	GUAYANA FRANCESA, GUADALUPE, MARTINICA 1961	GUAYANA FRANCESA, GUADALUPE, MARTINICA 1962	GUAYANA FRANCESA, GUADALUPE, MARTINICA 1963	HONDURAS 1961	HONDURAS 1962	HONDURAS 1963
	(Miles de toneladas métricas)								
ALGODON									
Consumo industrial	5.9	6.3	6.7	-	-	-	0.5	0.4	0.4
Comercio exterior									
Exportaciones: Hilados	1.0	0.6	1.6	-	-	-	-	-	-
Tejidos	0.2	0.6	1.0	-	-	-	-	-	-
Otras manufacturas	0.3	0.1	-	-	-	-	-	-	-
Total	1.5	1.3	2.6	-	-	-	-	-	-
Importaciones: Hilados	0.2	0.2	0.2	-	-	-	0.2	0.3	0.3
Tejidos	1.7	1.7	1.7	0.8	0.7	0.7	2.1	1.9	1.4
Otras manufacturas	-	0.1	0.2	-	-	-	0.3	0.5	0.5
Total	1.9	2.0	2.1	0.8	0.7	0.7	2.6	2.7	2.2
Balance del comercio exterior	+ 0.4	+ 0.7	- 0.5	+ 0.8	+ 0.7	+ 0.7	+ 2.6	+ 2.7	+ 2.3
Disponible para el consumo interior	6.3	7.0	6.2	0.8	0.7	0.7	3.1	3.1	2.7
LANA									
Consumo industrial de lana virgen (base limpia)	-	-	-	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Peinados	-	-	-	-	-	-	-	-	-
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Peinados	-	-	-	-	-	-	-	-	-
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	-	-	-
Tejidos	0.1	0.1	...	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	0.1	0.1	0.1	-	-	-	-	-	-
Balance del comercio exterior	+ 0.1	+ 0.1	+ 0.1	-	-	-	-	-	-
Disponible para el consumo interior	0.1	0.1	0.1	-	-	-	-	-	-
FIBRAS ARTIFICIALES (CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	-	-	-
Fibra continua	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	0.1	0.1	-	-	-	-	-	-
Tejidos	0.3	0.4	0.5	0.5	0.3	0.3	1.9	1.4	1.7
Otras manufacturas	-	-	-	-	-	-	0.1	-	-
Total	0.3	0.5	0.6	0.5	0.3	0.3	2.0	1.4	1.7
Balance del comercio exterior	+ 0.3	+ 0.5	+ 0.6	+ 0.5	+ 0.3	+ 0.3	+ 2.0	+ 1.4	+ 1.7
Disponible para el consumo interior	0.3	0.5	0.6	0.5	0.3	0.3	2.0	1.4	1.7
FIBRAS SINTETICAS (NO CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	-	-	-
Fibra continua	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	*0.03	...	...	-	-	-	-	-	-
Tejidos	*0.04	...	...	-	-	-	0.04	0.05	0.15
Otras manufacturas	0.03	0.03	0.03	-	-	-	0.04	0.04	0.04
Total	0.10	0.10	0.10	-	-	-	0.08	0.09	0.19
Balance del comercio exterior	+ 0.10	+ 0.10	+ 0.10	-	-	-	+ 0.08	+ 0.09	+ 0.19
Disponible para el consumo interior	0.10	0.10	0.10	-	-	-	0.08	0.09	0.19
TODA CLASE DE FIBRAS: Disponibilidades para el consumo interior	6.8	7.7	7.0	1.3	1.0	1.0	5.2	4.6	4.6
POBLACION (millones)	2.51	2.63	2.72	0.58	*0.60	*0.61	1.89	1.95	2.00
DISPONIBILIDADES POR HABITANTE (kg.)									
Toda clase de fibras	2.7	2.9	2.5	2.3	1.7	1.7	2.7	2.3	2.3
Algodón	2.5	2.7	2.3	1.4	1.2	1.2	1.6	1.6	1.4
Lana	-	-	-	-	-	-	-	-	-
Fibras artificiales (celulósicas)	0.1	0.2	0.2	0.9	0.5	0.5	1.1	0.7	0.8
Fibras sintéticas (no celulósicas)	0.04	0.04	0.04	-	-	-	0.04	0.05	0.10

AMERICA LATINA (continuación)

PAIS O REGION / ARTICULO	MEXICO 1961	MEXICO 1962	MEXICO 1963	ANTILLAS NEERLANDESAS 1961	ANTILLAS NEERLANDESAS 1962	ANTILLAS NEERLANDESAS 1963	NICARAGUA 1961	NICARAGUA 1962	NICARAGUA 1963
	(Miles de toneladas métricas)								
ALGODON									
Consumo industrial	109.3	110.6	116.9	-	-	-	1.5	1.5	1.9
Comercio exterior									
Exportaciones: Hilados	3.1	2.3	1.8	-	-	-	-	-	-
Tejidos	4.2	3.2	2.1	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	7.3	5.5	3.9	-	-	-	-	-	-
Importaciones: Hilados	-	-	-	-	-	-	0.2	0.3	0.4
Tejidos	-	0.1	-	0.3	0.4	0.4	1.4	1.6	1.8
Otras manufacturas	-	-	-	0.2	0.3	0.5	0.2	0.3	0.3
Total	-	0.1	-	0.5	0.7	0.9	1.8	2.2	2.5
Balance del comercio exterior	- 7.3	- 5.4	- 3.9	+ 0.5	+ 0.7	+ 0.9	+ 1.8	+ 2.2	+ 2.5
Disponible para el consumo interior	102.0	105.2	113.0	0.5	0.7	0.9	3.3	3.7	4.4
LANA									
Consumo industrial de lana virgen (base limpia)	6.5	7.8	7.2	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Peinados	-	-	-	-	-	-	-	-	-
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Peinados	-	-	-	-	-	-	-	-	-
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	0.1	0.1	0.1	-	-	-	-	-	-
Tejidos	-	0.1	-	-	-	-	-	-	-
Otras manufacturas	0.1	0.1	0.1	-	0.1	0.1	0.1	...	...
Total	0.2	0.3	0.2	-	0.1	0.1	0.1	0.1	0.1
Balance del comercio exterior	+ 0.2	+ 0.3	+ 0.2	-	+ 0.1	+ 0.1	+ 0.1	+ 0.1	+ 0.1
Disponible para el consumo interior	6.7	8.1	7.4	-	0.1	0.1	0.1	0.1	0.1
FIBRAS ARTIFICIALES (CELULOSICAS)									
Producción:									
Fibra cortada	8.1	7.7	8.9	-	-	-	-	-	-
Fibra continua	13.3	15.7	16.4	-	-	-	-	-	-
Total	21.4	23.4	25.3	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Fibra cortada	-	0.1	0.1	-	-	-	-	-	-
Hilos e hilados	0.9	1.4	0.7	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	0.9	1.5	0.8	-	-	-	-	-	-
Importaciones: Fibra cortada	0.2	0.1	0.1	-	-	-	0.1	-	-
Hilos e hilados	0.1	0.1	0.1	-	-	-	0.1	0.1	0.1
Tejidos	0.4	-	-	0.2	0.4	0.3	0.1	0.1	0.2
Otras manufacturas	0.1	0.1	0.1	-	-	-	-	-	-
Total	0.8	0.3	0.3	0.2	0.4	0.3	0.3	0.2	0.3
Balance del comercio exterior	- 0.1	- 1.2	- 0.5	+ 0.2	+ 0.4	+ 0.3	+ 0.3	+ 0.2	+ 0.3
Disponible para el consumo interior	21.3	22.2	24.8	0.2	0.4	0.3	0.3	*0.4	0.3
FIBRAS SINTETICAS (NO CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	-	-	-
Fibra continua	1.59	3.27	3.99	-	-	-	-	-	-
Total	1.59	3.27	3.99	-	-	-	-	-	-
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	0.48	0.52	0.84	-	-	-	-	-	-
Hilos e hilados	2.71	3.25	1.21	-	-	-	-	-	-
Tejidos	0.03	0.02	0.05	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	3.22	3.79	2.10	-	-	-	-	-	-
Balance del comercio exterior	+ 3.22	+ 3.79	+ 2.10	-	-	-	-	-	-
Disponible para el consumo interior	4.81	7.06	6.09	-	-	-	-	-	-
TODA CLASE DE FIBRAS: Disponibilidades para el consumo interior	134.8	142.6	151.3	0.7	1.2	1.3	3.7	4.2	4.8
POBLACION (millones)	36.09	37.23	38.42	0.19	0.20	0.20	1.53	1.58	1.54
DISPONIBILIDADES POR HABITANTE (kg.)									
Toda clase de fibras	3.7	3.8	3.9	3.7	6.0	7.0	2.5	2.7	3.2
Algodón	2.8	2.8	2.9	2.6	3.5	4.5	2.2	2.3	2.9
Lana	0.2	0.2	0.2	-	0.5	0.5	0.1	0.1	0.1
Fibras artificiales (celulósicas)	0.6	0.6	0.6	1.1	2.0	2.0	0.2	0.3	0.2
Fibras sintéticas (no celulósicas)	0.13	0.19	0.16	-	-	-	-	-	-

ARTICULO / PAIS O REGION	PANAMA 1961	PANAMA 1962	PANAMA 1963	PARAGUAY 1961	PARAGUAY 1962	PARAGUAY 1963	PERU 1961	PERU 1962	PERU 1963
	(..... Miles de toneladas métricas .....)								
ALGODON									
Consumo industrial	-	-	-	3.3	3.3	3.3	17.4	19.5	18.3
Comercio exterior									
Exportaciones: Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Hilados	0.1	0.1	...	0.1	-	-	-	-	-
Tejidos	1.6	1.9	...	0.9	1.0	0.8	0.7	0.6	...
Otras manufacturas	0.3	0.3	...	0.2	0.1	-	0.1	0.1	...
Total	2.0	2.3	2.3	1.2	1.1	0.8	0.8	0.7	0.7
Balance del comercio exterior	+ 2.0	+ 2.3	+ 2.3	+ 1.2	+ 1.1	+ 0.8	+ 0.8	+ 0.7	+ 0.7
Disponible para el consumo interior	2.0	2.3	2.3	4.5	4.4	4.1	18.2	20.2	19.0
LANA									
Consumo industrial de lana virgen (base limpia)	-	-	-	-	-	-	5.2	4.8	4.6
Comercio exterior									
Exportaciones: Peinados	-	-	-	-	-	-	0.1	0.1	...
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	0.1	...
Total	-	-	-	-	-	-	0.1	0.2	0.2
Importaciones: Peinados	-	-	-	0.2	0.2	...	0.1	0.1	...
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	...	...	-	-	-	0.1	0.1	...
Otras manufacturas	0.1	...	...	-	-	-	-	0.1	...
Total	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3
Balance del comercio exterior	+ 0.1	+ 0.1	+ 0.1	+ 0.2	+ 0.2	+ 0.2	+ 0.1	+ 0.1	+ 0.1
Disponible para el consumo interior	0.1	0.1	0.1	0.2	0.2	0.2	5.3	4.9	4.7
FIBRAS ARTIFICIALES (CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	-	-	-
Fibra continua	-	-	-	-	-	-	1.1	1.2	1.3
Total	-	-	-	-	-	-	1.1	1.2	1.3
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	-	-	-	-	-	-	2.9	2.9	3.4
Hilos e hilados	-	-	-	-	-	-	-	0.4	0.5
Tejidos	0.9	1.0	...	*0.4	*0.5	...	-	-	-
Otras manufacturas	0.1	0.1	...	-	-	-	-	-	-
Total	1.0	1.1	1.1	0.4	0.5	0.5	2.9	3.3	3.9
Balance del comercio exterior	+ 1.0	+ 1.1	+ 1.1	+ 0.4	+ 0.5	+ 0.5	+ 2.9	+ 3.3	+ 3.9
Disponible para el consumo interior	1.0	1.1	1.1	0.4	0.5	0.5	4.0	4.5	5.2
FIBRAS SINTETICAS (NO CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	-	-	-
Fibra continua	-	-	-	-	-	-	0.05	0.14	0.32
Total	-	-	-	-	-	-	0.05	0.14	0.32
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	-	-	-	-	-	-	0.77	0.86	1.23
Hilos e hilados	-	-	-	-	-	-	0.54	1.04	1.04
Tejidos	-	-	-	-	-	-	0.06	0.15	0.19
Otras manufacturas	-	-	-	-	-	-	0.08	0.21	0.35
Total	-	-	-	-	-	-	1.45	2.26	2.81
Balance del comercio exterior	-	-	-	-	-	-	+ 1.45	+ 2.26	+ 2.81
Disponible para el consumo interior	-	-	-	-	-	-	1.50	2.40	3.13
TODA CLASE DE FIBRAS: Disponibilidades para el consumo interior	3.1	3.5	3.5	5.1	5.1	4.8	29.0	30.8	30.7
POBLACION (millones)	1.11	1.14	1.18	1.81	1.86	1.90	10.42	11.51	*11.85
DISPONIBILIDADES POR HABITANTE (kg.)									
Toda clase de fibras	2.9	3.1	3.1	2.8	2.7	2.5	2.8	2.7	2.6
Algodón	1.8	2.0	2.0	2.5	2.4	2.2	1.7	1.7	1.6
Lana	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.4	0.4
Fibras artificiales (celulósicas)	1.0	1.0	1.0	0.2	0.2	0.2	0.4	0.4	0.4
Fibras sintéticas (no celulósicas)	-	-	-	-	-	-	0.14	0.21	0.26

AMERICA LATINA (continuación)

ARTICULO / PAIS O REGION	SURINAM 1961	SURINAM 1962	SURINAM 1963	URUGUAY 1961	URUGUAY 1962	URUGUAY 1963	VENEZUELA 1961	VENEZUELA 1962	VENEZUELA 1963
	(Miles de toneladas métricas)								
ALGODON									
Consumo industrial	-	-	-	6.7	5.4	5.8	10.1	11.5	13.2
Comercio exterior									
Exportaciones: Hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Hilados	-	-	-	0.1	0.1	...	0.8	0.9	1.0
Tejidos	0.7	0.7	0.8	-	-	...	2.3	2.1	1.5
Otras manufacturas	0.1	0.1	0.1	0.1	0.1	...	3.3	3.0	2.1
Total	0.8	0.8	0.9	0.2	0.2	0.2	6.4	6.0	4.6
Balance del comercio exterior	+ 0.8	+ 0.8	+ 0.9	+ 0.2	+ 0.2	+ 0.2	+ 6.4	+ 6.0	+ 4.6
Disponible para el consumo interior	0.8	0.8	0.9	6.9	5.6	6.0	16.5	17.5	17.8
LANA									
Consumo industrial de lana virgen (base limpia)	-	-	-	20.0	18.6	20.9	-	-	-
Comercio exterior									
Exportaciones: Peinados	-	-	-	12.1	10.5	12.0	-	-	-
Blusas y desperdicios	-	-	-	1.8	1.8	3.3	-	-	-
Hilados	-	-	-	0.4	0.6	0.5	-	-	-
Tejidos	-	-	-	0.2	0.2	0.1	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	14.5	13.1	15.9	-	-	-
Importaciones: Peinados	-	-	-	-	-	-	-	-	-
Blusas y desperdicios	-	-	-	-	-	-	-	-	-
Hilados	-	-	-	-	-	-	0.4	1.3	1.5
Tejidos	-	-	-	-	-	-	0.9	0.2	0.2
Otras manufacturas	-	-	-	-	-	-	0.1	0.1	0.1
Total	-	-	-	-	-	-	1.4	1.6	1.8
Balance del comercio exterior	-	-	-	- 14.5	- 13.1	- 15.9	+ 1.4	+ 1.6	+ 1.8
Disponible para el consumo interior	-	-	-	5.5	5.5	5.0	1.4	1.6	1.8
FIBRAS ARTIFICIALES (CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	0.4	0.3	0.2
Fibra continua	-	-	-	0.6	0.5	0.6	2.7	2.7	2.5
Total	-	-	-	0.6	0.5	0.6	3.1	3.0	2.7
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	-	-	-	1.8	1.4	1.6	1.9	3.6	3.6
Hilos e hilados	-	-	-	0.5	0.2	0.1	1.2	0.3	0.2
Tejidos	*0.4	...	...	0.4	...	...	2.0	2.2	1.9
Otras manufacturas	-	-	-	0.4	...	...	0.3	0.2	0.2
Total	0.4	0.4	0.4	3.1	2.4	2.4	5.4	6.3	5.9
Balance del comercio exterior	+ 0.4	+ 0.4	+ 0.4	+ 3.1	+ 2.4	+ 2.4	+ 5.4	+ 6.3	+ 5.9
Disponible para el consumo interior	0.4	0.4	0.4	3.7	2.9	3.0	8.5	9.3	8.6
FIBRAS SINTETICAS (NO CELULOSICAS)									
Producción:									
Fibra cortada	-	-	-	-	-	-	-	-	-
Fibra continua	-	-	-	0.22	0.27	0.41	0.27	0.32	0.50
Total	-	-	-	0.22	0.27	0.41	0.27	0.32	0.50
Comercio exterior									
Exportaciones: Fibra cortada	-	-	-	-	-	-	-	-	-
Hilos e hilados	-	-	-	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	-
Importaciones: Fibra cortada	-	-	-	0.14	0.27	0.41	0.87	0.99	1.04
Hilos e hilados	-	-	0.01	0.68	0.36	0.18	1.07	1.65	1.41
Tejidos	-	-	-	-	-	-	-	-	-
Otras manufacturas	-	0.03	0.04	-	-	-	-	-	-
Total	-	0.03	0.05	0.82	0.63	0.59	1.94	2.64	2.45
Balance del comercio exterior	-	+ 0.03	+ 0.05	+ 0.82	+ 0.63	+ 0.59	+ 1.94	+ 2.64	+ 2.45
Disponible para el consumo interior	-	0.03	0.05	1.04	0.90	1.00	2.21	2.96	2.95
TODA CLASE DE FIBRAS: Disponibilidades para el consumo interior	1.2	1.2	1.4	17.1	14.9	15.0	28.6	31.5	31.2
POBLACION (millones)	0.28	0.31	0.36	2.87	2.91	2.95	7.59	7.87	8.15
DISPONIBILIDADES POR HABITANTE (kg.)									
Toda clase de fibras	4.3	3.9	3.6	6.0	5.1	5.1	3.8	4.0	3.9
Algodón	2.9	2.6	2.5	2.4	1.9	2.0	2.2	2.2	2.2
Lana	-	-	-	1.9	1.9	1.7	0.2	0.2	0.2
Fibras artificiales (celulósicas)	1.4	1.3	1.1	1.3	1.0	1.0	1.1	1.2	1.1
Fibras sintéticas (no celulósicas)	-	0.01	0.01	0.36	0.31	0.35	0.29	0.38	0.36

AMERICA LATINA (conclusión)

ARTICULO / PAIS O REGION	INDIAS OCCIDENTALES 6/			TOTAL AMERICA LATINA 7/		
	1961	1962	1963	1961	1962	1963
	(..................		Miles de toneladas métricas		....	)
ALGODON						
Consumo industrial	2.2	2.2	2.2	643.6	633.1	638.7
Comercio exterior						
Exportaciones: Hilados	-	-	-	5.0	4.5	4.7
Tejidos	0.2	0.2	0.2	5.2	5.2	6.0
Otras manufacturas	-	-	-	0.4	0.1	-
Total	0.2	0.2	0.2	10.6	9.8	10.7
Importaciones: Hilados	0.3	0.4	0.5	5.4	5.4	5.6
Tejidos	6.1	6.9	6.4	30.8	35.3	31.6
Otras manufacturas	0.6	0.6	0.6	6.9	9.4	9.0
Total	7.0	7.9	7.5	43.1	50.1	46.2
Balance del comercio exterior	+ 6.8	+ 7.7	+ 7.3	+ 32.5	+ 40.3	+ 35.5
Disponible para el consumo interior	8.9	9.9	9.5	676.1	673.4	674.2
LANA						
Consumo industrial de lana virgen (base limpia)	-	-	-	81.0	73.1	70.7
Comercio exterior						
Exportaciones: Peinados	-	-	-	13.6	12.8	16.9
Blusas y desperdicios	-	-	-	5.8	6.1	5.7
Hilados	-	-	-	0.4	0.7	1.2
Tejidos	-	-	-	0.1	0.2	0.3
Otras manufacturas	-	-	-	-	0.1	0.1
Total	-	-	-	19.9	19.9	24.2
Importaciones: Peinados	-	-	-	3.8	2.0	1.8
Blusas y desperdicios	0.1	0.1	0.1	0.1	0.2	0.2
Hilados	-	-	-	0.8	1.8	2.0
Tejidos	0.4	0.5	0.5	2.9	1.8	1.8
Otras manufacturas	0.1	0.1	0.1	0.5	0.8	0.8
Total	0.6	0.7	0.7	8.1	6.6	6.6
Balance del comercio exterior	+ 0.6	+ 0.7	+ 0.7	- 11.8	- 13.3	- 17.6
Disponible para el consumo interior	0.6	0.7	0.7	69.2	59.8	53.1
FIBRAS ARTIFICIALES (CELULOSICAS)						
Producción:						
Fibra cortada	-	-	-	31.8	30.6	32.8
Fibra continua	-	-	-	68.7	66.7	64.5
Total	-	-	-	100.5	97.3	97.3
Comercio exterior						
Exportaciones: Fibra cortada	-	-	-	1.7	2.3	2.4
Hilos e hilados	-	-	-	1.7	2.2	1.4
Tejidos	0.1	0.2	0.2	0.1	0.2	0.2
Otras manufacturas	-	-	-	-	-	-
Total	0.2	0.2	0.2	3.5	4.7	4.0
Importaciones: Fibra cortada	-	-	-	8.0	9.4	11.2
Hilos e hilados	0.1	0.1	0.1	9.7	8.7	6.1
Tejidos	4.1	4.7	5.4	16.4	17.1	17.2
Otras manufacturas	0.2	0.3	0.3	2.2	3.0	2.7
Total	4.5	5.1	5.8	36.3	38.2	37.2
Balance del comercio exterior	+ 4.3	+ 4.9	+ 5.6	+ 32.8	+ 33.5	+ 33.2
Disponible para el consumo interior	4.3	4.9	5.6	133.3	130.8	130.5
FIBRAS SINTETICAS (NO CELULOSICAS)						
Producción:						
Fibra cortada	-	-	-	0.68	1.91	3.13
Fibra continua	-	-	-	9.66	14.16	18.23
Total	-	-	-	10.34	16.07	21.36
Comercio exterior						
Exportaciones: Fibra cortada	-	-	-	0.06	0.06	0.06
Hilos e hilados	-	-	-	-	-	-
Tejidos	-	-	-	-	-	-
Otras manufacturas	-	-	-	-	-	-
Total	-	-	-	0.06	0.06	0.06
Importaciones: Fibra cortada	-	-	-	3.48	3.51	5.19
Hilos e hilados	0.02	0.04	0.05	9.40	10.28	7.58
Tejidos	0.20	0.26	0.31	1.07	1.42	1.64
Otras manufacturas	0.06	0.08	0.10	0.31	0.50	0.59
Total	0.28	0.38	0.46	14.26	15.71	15.00
Balance del comercio exterior	+ 0.28	+ 0.38	+ 0.46	+ 14.20	+ 15.65	+ 14.04
Disponible para el consumo interior	0.28	0.32	0.46	24.54	31.72	35.40
TODA CLASE DE FIBRAS: Disponibilidades para el consumo interior	14.1	15.6	16.3	903.1	895.7	893.2
POBLACION (millones)	4.03	4.10	*4.15	214.71	221.44	226.01
DISPONIBILIDADES POR HABITANTE (kg.)						
Toda clase de fibras	3.5	3.8	3.9	4.1	4.2	4.0
Algodón	2.2	2.4	2.3	3.1	3.1	3.0
Lana	0.1	0.2	0.2	0.3	0.3	0.2
Fibras artificiales (celulósicas)	1.1	1.2	1.3	0.6	0.6	0.6
Fibras sintéticas (no celulósicas)	0.07	0.08	0.11	0.11	0.15	0.16