OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

30602

6

04873

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

Distr.
RESTRICTED

UNIDO/ITD.211
29 August 1973

ENGLISH

FINAL REPORT

FEASIBILITY STUDY FOR A NEW GROUNDNUTS PROCESSING FACTORY INCLUDING PACKAGING 1/

by

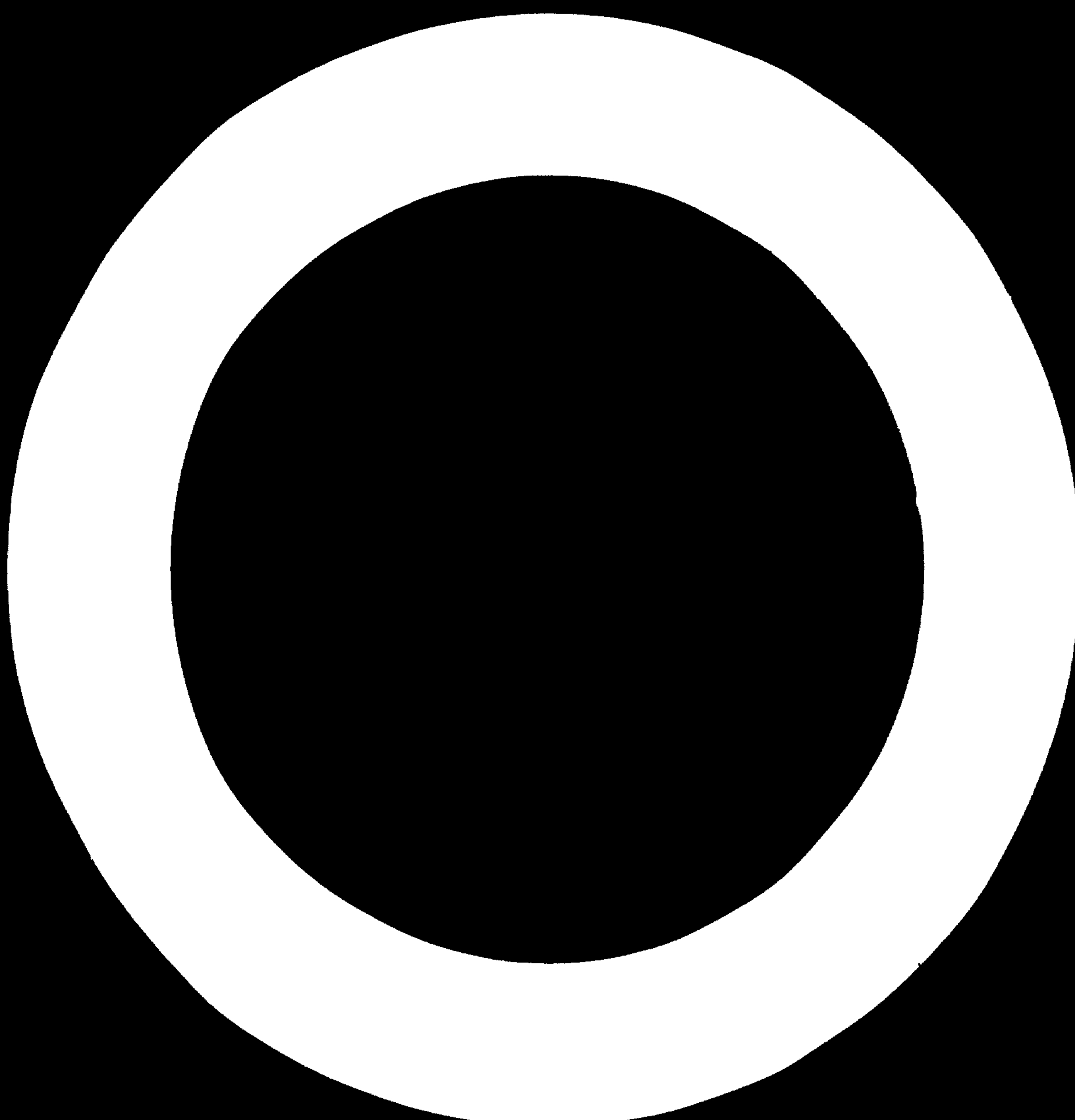
Iván Varsányi
UNIDO Expert

(IS/EGY/71/827)

1/ The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO. This document has been reproduced without formal editing.

id.73-5956

We regret that some of the pages in the microfic
copy of this report may not be up to the proper
legibility standards even though the best possible
copy was used for preparing the master fiche



LIST OF CONTENTS

Page

SUMMARY

The United Nations Industrial Development Organization (UNIDO) was asked by the Egyptian Government to assist in the elaboration of a feasibility study directed towards increasing the country's potential in the groundnuts sector. At present some 11-15 thousand tons of shelled and unshelled groundnuts are exported by the State in 30-50 kg jute bags. The export potential of this item could be increased considerably if further to traditional forms of export, a new processing line were to be set up including packaging units to meet the requirements of the foreign markets. This would stop the drain on the State's budgetary resources and offer considerable export revenue.

The first steps towards an up-to-date processing factory were taken when investments were made in a new decorticating plant. Although the new plant will have an effect upon budget structure, the benefit to the State will not be appreciable.

Investigation of foreign market requirements showed that there was a good market (Table 1 and Table 2) for a roasted, salted, glazed product in appropriate packaging (50-2500 g units) as there is an increasing trend towards that kind of product.

In view of the current demand abroad, it is proposed to increase present processing methods (Figure 1) to include a new processing factory as well as a packaging plant to process and pack some 5,000 tons of unshelled groundnuts which are currently exported.

The proposed factory would have two sectors; the processing and the packaging plants. The processing plant would have two similar lines, capacity 1 ton/hour each, for pre-roasting, cooling, blanching, end-roasting (frying), cooling, glazing and salting (in one unit) of the raw groundnut (Figure 3) kernels. The flow chart of the projected processing plant is shown in Figure 2.

The estimated costs of the proposed equipment and ancillaries are listed in Tables 5 (imported machinery), 7 (domestic machinery) and

and 9. The fixed capital is estimated at £E [illegible],000. The estimated quantity of raw materials, supplies and utilities are listed in Table 15. The estimated annual operational costs are presented in Table 16, the estimated prime cost of 1 ton processed groundnuts being £E 224.

Two alternative packaging plants are presented. One has three different lines, with three packaging units (with vacuum, without vacuum and in aluminium containers. The other has two lines, with six identical vacuum-packing units.

The first alternative has three packaging lines for large-scale diversified packing operations. The first line comprises bagging, filling and sealing equipment for 100-2,500 g units, using polyethylene and or coated cellophane packaging material. The shelf-life of the packed products is limited to three months, depending on storage conditions.

The second line works under vacuum throughout the filling and sealing process, producing bags (Figure 4) for 50-500 g units. The projected packaging materials are coated cellophane for limited shelf-life, about six months, and laminated aluminium foil (lacquered and printed cellophane + alu-foil + polyethylene) for unlimited shelf-life, i.e. more than one year. All the vacuum-packed products will be packed in three-colour printed carton boxes as the tight seal given by vacuum-packing lacks appeal.

The third line is a forming, filling, and sealing unit producing 110-250 g flat, round containers, using heat-sealable lacquered aluminium foil for unlimited shelf-life (Figure 6). All the packages would be packed for transportation purposes in water-proof corrugated cardboard boxes holding some 30 kg.

The flow chart of the packaging lines is presented in Figure 3, the estimated fixed capital totalling £E 75,000 being shown in Tables 6 and 9.

Table 17 gives further details about the estimated raw materials and utilities for the packaging plant. The estimated operational and packaging costs are presented in Table 18 in relation to 100 tons packed goods, which is deemed a viable production figure. The estimated annual operational costs are £E 48,000 not including packaging materials.

The second alternative comprises six identical units producing 50-150 g bags of groundnuts which are subsequently vacuum-sealed. The shelf life is unlimited. The projected packaging materials are PVC coated cellophane and laminated aluminium foil, the vacuum packed goods being packed in multi-coloured cardboard boxes. The estimated quantity of packaging materials and utilities are shown in Table [illegible], the flow chart of this packaging plant being given in Figure [illegible].

The estimated fixed capital (machinery) is [illegible] 101,000, presented in Table 21, the estimated operational costs being [illegible] year (Table [illegible]) without packaging materials. The estimated annual operational costs in Table 24 relate to the expenses incurred in the production of 100 tons of variously packed processed products and provide a basis for calculating the expected profit on vacuum packed goods.

The estimated costs of buildings and ancillaries for both the processing and packaging plant are listed in Tables 10 and 11. The costs of buildings are £E 1[illegible],000, however, linking them with the new decorticating factory would cost only £E 21,000.

To ensure a high quality product, both the processing and packaging lines are almost fully automatic. The requisite labour force is low, but must be highly skilled. The estimated labour force, including administration and associate staff, comprises [illegible] persons working in two shifts per day (Table 12). A quality control laboratory in the factory will check the quality of the products during and after processing as well as the raw material used. If necessary, the technological parameters of the units can be changed. This would seem to offer sufficient guarantee that the products and their packaging meet international standards.

As for the profitability of the packaging plant, the estimated profits of both alternatives have been calculated for in Tables 30 (three different units) and 25 (six identical units). Whereas the three different units offer greater variability, the six identical units offer an estimated average profit of about £E 500 per ton as against £E 270/ton.

The cash flow analysis (Table 28) also shows a good picture as the envisaged income of the processing and vacuum-packing plant is more than £E 1,800,000 per year, the fixed capital being £E 300,000. Fresh capital starts accruing in the third year of operation. By investing the latter in the new decorticating factory producing the raw groundnuts it would be possible to save about 25% of the fixed capital and 3% of the working capital.

Thus, the establishment of a groundnuts roasting, salting and vacuum packing factory would provide a source of considerable profit to the State.

CHAPTER 1: INTRODUCTION

In Egypt at present, some 30,000 tons of groundnuts are harvested annually in the season August-October, of which some 6-8,000 tons go to private traders on the home market and some 22-24,000 tons are bought by State exporters. Of the latter 22-24,000 tons, 7-10,000 tons are exported unshelled, 4-5,000 tons shelled, and the remainder is used for oil.

Shelled nuts are exported in 30 kg jute sacks, the unshelled nuts in 50 kg sacks. Groundnuts packed in bulk fetch a very low price on the world market, to such an extent that during the last five years the State has subsidized each ton of groundnuts sold abroad to the order of £ 55 per ton.

The first steps were taken to reduce this sum, when last year the Nile Co., the Egyptian General Foreign Trade Organization, bought modern, automatic equipment from the USA capable of cleaning, sorting, decorticating, grading and packing the nuts in jute sacks. The processing capacity of this plant is 12 tons/raw material per hour.

Consequently, the Egyptian Government sought UNIDO's assistance in establishing a new processing line, including consumer packaging, thus promoting exports. The UNIDO expert was thus commissioned to elaborate a feasibility study for the processing and packaging of groundnuts, to establish the investment needed and to identify the economic level of production from the standpoint of the finished product's competitiveness.

The expert's task was thus directed towards establishing on the basis of the present situation the most convenient and most economic processing and packaging method which would permit the sale of the groundnuts on the world market at a fair price.

The expert was greatly assisted in his assignment by the different sections of the Egyptian General Foreign Trade Organization, as well as by those of the Ministry of Industry, and he is greatly indebted to them.

CHAPTER II: PRESENT SITUATION

2. The following chapter describes the quantity and the quality of raw materials, processing methods, and marketing in relation to domestic and export sales.

2.1 Raw materials

This section describes the quality and quantity of the groundnuts produced as well as the available packaging materials suitable for packing groundnuts, with an indication of prices.

2.1.1. Groundnuts

Some 40,000 feddan are under cultivation, planted with Virginia groundnuts, the average harvest being 30,000 tons a year harvested from August to November. The State trading and collecting organisations buy up about 22,000 tons at a fixed price of £I 100 per ton, irrespective of the quality of the groundnuts.

The collected groundnuts are then sorted into three categories: unshelled (for export), shelled (for export) and for oil extraction. The high-grade nuts are exported directly, unshelled. Table 1 below shows grading standards.

TABLE 1

Export grading standards for unshelled groundnuts

Grades	Nuts per 100 g	% of splits and cracks	Maxi-% of kernels	% of foreign bodies
1	41 - 44	1 - 2.5	2	0
2	45 - 50	1 - 3	5	0

Any spotted or flecked gr[illegible] are [illegible] shelled. Table 2 below shows grading standards.

Table [illegible]

Export grading standards for [illegible]
(Packed in [illegible], [illegible] kg)

Grades	Nuts per [illegible]	Maximum broken [illegible]	[illegible]
1	11[illegible] - [illegible]	[illegible]	[illegible]
[illegible]	127 - 140	[illegible]	[illegible]
3	141 [illegible]	[illegible]	[illegible]
4	161 - [illegible]	[illegible]	[illegible]
5	181 [illegible]	[illegible]	[illegible]

Sub-standard nuts are used for [illegible].

The oil content of the kernels is [illegible] and there is no trace of aflatoxin. Relevant literature ([illegible], 19) explains that the fungus, Aspergillus Flavus, which produces aflatoxin, cannot develop if harvesting, drying and storage conditions are warm and dry. Since the average relative humidity during harvesting in the region is below [illegible] and below [illegible] in the processing plant, the fungus cannot develop.

Unshelled groundnuts have a maximum shelf life of eight months, and shelled groundnuts only two-four months, depending on storage conditions (see literature 7, 15, 19). These values were also confirmed by the factory, following experiments in a covered storage facility (two open sides) in Alexandria, where the average minimum temperature was 15.[illegible]°C, the maximum 25.0[illegible]°C and the average relative humidity 6[illegible]. The climatic conditions of Alexandria are presented in Table 3.

Table [illegible]

[illegible] of Alexandria

(The data were provided by the [illegible] Dept. [illegible])

	Recorded period	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
Average max. air temperature in C°	1942-70	18.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Average min. air temperature in C°	1942-70	9.1	[illegible]	11.2	[illegible]	[illegible]	20.2	[illegible]	22.9	21.2	[illegible]	14.6	10.8	[illegible]
Average relative humidity in %	1945-70	70	67	65	65	[illegible]	70	72	71	68	70	[illegible]	70	[illegible]

2.1.2. Packaging materials

This section describes the packaging materials available for both the consumer and transportation packaging, and their implications with regard to the shelf-life of the packed product.

2.1.2.1. Polyethylene

As polyethylene granulate is not produced in Egypt, it has to be imported from various foreign countries. Local processing plants using blow-moulding methods make film, foil and sheet from the low-density granulate ($0.91 - 0.92$ g/cm^3).

The total processing capacity (estimated) of 15,000 tons per year is concentrated in three firms: Merta Factory/Alexandria, the Egyptian Plastic Co./Alexandria and the National Plastic Co./Cairo. They also have modern high-capacity equipment producing polyethylene sachets and bags. However, as they are operating at less than 60% capacity there is adequate scope for the production of packaging materials for the processed groundnuts.

The processing system is also suitable for the production of two-tone printed pouches. There are two possibilities: a fully automatic printing, sealing and cutting unit, or two units, one for printing and the other for making the bags.

The bags vary in size between 10-55 cm and in thickness between 0,002-0.02 cm, the accuracy being ± 5%. Three-colour printing is possible, the inks being manufactured locally.

Three-colour, printed pouches (19 x 26 cm and 0.005 cm thick) capable of holding 250 g of groundnuts cost about £E 6.2 per 1,000. Single-colour printed bags (22 x 45 cm, and 0.008 cm thick) to hold 2500 g of groundnuts cost about £E [illegible] per 1,000.

At present laminated aluminium foil (with polyethylene) packaging materials which would be suitable for unlimited shelf-life storage, are not produced. Plans have been made to establish a production plant, but have since been postponed indefinitely.

2.1.2.2 Moisture-proof cellophane

One plant, Misr Rayon Co., manufactures regenerated cellulose (cellophane) foil. The capacity of the factory is 9 tons/day for uncoloured and coloured anchor materials, however, the capacity of the coating line which is used to manufacture moisture-proof and or heat-sealable coating on one or both sides is only 5 tons/day.

The following products are manufactured: anchor material (30 g/m2, 40 g/m2, and 60 g/m2) and material coated on both sides (35 g/m2, 45 g/m2, and 70 g/m2), the latter being available in plain or five different colours.

Available sizes are 90 cm, 110 cm and 125 cm (rolls), and 80 x 125 cm (sheet). The rolls can, of course, be split at £E 0.01 a time. Printing, however, has to be done at the Verta plant as Misr Rayon do not have any printing equipment.

Rolls of plain, double-coated 70 g/m2 quality cellophane cost £E 0.82 per kg. Thus, three-colour pouches, 10 x 20 cm holding 100 g groundnuts, for use on the home market, cost £E 3.3 per 1,000 pieces.

Flat and twisted tapes are also produced. The factory has new and modern equipment, including quality control instruments, however, owing to the fact that the coating line is working at full capacity, no further orders can be accepted. However, plans have been made to enlarge coating capacity using polyvinylidenechloride emulsions as well. Thus, locally produced packaging material could be used for export packaging, and a local base could be set up serving the food industry at large.

2.2.3. Tin cans

The present annual tin can production capacity is 30,000 tons, of which the public sector consumes some 15,000 tons. The raw material is imported in sheet form; 10 per cent of sheets used are printed locally.

Production capacity is full, with 5 per cent fluctuations, i.e. 12.5 million tin cans (average cubic content 350 cm3) a year. This latent capacity meets the groundnuts packaging requirements, which would seem to be no more than 1 million tin cans a year.

Tin cans suitable for vacuum packing of 250 g groundnuts (diameter 7 cm, height 10 cm) sell at £E 25 per 1,000. Furthermore, three-colour printed sleeves cost £E [illegible] per 1,000 or surface treated £E 3.0 per 1,000. Five-colour printed sleeves cost £E [illegible].75 per 1,000 or surface treated £E 3.15 per 1,000 (the sleeves measure 10 x 26 cm).

Five-colour printed tin cans (tin lithography) cost £E 58 per 1,000 and three-colour cans £E 41 per 1,000.

2.2.4 Cardboard boxes

The Moharrem Press Factory of Alexandria manufactures cardboard boxes suitable for the packing and transportation of consumer goods according to international standards. It would be the most economic to pack in [illegible] kg units, the boxes measuring 40 x 40 x 30 cm. The Moharrem Press Factory has the capacity and adequate imported raw material to produce the requisite corrugated cardboard boxes. The latter also can be surface treated with silicone oil if necessary.

The corrugated cardboard would be transported in sheet form from the factory to the users where it would be folded and fixed using staples and water-glass glue. The boxes would be closed in the same manner.

Corrugated cardboard boxes made of double board and treated, which are suitable for export purposes, cost £E 280 per 1,000. Single-board untreated boxes costing £E 150 per 1,000 are suitable for the domestic market.

The sachets of vacuum-packed groundnuts could be individually packed in three-colour printed carton boxes ([illegible] g m^2 carton paper measuring 10 x 14 x 3 cm) which cost £E 3.2 per 1,000. The smaller sachets could be packed in boxes measuring 6.5 x 9.5 x 2 cm which cost about £E 2.0 per 1,000. The factory in question is capable of meeting such requirements.

2.2 Processing methods

Current processing methods, primary processing costs, as well as packaging costs were investigated in relation to the export and domestic markets.

2.2.1. Processing groundnuts for the export market

After their purchase, the groundnuts are transported from various parts of the country to the temporary storage facility at the processing factory, where they are stored in jute sacks and grouped according to the five harvest areas

Manual labour is used to move the groundnuts to the sorting area where they are sorted by hand, into three categories: export (unshelled), decortication and oil extraction.

2.2.1.1. Unshelled

The groundnuts are sorted and graded according to the standards in Table 1, whereafter they are packed in jute bags, weighed (in 30 kg units) and the bags are sewn. All these operations are manual.

The basic cost of the groundnuts thus packed is £F 150 per ton, including the price of the jute sack (£' 0.25 for 33) and packaging, about £E 0.75 per ton.

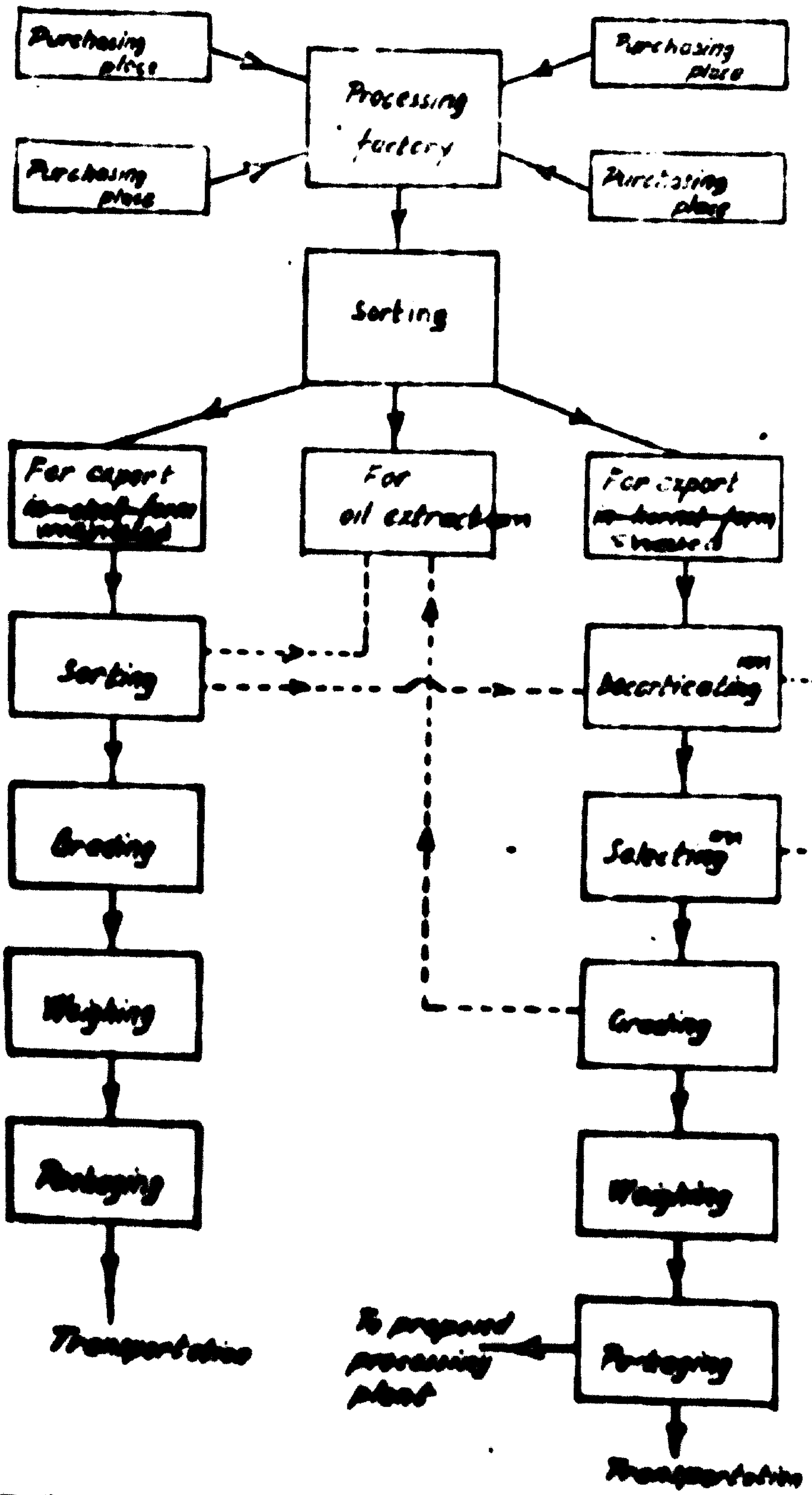
The flow sheet of the above process is presented below in Figure 1.

Upon harvest the groundnuts are brought to the various State purchasing stations, whence they are transported to the processing factory for sorting and decorticating. As can be seen, the ratio of decorticated and non-decorticated nuts can be easily changed according to export market requirements.

2.2.1.2. Shelled

The groundnuts destined for decortication are also sent to the factory in jute bags. The nuts are mechanically decorticated prior to

FIGURE 1: Flow sheet of [illegible]



selection and grading. Selection is a manual operation, as is grading, for the most part. Broken or sub-standard kernels are used for oil extraction, the graded kernels being packed in 50 kg jute sacks. Packaging, weighing and sewing are done by hand.

The two factories presently in operation are old and their obsolete methods of operation also constitute a health hazard. Thus, the Egyptian General Foreign Trade Organization decided to establish a new plant with a capacity of 1[illegible] tons/hour (raw materials), where the processing and the handling of the material will be fully automatic.

All the constructing and building plans have been completed. The machines and equipment have arrived from the USA. The building site has been selected and construction starts this year; the factory will start operations in the 19[illegible] season. The new factory site is next to the storage area, there being enough room for expansion inside and outside the new building.

Packed kernels presently cost £E 1[illegible]5 per ton. This sum includes the cost of packaging, the sacks costing £[illegible] 44 per 20, and handling, about £[illegible] 0.6 per ton.

2.2.2. Processing groundnuts for the domestic market

Of the harvested groundnuts, some 8,000 tons go to the home market to be sold by about 3,500-4,000 shopkeepers throughout the country. Of the 8,000 tons, about 2,000 tons are sold unprocessed, the other 6,000 tons being roasted in the shell or roasted and salted after decortication. The raw material is transported in returnable 50 kg jute sacks.

Roasting is usually done on open stoves by hand; some 10% of the roasters have some kind of gas-fired roasting equipment.

The salting process follows immediately after roasting. The hot kernels are sprayed with a solution of salt (10% concentration). The red skins of the kernels are not removed, so weight is gained by this process.

Smaller quantities of groundnuts are sold unweighed, simply being put in paper bags holding about 100 g groundnuts, the price of packaging material being about £E 1.? per 1,000.

2.3 Marketing of groundnuts

The marketing of groundnuts on both the domestic and export markets was studied in order to assess selling prices and profit margins.

2.3.1. Export market

Of the 22,000 tons of groundnuts purchased yearly by the State, 10,000 tons are exported unshelled in 50 kg jute bags. Premium prices on the European market are £E 185 per ton. The average price during the last two years (1968-72) was £E 135 per ton. There is an upward trend at present, the best price last season being £E 180 per ton.

The factories shell about 5,000 tons yearly for export in 50 kg jute sacks. Premium prices on the European market were on an average £E 190 per ton. The average price during the last five years was £E 130 per ton. Here too, an upward trend is evident, the best prices this year being £E 181.5 per ton for grades 1 and 2, and £E 171.5 per ton for grades 3 and 4 (see Table 2).

The experience of the last five years has shown that selling groundnuts in bulk is not profitable, as the State has to subsidise export sales at the rate of £E 55 per ton. This figure is expected to drop to zero when the new factory starts up in 1974; but the profit to the State will not be significant.

At present, no groundnuts of any kind are sold in consumer packages on the export market.

2.3.2. Domestic market

Of the 8,000 tons of groundnuts sold locally by the shopkeepers, some 2,000 tons are unprocessed, the price being £E 140-180 per ton.

About 2,000 tons are roasted unshelled, the price being £E 200-240 per ton. The remaining 4,000 tons are either roasted or roasted and salted, there being no great difference in price. The price for large kernels is £E 320-360 per ton, for medium kernels £E 280-320 per ton, and for small kernels £E [illegible] per ton.

All prices depend upon the size of the kernels and on the location of the shop. The nuts are wrapped in paper bags most of which are locally produced from different kinds of paper.

2.4 Export market requirements

Export market requirements were studied from a variety of angles as to the type of processed groundnuts, the shelf-life of packed products and the packages used.

2.4.1. Preferred type of processed groundnuts

On studying export market requirements, it became clear that the most preferred type of groundnuts was the salted and roasted product. Quality-wise, tastes differ: some countries prefer small kernels (grades 4 and 5), and others larger kernels (grades 1 and 2), the basic factor being that the kernels are whole and of standard quality.

2.4.2. Shelf-life requirements

Export markets require products with both a shorter, limited shelf-life (1-6 months) and a longer, unlimited shelf-life (12 months or more). The selling price and packaging price are very closely related, as are packaging material used and the shelf-life obtained.

The packaging material for limited shelf-life is usually cheaper: transparent wrap in one or three colours, which is preferred by smaller shops with reduced stocks. The packaging material for unlimited shelf-life is expensive, usually metal or combinations of metal and plastic. The material is gas and aroma-tight, and light-proof; the product is sold by a different type of shop as it is to all intents and purposes a preserve.

2.4.3. Common types of packages

There are two basic types: bags or boxes, both of which are used for limited and unlimited storage periods depending on the material.

The bag form is commonly used for the limited shelf-life packaging. Sizes vary depending on the contents, 50-250 g. The transparent pouches in one or three colours are either coated cellophane, cellophane plus polyethylene, polypropylene, or polyamide (nylon 11) plus polyethylene.

Large consumers, such as restaurants, bars and hotels, prefer 1-3 kg polyethylene bags printed in one or three colours.

The possibility of extending shelf-life but using the same packaging material was investigated. It was found that vacuum and/or gas packaging could also be used for processed (roasted and salted) groundnuts. The most common packaging materials are polyvinylidene-chloride and coated cellophane. However, as vacuum packed groundnuts do not look very appealing, they are packed in an attractive, multi-coloured box. This can also assure a shelf-life of up to six months depending on local storage conditions.

To prolong shelf-life in the absence of vacuum, plastic boxes are applied, made of styrene, vinyl-polymers or co-polymers. The boxes are either angular or round, containing usually 150-250 g per unit. They are sealed in a variety of manners, and the shelf-life is about six months.

Vacuum-sealed tin cans are the containers most commonly used to ensure unlimited shelf-life, for periods of more than two years irrespective of storage conditions. The cans usually hold 150-250 g, occasionally 500 g; the sleeves are printed in three or five colours, the vacuum used is less than 10 Hg/mm.

Bags can also be used to ensure unlimited shelf-life, coated or extruded aluminium foil being the best material. However, because vacuum packed products in small sachets (50-125 g) look more like drugs than candies, they are put in attractive boxes.

One of the latest packaging methods for groundnuts and one which also ensures unlimited shelf-life is the "Aluseal" system, comprising a smoothwalled, semi-rigid heat-sealable container with a 0.006-0.015 cm foil body, a 0.0015-0,005 cm plastic liner (polyethylene or polypropylene, or other kind of heat-seal coating as lacquer) and a lid of 0.005-0.011 cm foil with a heat sealable liner. The lid is applied by pressure and heat-sealed to form a fully hermetic gas- and aroma-tight pack. The lid is usually a multi-coloured laminated material. The pack has an easy-to-open system which has been a very important design and marketing factor.

CHAPTER III: PROPOSALS FOR INCREASING EXPORT POTENTIAL

3. In view of the present situation, the proposals below relate to the development of groundnut processing, investment in the proposed development, and for the location of investment.

3.1. Proposition for development of groundnut processing

In keeping with export market requirements and the quality and quantity of groundnuts available now and in the future, it is proposed that two processing lines be set up with a total processing capacity of 2 tons of raw groundnuts per hour, including a packaging plant for both limited and unlimited shelf-life. Thus, the plant can also be set up in a two-phase operation. Whereas there is no question as to the processing method used to satisfy market requirements, there are numerous types of acceptable packages, as mentioned in 2.4.1. and 2.4.3.

3.1.1. Processing groundnuts

In view of export market demand, it is proposed to invest in a processing line for roasting and salting the groundnuts (4, 6, 14, 17), which would use three qualities as shown in Table 4 below.

TABLE 4

Proposed grades of kernels for processing and packaging

Grade	Kernels per 100 grams	Maximum percentage of broken and split kernels	Percentage of foreign bodies
1	112 - 140	3	0
2	141 - 160	3	0
3	161 - 220	3	0

The processing of the three grades of groundnuts will be the same, only the roasting, cooling and frying temperatures and times will differ, experiments being made to identify the optimum approach.

Local laboratory-scale experiments would not permit a proper determination of processing technology and operation (6, 14, 17) in view of the high degree of automation. The few laboratory-scale experiments carried out at a canning factory by the General Organisation of Food Industries clearly indicated that the groundnuts produced are suitable for roasting and salting, but the elaboration of a processing technology in a similar manner would be to no avail. It would be more practical to establish the technological parameters in co-operation with the equipment supplier, such work being one of the contractual conditions. Experts from the suppliers would work on the new line in the plant, thus ensuring the quality of the processed goods.

The projected processing line would be as follows:

Storage of raw kernels

The kernels are delivered in jute sacks, loaded onto pallets and placed in the storage area. As required, fork-lift trucks are used to remove batches for roasting and to convey them to the hopper. The new decorticating line does not need an extra cleaner unit to separate such impurities as stones, bag-ribbons, sand and shells.

Optimum storage conditions for raw kernels are an average temperature of 20°C and relative humidity not higher than 80%. Climatic conditions in Alexandria meet this requirement, hence an additional ventilation system is not needed. However, care should be taken when using insecticides to avoid the kernels, by spreading them on the floor between the pallets.

The roasting unit

The raw kernels are taken by the fork-lift truck to the feed hopper, which has a capacity of about 150 kg, three bags of kernels (5,6, 10, 17).

The kernels pass on to the bucket elevator and through [illegible] cleaner to the surge hopper which is fitted with [illegible] which stops the elevator if necessary. The capacity of the feeding system, which is linked directly to the [illegible], is [illegible].

The roaster would [illegible] completely [illegible], providing uniform roasting and [illegible] flavour development [illegible] colour penetration would be accurately controlled by [illegible] equipment, which actuates the pilot light [illegible] high temperature cut-out of the roaster [illegible] roaster, empties [illegible] capacity of the roaster is about [illegible] kg per hour, depending on the shape of the kernels and their moisture [illegible] between 170°C and [illegible], resulting in [illegible] per hour. The roaster would be equipped with [illegible] producing approximately three batches an hour. The storage tanks and piping with pump are attached to the unit, [illegible] holding [illegible] litres, which is enough for two working days.

The cooler unit

The roaster is linked directly to the cooler [illegible]. The cooler has a conventional automatic cooling method, moving the roasted kernels through the cooling tunnel at the speed indicated by the standardized colour control unit. Cooler capacity is about 14 cu.m air per minute, which varies depending on the shape of the roasted kernels and the air temperature. The cooling tunnel is about 4 m long, the capacity of the conveyor buckets being 0.2 m3 per minute. For space reasons it is recommended that the tunnel be set up horizontally.

Whole-nut blanching unit

On emerging from the cooler, the roasted nuts are collected in the blanching hopper, to remove the red skin [illegible].

As kernel sizes vary, the blancher needs simple manual adjustment of the control gates. The capacity of this double head blancher is about 400-500 kg per hour, depending on the shape of the kernels; three machines would be thus necessary in this [illegible].

A suction unit is an integral part of the blanching unit, which removes the skins and dust. It comprises a cyclone collector, tubes, air control sliding gates and a fan to expel the impurities. The three blanchers have one suction unit. The diameter of the cyclone is about [illegible] cm, and that of the pipes is about 1[illegible] cm, the length of the pipes depending on the installation. The capacity of the fan motor is 1 HP. A kernel collector conveyor and bucket elevator are attached to the blanching unit, to take the blanched kernels to the hopper of the nut fryer.

Two or three people should be stationed alongside the kernel collecting conveyor to check the products and pick out any sub-standard kernels. The conveyor is [illegible]5 m long and leads directly to the elevator feeding the groundnuts into the fryer; the [illegible] litre bucket elevator hoists the nuts some [illegible]5 m, its capacity being about 1,[illegible] kg of kernels per hour.

[illegible] Fryer unit

In keeping with consumer preferences, a nut fryer needs to be installed to give the kernels a final roasting. This ensures standard quality, attractive colour and surface, as well as a good flavour and odour, (6, 16, 17). The unit comprises two parts: the oilbath-fryer and the cooling and drying equipment. The nut fryer also includes an oil regenerator to clean and change the oil bath.

The kernels proceed from the surge hopper via a flexible stainless steel conveyor belt through the oil bath, which contains 500 litres of peanut and or sunflower oil (according to customer requirements) at a temperature of 180°C (electric immersion heater). Frying time is variable, one to seven minutes depending on the moisture content of the raw product. Thus the oil absorption rate is approximately 2.5-3%, the energy input of the fryer being 60,000 BTU per hour.

The fryer is a covered unit, the vapours being exhausted by a blower. The oil bath is also equipped with a circulating system, whereby at the end of every shift the used oil is pumped back into the storage tank and filtered to remove all impurities. The oil stand should be checked regularly, possibly using a colorimetric method, to establish the best period of use. Oil loss is about 10% per shift. Oil storage comprises two 600-litre tanks, an oil filter and pump with the requisite stainless steel piping.

The finishing unit

After the fryer, the kernels proceed to the cooling, glasing and salting unit (6, 14, 17). Operation is continuous as the nuts are conveyed per conveyor to the tunnel for cooling, glasing and salting. The unit contains a suction unit with an exhaust fan and fat filter. Glasing is done using an electric heating and controlling system with an oil tank, and the salting equipment comprises a salting funnel and a solution-level controller. Salt concentration is about 3%, depending on consumer preferences. The fan is driven by a 0.5 HP motor.

Following the above, the roasted, salted and glased kernels are ready for packing. A conveyor belt carries the product from the cooling tunnel to the packing unit. Some two to four people should stand alongside the belt, checking the quality and picking out the sub-standard nuts.

The flow-sheet of the processing lines, including the raw material and energy requirements, is shown in Figure 2, and an outline sketch is given in Figure 3.

The data in Figure 2 relate to the material and energy requirements in the two processing lines proposed. The quantity and quality of the packaging materials are related to 100 g units and to an average quantity of packaging materials. The packaging lines proposed can be varied with corresponding changes in the packaging materials needed (see 3.1.2. below).

The sketch of the processing line in Figure 3 offers a bird's eye view of the line "A" and a side-view "B".

... sheets of processing lines, ...ding packaging

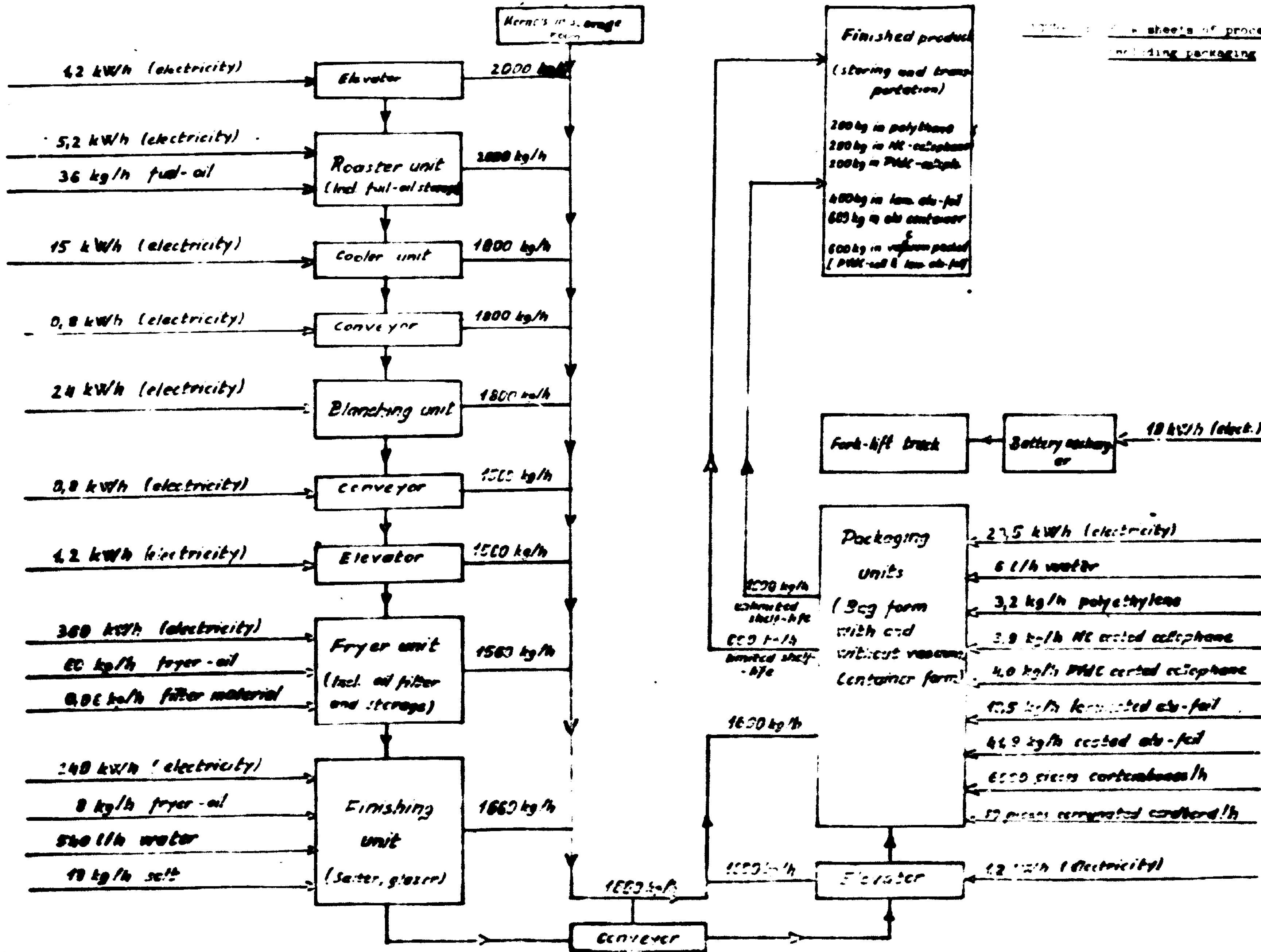
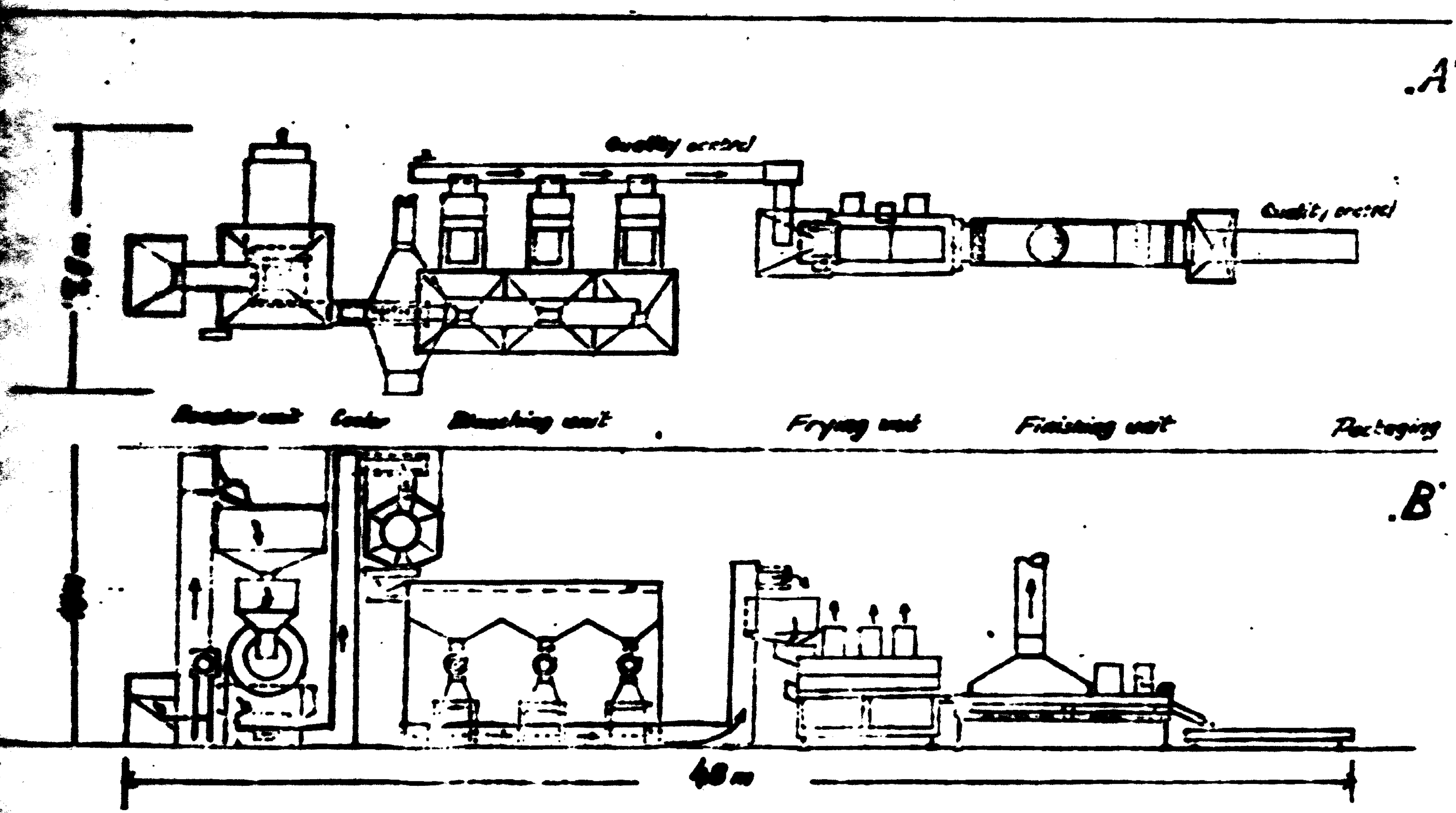


FIGURE 3

Sketch of the processing line for 1,000 kg/hr groundnuts



3.1.2. Packaging processed groundnuts

In view of the export market requirements and the locally available packaging materials, it is proposed that two packaging lines be set up; one for limited shelf-life packaging, the other for unlimited shelf-life, both of which involve several variations.

3.1.2.1. Limited shelf-life

The limited shelf-life packaging line would have an annual capacity of about 2,000 tons using low density polyethylene (for major consumers such as bars, hotels, and restaurants), NC (nitrocellulose) coated cellophane (for the domestic market), polyvinylidene-chloride coated cellophane (for the export market) with and without vacuum processing (12, 13).

Thus an automatic packaging machine is proposed with variable filling (100 - 2500 g) and bagging (width 8-25 cm, length 8-45 cm) systems. The capacity of the machine is approximately 20-45 bags per minute, depending on the weight being filled (12).

An automatic vacuum-packing machine is also recommended to pack groundnuts from 50-250 g. Bag size depends on the weight being filled (width 8-16 cm, length 8-25 cm). The capacity of the machine is 35-55 bags per minute depending on the filling. The equipment has dosing and filling devices and uses polyvinylidene-chloride coated cellophane (13).

It should be noted that this type of machine can also be used to pack groundnuts for unlimited shelf-life, in which case a different packaging material is used. Thus depending on market demands, two packaging machines could be set up, one with vacuum and the other without.

Vacuum packing would be used on the export market to prolong shelf life, multi-coloured cartons being used to cover the tight packs.

The outer boxes for transportation are also made by hand from corrugated cardboard sheets.

3.1.2.2. Unlimited shelf-life

The unlimited shelf-life packaging unit would comprise two lines with a total annual capacity of 3,000 tons, one producing bags, the other containers (11, 13).

The vacuum-packing machine mentioned above (14) would be suitable for the production of bags, the packaging material being cellophane + aluminium foil + low-density polyethylene. (If so required, the machine could also be equipped with a gas-flushing device, although this is of no real importance as the actual surface of the groundnuts is comparatively small.) The vacuum packed bags are inserted in cartons and the operation is the same as described in 3.1.2.1 above.

There are two types of suitable cans: very modern Alu-seal system using aluminium-foil coating with heat-sealable plastic (2), and the traditional vacuum packed tin cans.

The Alu-seal method requires the installation of a deep-drawing press to manufacture the 100-250 g containers. The press is fully automatic, the operation is mechanical, and the auxiliary functions are pneumatic. Depending on the type of foil and the shape of the container, output can be up to 100 cycles per minute (11).

The filling and sealing unit is attached to the press. It is equipped with a rotary table, push-out station for containers, filling hopper, a unit stamping the aluminium tear-off lids from reel-fed aluminium foil (with or without a coding device), and a conveyor belt: output is 40-45 containers per minute (11).

Both bags and containers could be used for unlimited shelf-life packaging, one aluminium container packaging unit being installed to meet requirements.

The alternative is to vacuum pack the roasted and salted groundnuts in prefabricated tin cans. In this case, a tin can filling and vacuum-sealing machine is needed with an output of about 50 cans per minute.

From the technical and economic point of view, investment in the Aluseal system is expedient. Both canning systems use imported raw materials; however, the transportation of rolls of the aluminium foil is much simpler than metal sheeting for tin cans. Economically speaking aluminium packaging is more profitable, as the three-colour tin cans cost AF 44 per 1,000, and cans with labels cost AF 20 per 1,000 (see 2.1 [illegible] 3) as against two-colour aluminium containers which cost AF 16 per 1,000 (2). Tin cans can only be opened with the aid of some appliance, whereas the aluminium containers have a tear-off lid.

Outer packaging for transport would be the same as for the bags, i.e. corrugated cardboard boxes put together by manual labour, who would also constitute the final control station.

The large cartons would be palletised and moved by fork-lift truck to the storage area, which could hold 800 tons of palletised products ready for transportation.

3.1.3 Quality control of processed groundnuts

Today throughout the world, consumers expect and demand standard quality. Hence the quality of the processed and packed groundnuts must be checked. Thus it is proposed that a quality control laboratory be set up to check continuously both the semi-finished product, i.e. after roasting and finishing, and the finished product, after packaging, and to carry out random checks on the raw materials (the groundnuts and packaging materials).

Thus, the laboratory would be equipped with instruments to identify the moisture, oil and protein content of the kernels and their colour. It would also be equipped to check the closing and sealing of the packages and whether the material is leak-proof. The number of samples, the sampling methods, as well as the evaluation of the results, would be in accordance with international statistical methods and standards.

3.2. Proposed investment

The costs and expenses below were estimated in collaboration with the competent department of the Tractor and Engineering Company who inquired about the prices of the equipment selected and supplied the investment data and information.

The fixed capital for the processing and packaging plant are presented separately. As for the packaging plant, the costs have been estimated for three different packaging possibilities, thus ensuring greater variation to meet the demands of the export market.

3.2.1. Fixed capital

The fixed capital below has been estimated in two parts: the first figures relate to the fixed capital outlay for equipment and its installation, the second figures to the buildings and ancillaries.

3.2.1.1. Estimated cost of equipment

The equipment costs have been split into three sections; the first shows the costs of imported processing equipment FOB Italian port; the second the costs of locally made equipment; and the third the costs of accessories.

In all three sections, the figures for the processing and packaging plant are shown separately, average costs being shown throughout.

Estimated cost of imported processing and packaging equipment

The estimated cost of the imported processing and packaging lines described in 3.1. of this report are shown in Tables 5 and 6 in US dollars FOB Italian port.

The estimated cost of importing equipment for the processing plant would be US$ 116,200 (£E 46,480), and for the packaging plant US$ 129,600 (£E 51,840).

TABLE 5

Estimated cost of two processing lines (total capacity 2 tons/hr.) in US dollars, imported [illegible] Italian port

Process	Description of equipment	Estimated costs in US$	Remarks
Roasting	Feed hopper with motor gate	[illegible]	Assembled locally
	Bucket elevator	[illegible]00	"
	Roaster	31,000	"
Cooling	Cooler	1[illegible],600	
Blanching	Blanchers	2[illegible],000	Two triple units required
Frying	Fryer	19,400	
Finishing		1[illegible],800	
Material handling	Fork-lift truck	[illegible],500	Battery charger needed
TOTAL		11[illegible],200	

TABLE 6

Estimated cost of three packaging lines (total capacity 1.[illegible] tons/hr) imported [illegible] Italian port, in US dollars

Type of packaging	Estimated costs in US$	Packaging material	Remarks
Bag without vacuum	22,300	Polyethylene + coated cellophane	Limited shelf-life
Bag with vacuum	31,800	Coated cellophane + laminated alu-foil	Limited shelf-life
Container moulding	3[illegible],600	Coated alu-foil	Unlimited shelf-life
Container filling and closing	32,400	Coated alu-foil	Unlimited shelf-life
Material-handling	5,500		Fork-lift truck
TOTAL	129,600		

Estimated cost of locally manufactured equipment

Table 7 shows the estimated cost of machinery and ancillary equipment for the processing plant in US dollars, made locally, to effect foreign currency savings.

TABLE 7

Estimated cost of locally made processing equipment (capacity 2 tons/hour) in US dollars

Name of unit	Description of equipment	Estimated cost US $	Remarks
Roasting	Feed hopper	900	Attached to imported equipment
	Bucket elevator	2,200	"
Blanching	Feed hopper	1,800	For 6 machines
	Conveyor	1,000	
Nut fryer	Feed hopper	800	
Finishing	Conveyor	1,100	
Storage for fuel oil	Storage tanks	4,300	2 tanks
	Pumps	360	2, including piping
Storage for frying oil	Storage tanks	960	2 tanks
	Pumps	370	2, including piping
TOTAL		13,790	

The machinery and ancillary equipment listed do not change the technological concept, hence the contractor's guarantee retains its validity.

The machinery and equipment listed cost US$ 13,790 (£E 5,516).

Estimated cost of accessories

The cost of accessories for the processing and packaging plant are specified separately, the calculation being based on the value of the imported and locally manufactured machinery. The listed expenses are: installation, i.e. 10% of the equipment value; measuring instruments for quality control laboratory, i.e. 3% of the equipment value; supervision, i.e. 1% of the equipment value; transportation and insurance, as well as customs duty and clearance which are 10% and 15% respectively; training, for two persons in the processing plant, one in processing and the other in quality control methods; and sundries and contingent costs. Table 8 shows the breakdown for the processing plant, and Table 9 that for the packaging plant.

TABLE 8

Estimated cost of accessories for the processing plant equipment in US dollars

Outlay	Estimated cost US$	Remarks
Installation	13,000	Including electricity, water, ventilation, etc.
Supervision	1,3[illegible]0	
Measuring instruments	3,900	For quality control laboratory
Transportation and insurance	12,010	FOB Italian port
Customs, including clearance	18,015	
Training	2,200	Two fellows for processing and quality control
Sundries and contingency costs	5,045	10% of the costs
TOTAL	55,470	

TABLE 9

Estimated cost of accessories for the packaging plant in US dollars

Outlay	Estimated cost US $	Remarks
Installation	13,000	Including electricity and water
Supervision	1,300	
Measuring instruments	3,900	For quality control laboratory
Transportation and insurance	12,010	FOB Italian port
Customs, including clearance	18,015	
Training	2,200	Two fellows for processing and quality control
Sundries and contingency costs	5,045	10% of the costs
TOTAL	56,835	

The costs of accessories for the processing plant are US$ 55,470 (£E 22,188) and for the packaging plant US$ 56,835 (£E 22,734), a total of US$ 112,305 (£E 44,922).

3.2.1.2. Estimated cost of factory buildings

The estimated cost of factory buildings have been broken down into two parts: the cost of the buildings, and the cost of accessories. As the processing and packaging units are to be housed in one building, there is no reason to break down the costs in any other way.

Estimated cost of buildings

Table 10 indicates the estimated cost of the buildings, a standard price of £E 25/m2 being taken as the basis of calculation.

TABLE 10

Estimated cost of buildings in Egyptian Pounds

Description of building	Estimated cost in £E	Remarks (area, etc.)
Processing building	57,600	2304 m2
Raw material storage	16,000	640 m2 with 10 days capacity
Warehouse for end-products	24,000	960 m2 with 60 days capacity
Laboratory and offices	1,350	54 m2 (33m2 + 21 m2) for 5 and 3 people
Social amenities	2,200	Showers, locker rooms for 88 workers, 88 m2
TOTAL	101,150	4046 m2

Table 10 shows that the total planned area is 4046 m2, costing £E 101,150. It should be noted here that the plant can be linked with the new raw material production plant mentioned in 2.2.1.2. of this Report. The buildings area could be reduced to 2427 m2, costing £E 60,675, a saving of £E 40,475, as the warehouses and offices are not indispensable.

Estimated cost of accessories:

The estimated cost of building accessories are presented in Table 11.

The costs of accessories include the following items: land, i.e. £E 3/m2; site improvement, i.e. 1% of land price; link-roads, a total road surface of 480 m2 at £E 5/m2; design and supervision, i.e. 2% of the buildings costs; service installations in the social building, i.e. 1% of the building costs; laboratory and office equipment, i.e. in toto 1.5% of the estimated costs of the building for the processing plant, and laboratory; as well as sundries and contingency costs, i.e. 10% of the above-mentioned costs. The estimated costs total some £E 21,025. By merging the processing factory and the raw material production plant, it would be possible to achieve savings

TABLE 11

Estimated cost of building accessories in Egyptian Pounds

Outlay	Estimated cost in LE	Remarks
Land	12,350	4650 m2
Site improvement	1,235	
Link-roads	2,400	480 m2, with proper underlay and surfacing
Design and supervision	2,025	
Service installations in social building	220	
Office and laboratory	885	
Sundries and contingency costs	1,910	
TOTAL	21,025	

in terms of land and roads to the order of LE 10,030, i.e. half the estimated costs of the accessories.

3.2.2. Working capital

The primary costs of the roasting and packaging processes have also been estimated separately for the two plants. Thus, the cost of labour, processing and packaging, and property and inventory insurance relates to the processing and packing of groundnuts.

3.2.2.1. Labour costs

The labour requirements of both the processing and packaging plants include administrative and associated staff, annual salaries being indicated in Egyptian Pounds in Table 12 below.

Table 12 shows that the labour force in the processing plant is LE 17,165 and in the packaging plant LE 18,425, a total of LE 35,590 per year. These costs include: salaries (100%); social security (25%); the allowances (20%, production bonus (20%); medical care (5%), and social welfare (5%), all of which amount to 75% of the net salaries.

Table [illegible]

Labour force and annual costs, in Egyptian pounds including administrative and associated staff, for the production of 4,000 tons/year roasted and packed groundnuts (two-shifts)

Position	No of persons	Annual salary (£E)	Remarks
Factory leader (manager)	1	840	In one shift
Foreman	2	1150	
Laboratory staff	10	5250	Working in the laboratory
Maintenance personnel	6	3150	
Buildings management	14	5880	
Truck drivers	4	1680	
Storeman	4	1680	
Quality controller	20	6300	Working in the line
Packer	24	7560	For transporter packaging
Clerk	2	840	In one shift
Unskilled labourer	4	1260	
TOTAL	91	35590	
Processing plant		17165	
Packaging plant		18425	

3.2.2.2. Estimated processing costs

The estimated quantity and cost of raw material, supplies, utilities, and sundries for the processing plant are presented in Table 13.

TABLE 13

Estimated quantity and cost of producing 4,000 tons processed groundnuts per year

Input	Units	Estimated quantity per year	Estimated cost £E	Remarks
Raw material				
Groundnuts	ton	5,000	775,000	
Supplies				
Fryer-oil	ton	170	51,000	Sunflower and/or peanut oil
Salt	ton	45	450	
Filter material	ton	0.3	240	Import, US£ 960
Utilities				
Fuel-oil	ton	90	2,500	
Electricity	kWh	1647500	24,713	Including battery charger
Water	m3	1,350	16	
Sundries			8,540	1% of costs
TOTAL			862,459	

Costs are based on current prices; groundnuts cost £E 155/ton, sunflower and/or peanut oil £E 300/ton, salt £E 10/ton, filter media £E 20/month, fuel oil £E 0.025/litre, electric energy £E 0.015/kWh, and non-potable water is £E 0.012/m3. The expenses of other unforeseen materials which are presently indefinable are shown as sundries, i.e. 10% of the above-mentioned costs. The total cost of processing groundnuts is £E 862,459/year for 4,000 tons. It did not seem meaningful to present the working capital costs of the packaging plant in the same three steps as a whole variety of packaging materials are used, the costs being indicated in the annual operating costs of the packaging plant in Table 18.

3.2.2.3. Estimated costs of property and inventory insurance

The costs of property and investory insurance are 1% of the total property and inventory values, in accordance with the local insurance custom. The insurance costs of the processing plant are presented in Table 14, and those of the packaging plant in Table 15.

TABLE 14

Estimated cost of property and inventory insurance for the processing plant, in Egyptian Pounds

Items	Estimated value in £E	Cost of insurance in £E	Remarks
Property:			
Equipment	73,216	733	
Buildings	61,088	611	
Inventory:			
Raw material	46,500	465	Ten days' stock
Finished products:	-	-	Direct lines for packaging
Supplies:	3,107	32	Ten days' stock, filter media for one month
Utilities:	150	2	Ten days' stock
Miscellaneous:	-	22	
TOTAL		2,165	

The property values include the value of the equipment and buildings, the inventory values of the processing plant in Table 14 including the values of ten days' stock of groundnuts, frying oil, fuel oil, and a month's stock (25 days) of filter material according to storage possibilities (one working day = 15 hours, two shifts).

In Table 15 the inventory values include packaging materials for ten days (110 g unit for bags and 250 g unit for containers) and two months' stock of finished products (based on average sales prices ex factory). As the finished product goes via conveyor from the processing plant to the packaging plant direct, the value thereof has not been included.

TABLE 15

Estimated costs of property and inventory insurance for the packaging plant in Egyptian Pounds

Items	Estimated value in £E	Cost of insurance in £E	Remarks
Property:			
Equipment	74,574	746	
Buildings	61,087	611	
Inventory:			
Raw materials:		317	Ten days' stock
Polyethylene	933		
MC coated cellophane	1,178		
PVC coated "	1,750		
Laminated alu-foil	14,267		
Coated alu-foil	4,464		
Boxes	5,760		
Corrugated cardboard	3,360		
Finished products:		3,376	Two months' stock
Non-vacuum-packed in bags	18,000		
Vacuum-packed in bags	158,400		
Containers	131,200		
Miscellaneous:		50	
TOTAL		5,100	

Miscellaneous insurance costs have been taken to be 1% of total values. Thus the estimated costs of property and inventory insurance for the processing plant is £E 2,165/year, and for the packaging plant £E 5,100/year.

3.2.2.4. **Estimated annual operational costs**

The estimated annual operational costs for the processing plant are shown in Table 16, and for the packaging plant in Table 17.

TABLE 16

Estimated cost of operating the processing plant in the first year and the years thereafter

Items	Estimated cost in £E		Remarks
	1st year*	Further years	
Raw material	387,500	775,000	* 50% capacity
Supplies	25,845	51,690	
Utilities	13,615	27,229	* Other costs in part of trial operations and experimental work
Sundries	4,270	8,540	
Labour	15,019	17,165	
Property and ~~tax~~ inventory insurance	2,165	2,165	
Depreciation:			
Equipment	7,322	7,322	10% of value
Buildings	1,833	1,833	3% of value
Maintenance:			
Equipment	3,661	3,661	5% of value
Buildings	611	611	1% of value
TOTAL	461,841	895,216	

In the tables, the depreciation on equipment is 10%, and on buildings 3% in relation to the capital invested. The maintenance costs for equipment is 5%, and for buildings 1% in relation to the capital invested.

As indicated in Table 16, the estimated annual operational costs for the processing plant in the first year are £E 461,841, running at half capacity, and in the years thereafter £E 895,216. Relating these sums to the groundnuts processed, the primary cost of the processed product is £E 230.92/ton and £E 223.80/ton respectively.

TABLE 17

Estimated cost of operating the packaging plant (without raw material)

Items	Estimated annual equipment costs in £E			Remarks
	bag no vacuum	bag with vacuum	container	
Utilities:				
Electricity	214	281	432	
Water	-	1	-	
Labour	6,141	6,142	6,142	
Property and inventory insurance	918	1,300	2,882	Proportional to value of equipment
Depreciation				
Equipment	1,342	1,909	4,206	10% of value
Buildings	611	611	611	3% of value
Maintenance				
Equipment	671	955	2,103	5% of value
Buildings	203	204	204	1% of value
TOTAL	10,100	11,403	16,580	

The annual costs of the packaging plant are presented in Table 17, broken down according to the three machines proposed. Table 17 does not contain the price of the packaging materials, as several variations are shown in Table 18.

The costs of utilities, labour, property and inventory insurance, depreciation and maintenance of machines and equipment shown in Table 17 were calculated separately for the bag forming, filling and closing unit (without vacuum) at £E 10,100/year, for the bag forming, filling and closing unit (with vacuum) at £E 11,403/year, for the container forming, filling and closing unit at £E 16,580/year. The costs of a fork-lift truck, accessories and property and inventory insurance were related to the value of the units.

The annual operating costs of the packaging plant are summarised in Table 18, the costs being related to 100 tons of variously packed products. The aim is to indicate the primary cost of a variously packed, but same, product.

The estimated quantity of packaging material was calculated on the basis of available samples of 50, 65 and 100 g net bags and 250 g containers, extrapolating these sizes according to the technical specification of packaging units.

When estimating the annual quantity of packaging materials used, the same thickness was assumed for the bags in the 50-150 g range; 0.004 cm for polyethylene, 0.0028 cm for NC coated cellophane, 0.003 cm for PVC coated cellophane and 0.0072 cm for laminated (35 cellophane/12 Alu-foil/25 polyethylene) aluminium foil.

The thickness of the polyethylene for 25 g bags was assumed to be 0.005 cm and for 2,500 g sacks 0.008 cm: the 250 g sacks in NC coated cellophane were assumed to be 0.0045 cm thick. The thickness of the aluminium containers is the same for all three sizes as it does not represent mechanical strength, but processing requirements: the container body is 0.014 cm thick and the lids 0.009 cm.

The specific gravities used in the calculations were as follows: 0.92 g/cm3 for polyethylene; 1.60 g/cm3 for the 0.0028 cm thick NC coated cellophane; 1.50 g/cm3 for the PVC coated cellophane; 1.46 g/cm3 for the laminated aluminium foil; and 2.40 g/cm3 for the container body and lid material.

The sizes calculated were as follows; allowing for loss during sealing operations: 50 g bags 243 cm2; 65 g 290 cm2; 100 g 440 cm2; 125 g 540 cm2; 150 g 600 cm2; 250 g 970 cm2; and 2,500 g 2160 cm2. The sizes of the body of the aluminium containers were, allowing for sealing shrinkage: 100 g 168 cm2; for 150 g 240 cm2, and for 250 g 400 cm2. For the lids of the containers, the calculated sizes are: for 100 g 62 cm2; for 150 g 80 cm2; and for 250 g 123 cm2.

The proposed packaging forms are shown in Figures 4 and 5.

TABLE 18

Estimated annual operational costs of the packaging plant (in Egyptian Pounds)
related to the cost of 100 tons of differently packed products
indicating the marketing area, the primary cost of 1,000 units and 1,000 packages

Estimated quantity	Polyethylene				PE coated cellophane			
	no vacuum			vacuum	no vacuum			vacuum
	Net weight in grammes				Net weight in grammes			
	100	250	2500	100	100	150	250	100
Estimated quantity of packaging material	1619	1785	636	1619	1971	1797	2636	1971
Estimated cost of packaging material	1295	1428	509	1795	1636	1487	2188	1636
Estimated cost of wrapping material	-	-	-	3200	-	-	-	3200
Estimated cost of transport packaging material	1400	1400	1400	1400	1400	1400	1400	1400
Estimated cost of packing	1683	769	135	1580	1683	1181	769	1520
TOTAL	4378	3597	2044	7415	4719	4068	4357	7756
Marketing	domestic		export		domestic			
Price of 1,000 units	4,38	8,99	5,11	7,41	4,72	6,10	10,89	7,76
Primary cost of 1,000 packages	2,98	5,49	26,10	2,81	3,32	4,08	7,46	3,16

Estimated quantity	PVC coated cellophane				Laminated aluminium				Aluminium container		
	no vacuum			vacuum	vacuum				no vacuum		
	Net weight in grammes				Net weight in grammes				Net weight in grammes		
	100	50	100	150	50	65	100	125	100	150	250
Estimated quantity of packaging material	1980	2187	1980	1980	5109	4649	4825	4561	6486	6588	6439
Estimated cost of packaging material	2136	2581	2136	2124	16655	15496	15018	14804	5097	5368	4960
Estimated cost of wrapping material	-	4000	4200	2133	4000	3077	4200	2984		-	-
Estimated cost of transport packaging material	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400
Estimated cost of packing	1683	2764	1520	1120	2764	2261	1520	1267	22[illegible]	1988	1105
TOTAL	5419	10745	8656	6784	24819	22234	21168	20541	9148	8166	7465
Marketing	export										
Price of 1,000 units	5.42	5.37	8.66	[illegible]	12.41	13.92	21.18	25.68	9.15	12.67	18.66
Primary cost of 1,000 packages	4.02	2.67	4.38	4.07	4.71	11.41	16.60	20.09	7.71	10.37	15.86

FIGURE 4: Size of 100 g box

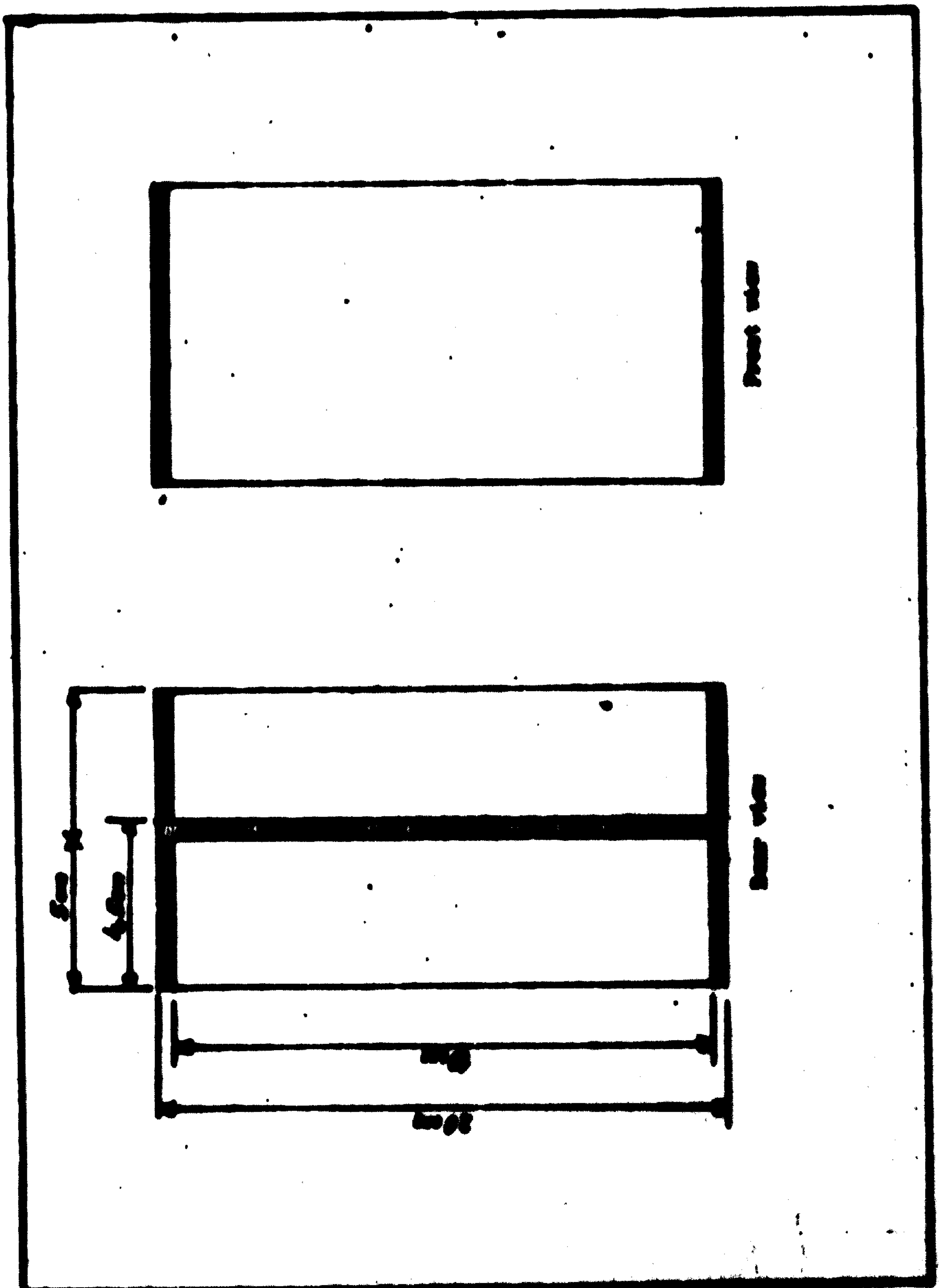
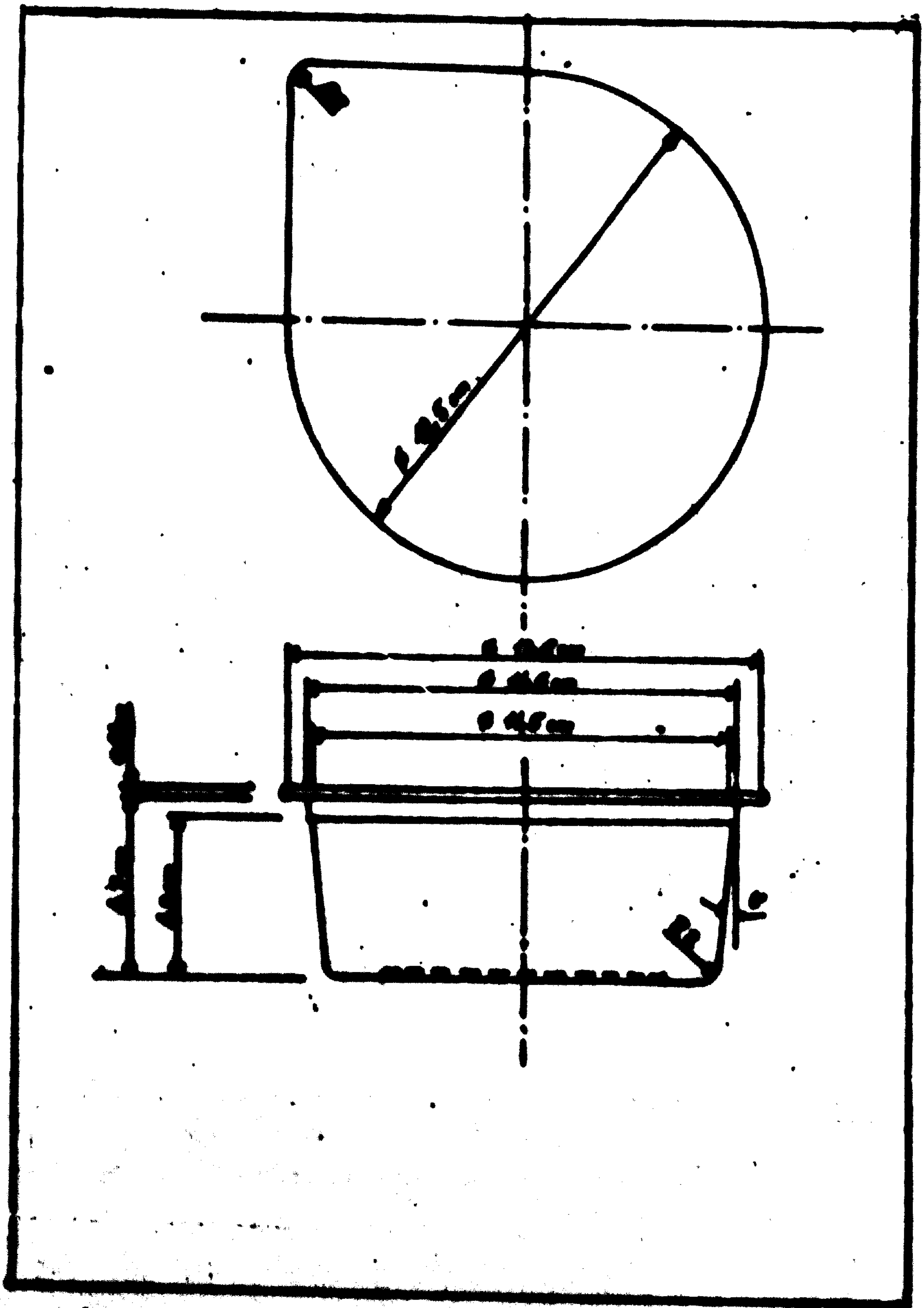


FIGURE 3: Size of 250 g product aluminium container



The 100 g bag and the 250 g aluminium container are depicted as the most common type of package. Figure 4 also shows sealing strips, and Figure 5 shows a cross-section of the container and lid.

It is recommended that boxes be used to wrap the vacuum packed goods in, two sizes being recommended for easier handling: 6.5 x 9.5 x 2 cm boxes for 50-65 g units, and 10 x 14 x 3 cm for 100-150 g units.

For transport purposes it would seem reasonable to use standard boxes (40 x 40 x 30 cm) containing some 20 kg of packed goods.

The packaging material costs were based on information supplied by the Paper Converting Co. (polyethylene), Misr Rayon Co. (coated cellophane), The Tractor and Engineering Co. (aluminium foil and containers), and the Moharrem Press (paper for overwrapping and transportation purposes). The mentioned samples were obtained by the Nile Co., Cairo. It should be noted that according to Egyptian law, imported packaging materials are duty-free if they are used for export.

The cost of the packaging operations was calculated on the basis of brochures and leaflets obtained by the Tractor and Engineering Co. The bag out-put estimated for the bag-forming units (without vacuum) is as follows: forty 100 g bags/minute; thirty-eight 150 g bags/minute; thirty-five 250 g bags/minute; and twenty-five 2,500 g bags/minute. The bag output of the vacuum packaging unit was estimated as follows: fifty-five 50 g bags/minute; fifty-three 65 g bags/minute; fifty 100 g bags/minute; forty-eight 125 g bags/minute; and forty-five 150 g bags/minute. The basis of calculation was 2,500 working hours per year.

Table 18 also indicates possible marketing areas and the price of packages and units per 1,000.

3.3. Proposed location

In view of the basic raw material - groundnuts in kernel form - and the different types of packaging materials, and the transportation of the finished products, it is proposed that the plant be located in Alexandria, near the decorticating plant.

Study of the location problem shows that all the allied factories are located in Alexandria, as well as the factory producing the packages and wrappers, and the manufacturers of cellophane and polyethylene.

The imported packaging materials will be shipped to Alexandria, whilst the palletised finished products will depart from the same harbour, thus leaving no choice as to location.

In 2.2.1.2. above, it was mentioned that the plans of the new decorticating factory also provide for adequate space for enlargement and extension. Thus, depending on the building costs and the ancillaries estimated in 3.2.1.2., the estimated fixed capital for processing and packaging grountnuts has been broken down for both an independant plant and one linked to the groundnut decorticating plant (see Table 19).

TABLE 19

Estimated fixed capital for 5,000 tons/year groundnuts processing and packaging factory, as an independent or ancillary plant

Investment item	Independent plant (£E)	Ancillary plant (£E)	Requisite hard currency investment (US $)
Machinery:	98,380	98,380	245,800
Imported machinery			
Locally manufactured machinery	5,516	5,516	
Accessories	44,922	44,922	11,000
Buildings:			
Buildings	101,150	60,675	
Accessories	21,085	10,030	
TOTAL	270,933	219,463	256,800

Table 19 shows that by linking up to the existing plant, 2[illegible]% fixed capital savings would be achieved (£E 219,463 as against £E 270,913). However, in all probability during realisation, there would be an even greater chance to economise.

As for working capital, exact computation at such an early stage is impossible, and would detract from the accuracy of the feasibility study. It can also be assumed that working capital could be reduced. In the final analysis fixed capital could be reduced by 30% and working capital by [illegible]%, i.e. £E 65,000 and £E 5,000 per year respectively.

CHAPTER IV: PROFITABILITY

4. When determining the profitability of the proposed processing and packaging factory, groundnuts exporters provided information on their plans for the sale of roasted and other packed groundnuts in the future. Present prices and projected prices were also supplied by the Groundnuts Export Department of the Nile Company in Cairo.

4.1. Estimated profit

In 2.3. above the operational costs of both the processing (Talbe 16) and packaging plant (Table 18) were elaborated. In Table 20 the primary costs of the variously packed processed groundnuts were estimated on the basis of these costs and using the prices obtained, profits were forecast in Table 20.

Table 20 shows that vacuum packing is the most profitable, followed by aluminium containers. Packing in bags, without vacuum, is not profitable. Comparing vacuum packs and containers, it appears that the aluminium foil pack (unlimited shelf-life in bag form) is the most profitable packaging, whereas aluminium containers do not offer as high profit as would be expected owing to the relatively expensive technology.

TABLE 20

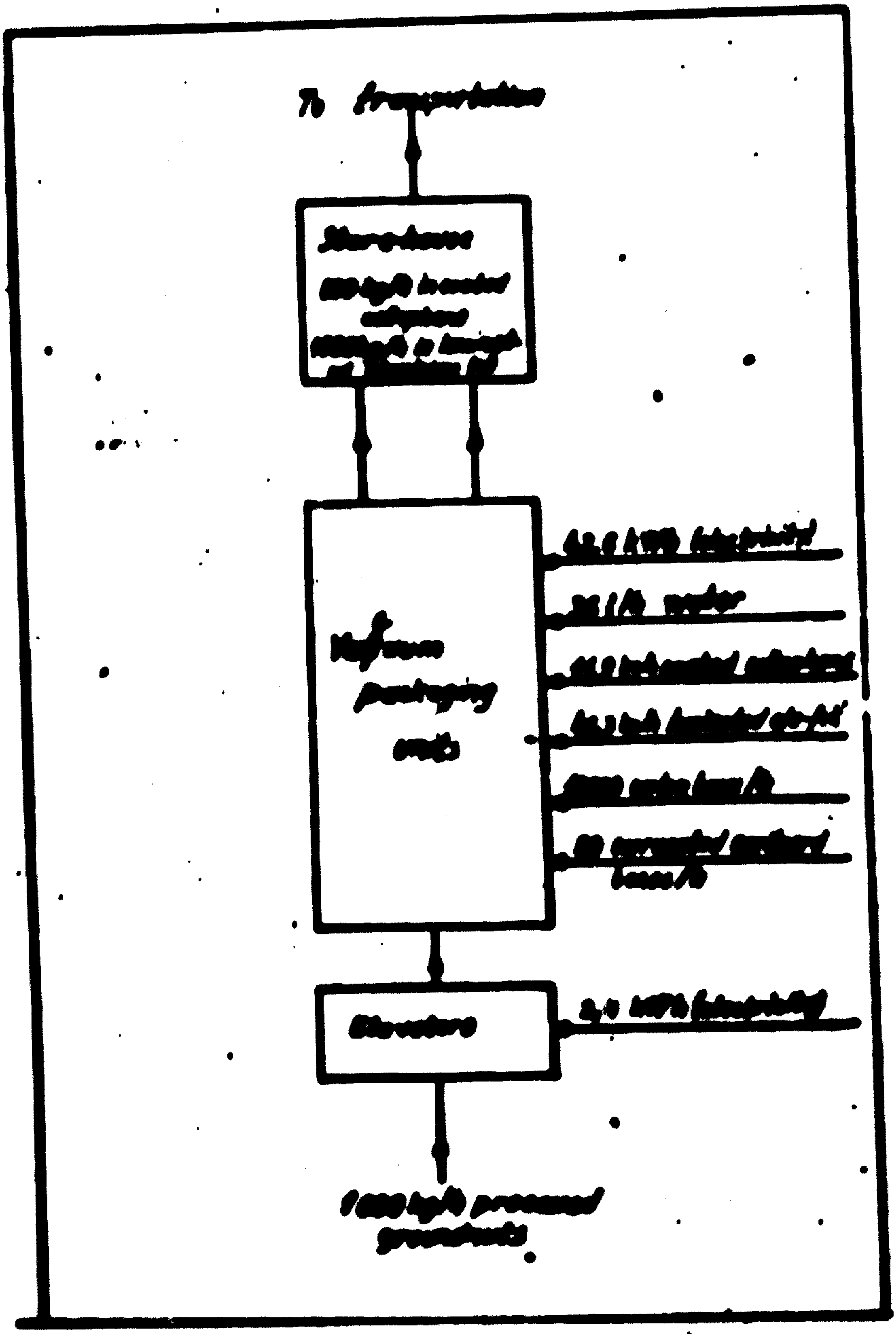
Estimated profit of 1 ton variously packed processed groundnuts in Egyptian Pounds, FOB Alexandria

Packaging material	Method of packaging	Unit in grammes	Primary cost of groundnuts	Primary cost of packaging	Total primary cost	Estimated sales price	Profit in £E per ton
Poly-	normal	100	224	44	268	253	-
ethylene	normal	250	224	36	260	206	-
	normal	2500	224	20	244	173	-
	vacuum	100	224	74	298	654	356
MC coated	normal	100	224	47	271	250	-
cellophane	normal	150	224	41	265	205	-
	normal	250	224	44	268	200	-
	vacuum	100	224	78	302	634	332
PVC coated	normal	100	224	54	278	260	-
cellophane	vacuum	50	224	107	331	736	405
	vacuum	100	224	85	309	468	159
	vacuum	150	224	68	292	627	335
Laminated	vacuum	50	224	248	472	1130	658
alu-foil	vacuum	65	224	220	444	1096	652
	vacuum	100	224	212	436	974	538
	vacuum	125	224	200	424	913	489
Aluminium	normal	100	224	91	315	725	410
container	normal	150	224	83	307	702	395
	normal	250	224	75	299	678	379

The sales prices were estimated by the Groundnuts Export Department of the Nile Company, Cairo.

In view of the imports arising from the packaging technology, it would be most profitable to invest in six vacuum packing units to handle the 4,000 tons of groundnuts a year (see Figure 6). Six units are needed because the contents of the packages do not exceed 150 grammes, hence unit capacity is relatively low. Admittedly, container packaging offers good profit as well, but two machines (deep drawing and filling and closing units) are needed, entailing increased operation and maintenance problems. If the six units comprise the same equipment, the increased flexibility helps to overcome certain production and maintenance problems.

[illegible] plant


To transportation
Storehouse
Vacuum packaging unit
Elevators
kg/h processed products

On the other hand, in view of the lack of experience in operating such high-capacity packaging lines, it may be more advisable to use less sophisticated packaging technologies in the initial stages.

4.2. Most profitable packaging

I 4.1. above the estimated profits were calculated, the conclusion being that the vacuum packs were most profitable. Thus, it is recommended that six identical packaging units be purchased and linked to the two groundnuts processing lines as specified in 3.1.2.2. (13). The estimated cost of one unit was listed in Table 6, and the annual operational costs in Table 17 and 18. On the basis of these data, the fixed capital of the vacuum packaging plant is shown in Table 21.

TABLE 21

Estimated fixed capital for the vacuum packaging plant

Item	Estimated costs (US $)	Remarks
Vacuum packaging units	190,800	Six units
Material handling	5,500	Fork-lift truck
Installation	19,630	10%
Supervision	1,960	1%
Measuring instruments	5,890	3%
Transportation	20,220	10%, FOB Italian port
Customs, including clearance	30,330	15%
Sundries and contingency costs	7,800	10% of accessories
TOTAL	282,130	

Table 21 shows that the estimated costs of equipment are US$ 196,300 (£E 78,520), US$ 66,700 (£E 26,680) more than the estimated sum for three different packaging lines. However, since the productivity of this plant is almost twice that of the other, the 50% increase in investment is acceptable.

Accessories cost US$ 85,830 (£E 34,320), some US$ 29,995 (£E 11,980) more than the accessories for the three different units, involving a 25% increase to produce the most profitable packages.

In order to estimate the annual operational costs of this vacuum packaging plant, the property and inventory insurance costs were also calculated (see Table 22 below).

TABLE 22

Estimated costs of property and inventory insurance for vacuum packaging plant per year

Item	Estimated basic value in £E	Cost of insurance in £E year	Remarks
Property values:			
Equipment	90,212	902	
Buildings	61,087	611	
Inventory values:			
Raw materials		528	Ten days' stock
PVC-coated cellophane	5,606		
Laminated alu-foil	36,187		
Cardboard boxes	7,680		
Corrugated cardboard	3,360		
Finished product:			Two months' stock
in PVC-coated cellophane	175,000	5,750	
in laminated alu-foil	400,000		
Miscellaneous:		78	1% of value
TOTAL		7,869	

The cost of insuring the vacuum packaging plant is £E 7,869 per year, the sum involved being high, as the value of the finished products is significant.

The estimated annual operating costs of the vacuum packaging plant, without raw materials, are listed in Table 23, whist the annual operational costs of this plant related to the production of 100 tons variously packed products are shown in Table 24.

TABLE 23

Estimated annual operational costs of vacuum packaging plant (without raw materials)

Item	Estimated costs in £E for 1st year*	Estimated costs in £E for years thereafter	Remarks
Utilities:			* 50% capacity
Electricity	843	1,686	
Water	3	6	
Labour:	17,042	19,265	* other costs for trial operation and experimental work
Property and Inventory insurance:	7,869	7,869	
Depreciation:			
Equipment	11,285	11,285	10% of value
Buildings	1,833	1,833	3% of value
Maintenance:			
Equipment	5,644	5,644	5% of value
Buildings	611	611	1% of value
TOTAL	45,129	48,198	

TABLE 24

Estimated annual operational costs of vacuum packaging plant in Egyptian Pounds relating the costs to production of 100 tons of variously vacuum packed products, indicating the primary cost of 1,000 units and 1,000 packages for export markets

Estimated quantity and cost in kg and £E	Packaging materials						
	PVC coated cellophane			Laminated aluminium foil			
	Net weight in grammes			Net weights in grammes			
	50	100	150	50	65	100	125
Quantity of packaging material	2187	1980	1800	5109	4625	4625	4541
Cost of packaging material	2581	2336	2124	16655	15286	15078	14304
Cost of wrapping material	4000	3200	2133	4000	3077	3200	2562
Cost of trans-portation packaging	1400	1400	1400	1400	1400	1400	1400
Cost of operation	1948	1071	793	1948	1555	1071	902
TOTAL:	9929	8007	6450	24003	21318	20749	19656
Price of 1,000 units	4.96	8.00	9.68	12.00	13.86	20.75	24.57
Primary cost of 1,000 packages	2.27	3.41	4.38	9.30	10.95	16.15	19.62

It can be seen that the estimated annual operational costs of the vacuum packaging plant, without raw materials, are £E 45,129 for the first year, - 50% productivity - and £E 18,198 for the years thereafter. The difference between the first year of operation and the years thereafter is relatively small as property and inventory insurance, depreciation and maintenance costs are the same.

Studying the annual operational costs of the vacuum packaging plant (with raw materials) shown in Table 24, it appears that the primary costs of packaging are cheaper than the other methods. This confirms the suitability of the capacity chosen and offers a greater profit margin, as summarised in Table 25.

TABLE 25

Estimated profit on 1 ton of variously vacuum packed groundnuts FOB Alexandria

Packaging material	Unit in grammes	Primary cost of: groundnuts	Primary cost of: packaging	Total primary cost	Estimated selling price	Profit in £E / ton
PVC coated cellophane	50	224	100	324	736	412
	100	224	80	304	668	364
	150	224	65	289	627	338
Laminated alu-foil	50	224	240	464	1,130	666
	65	224	213	437	1,036	659
	100	224	207	431	974	543
	125	224	197	421	913	492

The sales prices were estimated by the Groundnuts Export Department of the Nile Co., Cairo.

The average profit is £E 496 per ton, when six vacuum packaging units are working, and the average profit is £E 462 per ton when three different units are working, and only one with vacuum. Profit analysis is simpler if the profit gained from three different packaging units is compared with that of six identical vacuum packaging units. Average profit in the first case is £E 270 per ton and £E 496 per ton in the second case, an increase of 80%.

Current selling prices are on the average £E 180 per ton (in jute sacks) and fail to yield the State any profit, whereas the projected selling price of £E 869 per ton offers a profit of £E 496 per ton.

4.3. Cash flow analysis

A cash flow analysis was carried out with respect to both the processing and vacuum packaging factory.

In Table 26, expensee and investment are summarised, such expenses being the cost of trial runs, experiments, primary charges and training fees.

The trial run would comprise a 25-day period (two shifts/day). The requisite raw material, supplies and utilitiee, are estimated at 150%. The raw material needed for consumer packaging is 125% for the 600 tons of groundnuts processed (300 tons in coated cellophane and 300 tons in laminated alu-foil, all in 100 g units) and 100% for transportation packaging. Contingency costs comprise 5% of the expenses, which total £E 302,853.

Experiments are planned for a two-week period (two shifts/day) under the guidance of two experts. Raw material requirements are 200%, supplies 150%, and utilities 125%. The goods would be packed in coated cellophane (100 g units). Contingency costs comprise 5% of the other expenses, which total £E 154,333.

Priming charges amount to the equivalent of ten day's stock (150 working hours), depending on storage facilities. Sundries come to 1% of the listed costs which are together £E 103,616.

The training costs of £E 880 cover two one-month periods for two candidates to study operations and quality control methods abroad, in the contractor's factory. This expense was listed in the accessory costs, but was subsequently deducted as it is not depreciable.

All expenses amount to £E 561,682.

TABLE 26

Summary of other expenses supplementary to investment costs

Item	Expenses in £E	Summary of expenses in £E	Remarks
Trial operation:		302,853	One month (two shifts)
Raw material	174,375		150%
Packaging materials	92,903		Consumer packaging 125% Transport " 100%
Supplies	11,606		150%
Utilities	6,512		150%
Labour	3,036		100%
Unforeseen	14,421		5% of expenses
Experimental work:		154,333	Two weeks (two shifts)
Raw material	111,600		200%
Packaging materials	24,970		Packaging in coated cellophane 100% Transport packaging 100%
Supplies	5,571		150%
Utilities	2,605		125%
Labour	1,518		100%
Experts	720		Fees in hard currency ($ 1800)
Unforeseen	7,349		5% of expenses
Priming charge:		103,616	Ten days' stock
Raw material	46,500		
Packaging materials	52,833		
Supplies	3,107		Filter media for one month
Utilities	150		Fuel oil
Sundries	1,026		1% of expenses
Training:	880		Abroad for operation and quality control
TOTAL		561,682	

In the cash flow analysis it was also necessary to estimate the working capital requirements for the processing and vacuum packaging factory for the first year and the years thereafter, as shown in Table 27.

TABLE 27

Estimated working capital requirements for processing and vacuum packaging factory in Egyptian Pounds

Item	1st year	Years thereafter	Remarks
Payroll	1,822	3,643	10% of annual costs
Raw material	96,875	193,750	25% of annual costs
Packaging material	149,000	298,000	50% of annual costs
Finished products	468,750	937,500	25% of annual sales
Supplies	6,462	12,923	25% of annual costs
Utilities	3,616	7,231	25% of annual costs
Accounts receivable	468,750	937,500	3 months of annual sales
TOTAL	1,195,275	2,390,547	

The requirements were calculated as follows: payroll is 10% of the annual costs, whereas raw material, finished products, supplies and utilities are 25% of annual costs. Imported packaging materials run to 50% of annual costs, and receivable accounts are equivalent to three months of annual sales.

It was established that the working capital required in the first year was £E 1,195,275, and £E 2,390,547 in the years thereafter.

In Table 28 the cash flow analysis for the first five years is summarixed. Table 28 shows that the expenses supplementary to capital investment, as estimated in Table 26, are returned within the first year.

TABLE 28

Projected cash flow analysis for processing and vacuum packaging factory

in Egyptian Pounds

Item	1st year	2nd year	3rd year	4th year	5th year
Gross sales revenues:					
Packaging in coated cellophane	501,000	1,002,000	1,002,000	1,002,000	1,002,000
" in laminated alu-foil	1,217,900	2,435,000	2,435,000	2,435,000	2,435,000
Sales losses (0.5%)	8,993	17,185	17,185	17,185	17,185
Net sales revenue	1,709,907	3,419,815	3,419,815	3,419,815	3,419,815
Plant operational costs:					
Processing of groundnuts	461,841	895,216	895,216	895,216	895,216
Packaging in coated cellophane	68,943	112,116	112,116	112,116	112,116
" in laminated alu-foil	274,181	521,997	521,997	521,997	521,997
Total plant operational costs	804,965	1,529,329	1,529,329	1,529,329	1,529,329
Gross margins	904,942	1,890,486	1,890,486	1,890,486	1,890,486
Residual investment	561,682	-	-	-	-
Cash inflow	343,260	1,890,486	1,890,486	1,890,486	1,890,486
Working capital requirements	1,195,275	3,242,562	1,352,076	-	-
Capital from sales	-	-	538,410	1,890,486	1,890,486
Capital outlays:					
Machinery	164,848	173,090	182,754	-	-
Buildings	122,175	128,284	134,698	-	-
Cumulative net equity	-	-	220.958	2,111,444	4,001,930

The working capital requirements (Table 27) will thus accumulate in the first three years. Capital outlay increasing at a rate of 5% per year will be returned by the third year, when net profit also begins to accumulate (£E 220,958). In the years thereafter the cumulative net profit will be £E 1,890,486 per year based on net sales revenue. Sales revenue is calculated at 1,500 tons/year of groundnuts packed in coated cellophane, and 2,500 tons/year packed in laminated alu-foil on a 100 g unit basis and allowing 0.5% for sales losses.

CHAPTER V: CONCLUSIONS

5.1. Materials and processing methods

Following an investigation of the present situation it would appear that both the quality and quantity of groundnuts available permit the establishment of an up-to-date processing and packaging factory. Cultivation, harvest and storage conditions guarantee immunity from aflatoxin and maintenance of quality prior to processing.

As for packaging materials available, it is clear that the raw materials will have to be imported. Low-density polyethylene is suitable for limited shelf-life packaging only. Moisture-proof cellophane would be good for the home market, but the plant capacity is already working at full capacity. Tin cans are produced locally, however, present qualities would have to be changed and supplies are irregular.

The local paper industry can produce adequate wrappings and cardboard boxes both in terms of printed boxes and pre-treated corrugated cardboard.

The present grading and decorticating methods are obsolete. Last year the General Foreign Trade Organization launched a programme in the Nile Co., Alexandria investing in new and modern decorticating plant. Processing lines have been purchased from the United States and construction starts this year. Projected decorticating capacity is 12 tons/hour, adjusted to the harvesting seasons and the expected increase in cultivation.

Groundnuts are currently exported unshelled (30 kg jute sacks) and shelled (50 kg jute bags). Primary costs are £E 150/ton for unshelled nuts and £E 155/ton for shelled nuts: these prices are not profitable.

Production for the home market is de-centralized, the processing methods are old, traditional methods involving manual labour.

5.2. **Marketing**

Of the groundnuts produced, some 10,000 tons/year are exported unshelled and 5,000 tons/year shelled. The sales prices are below the wholesale price, but there has been an upward trend over the last five years. Five years ago the nuts sold at about £E 130-135/ton, in the present season the price was more than £E 180/ton. However, since wholesale price is about £E 190/ton, the operation is still unprofitable.

Purchase prices on foreign markets point towards an upward trend and an increased interest in groundnuts, thus making the industry a good investment proposition.

On investigating foreign market requirements, it appears that all sizes of groundnuts have a market. The types of packages are in two groups: limited shelf-life storage (3-6 months) and unlimited shel-life storage (more than one year). Both groups use bags and containers. The most common packs are the 100 - 3,000 g polyethylene or coated cellophane bag, while vacuum packs are either 50 - 150 g bags in polyethylene or PVC coated cellophane, or laminated aluminium foil.

In the container category, vacuum packed tin cans are used for 125-500 g units, aluminium containers being used for 50-250 g units.

Packaging prices increase in proportion to the shelf-life guaranteed. The most expensive form of packaging is vacuum-packed laminated aluminium foil (approx. £E 1,000/ton), followed by the aluminium container (approx. £E 700/ton), polyvinylidenechloride coated cellophane vacuum pack and tin can (approx. £E 650/ton), the coated cellophane and polyethylene vacuum pack (approx. £E 600/ton) and without vacuum (£E 300/ton) (see Table 20).

5.3. Processing

Consumer demand on foreign markets is for roasted, salted and glazed groundnuts. In view of the quantity and quality of the groundnuts available, investment in two processing lines would appear reasonable. The estimated fixed capital of the processing plant is £E 74,000, the estimated operational costs £E 900,000/year. The primary cost of processed groundnuts is £E 224/ton, an acceptable figure as the purchase price of groundnuts is £E 100/ton and the cost of decorticating about £E 50/ton. The two automated lines guarantee the quality standards and the lines are elastic enough to keep pace with raw material production.

5.4. Experiments and training

In order to determine the most suitable technology and establish operational parameters, experiments have to be carried out. Present research facilities are inadequate for experimentation on the necessary scale. Hence, in order to ensure processing quality, it is recommended that the contract with the equipment supplier state that payment is contingent upon successful experimental work on the three shapes of groundnuts (Table 4) and the establishment of the requisite parameters of operation.

Two training fellowships are also needed for two persons to study operations and quality control methods for a month, whereafter they would return to the plant and accept responsibility for these duties in the factory. This could also be included in the contract.

5.5. Packaging

Basically, the report proposes two solutions to the packaging problem, and variations thereof. The first proposal comprises a packaging plant with three lines; the first packing in bags without vacuum, the second packing in bags with vacuum, and the third producing aluminium containers. The estimated investment costs of this plant are about £E 75,000, the estimated operational costs £E 38,000/year, and the calculated average profit is £E 270/ton. This packaging plant would meet both the requirements of export and domestic markets.

However, on studying the most profitable packaging methods and in consultation with the authorities, it would seem better to concentrate on one form only. The second line meets the domestic requirement that profits be as high as possible, as well as improving hard currency earnings.

It was thus concluded that investment should be made in a packaging plant with six identical vacuum-packing units, using laminated aluminium foil and polyvinylidenechloride-coated cellophane to pack the processed goods in 50-150 g units. The estimated fixed capital costs are approximately £E 113,000, the estimated operational costs, without packaging materials, are £E 50,000/year, and envisaged profit about £E 500/ton on the average.

Comparing the two packaging plants, the vacuum packaging plant clearly offers greater revenue in relation to both export and domestic markets.

5.6. Profitability

The computation of the profit envisaged points to a highly probable increase in the country's export potential. The cash flow analysis shows that investments are recouped in the third year and the requisite working capital will also accumulate during this period.

Profitability would be increased, were the investments to be linked with the new decorticating factory. The average savings would be £E 50,000 in the fixed capital and about £E 5,000/year in working capital.

5.7. Further proposals

With a view to developing Egyptian export potential, the following proposals could be studied:

- The establishment of a packaging factory capable of packing goods to meet foreign market requirements. This plant would be equipped with modern raw material storage facilities, properly conditioned packing areas and storage area for the end-product prior to transportation;

- Development of packaging material production, starting with an expansion of cellophane production capacity and investing in a polyvinylidenechloride coating line;

- Development of national plastics processing capacities to include various types of processed polymers, and establishment of combines producing raw material;

- Possible investment in an aluminium container plant to reduce the import of metal sheeting and to improve packaging quality;

- The establishment of a Packaging Research, Development and Quality Control Centre for elaborating modern packaging methods suited to the special products of Egypt, and enhancing the country's export potential and revenue.

* * * * *

ACKNOWLEDGEMENTS

The author wishes to express his thanks to all those who helped him in his work, in particular Mr. Osman Badran, Minister of Land Reclamation, who showed great interest and sympathy for the project.

He is also deeply indebted to the following persons for information and data they supplied:

Mr. A. AMER, Marketing Manager, The Nile Co., Alexandria
Mr. H. ASHMAWI, Chairman, General Organization of Food Industries
Mr. K. BADAWY, Chairman, The Alexandria Confectionery and Chocolate Co.
Mr. A.M. GAZARINI, Commercial Manager, Misr Rayon Co., Alexandria
Mr. G.D. GHALI, Production Manager, Medical Packaging Co.
Mr. A.M. HAMZA, Director, The Nile Co., Alexandria
Mr. A.M. HANNA, Chairman, Paper Converting Co.
Mr. M. LOUTFI, General Manager, General Organization of Food Industries
Mr. A.F. MASSOUD, Export Director, The Nile Co., Cairo
Mr. A. MOKHTAR, General Manager, Horticultural Research Department of the Ministry of Agriculture, Cairo
Mr. H. NASHED, Ass. Technical Manager, Misr Rayon Co., Alexandria
Mr. A. OSSMAN, General Director, The Nile Co., Alexandria
Mr. I. RASHID, Chairman, El Nasr for Food Canned Co., "Kaha"
Mr. A. REFAAT, General Director, El Nasr for Food Canned Co., "Edfina"
Mr. M. SAFWAT, Head of Food Technology Department, University of Alexandria
Mr. I. SALEH, General Director, the Alexandria Confectionery and Chocolate Co.
Mr. H.M. SALLAM, Planning and Projects Director, Misr Rayon Co., Alexandria
Mr. M. SHATELA, Director, The Nile Co., Alexandria
Mr. S. SHARKAWY, Chairman, The Nile Co., Alexandria
Mr. F. WAKIL, Head of Food Technology Department, Universityof Cairo
Mr. I. ZULAL, Dean, University of Alexandria

He is also most grateful to the various UN personnel for their help and advice, and likewise indebted to Mr. Abd El Kadir FATHI, General Director of The Egyptian General Foreign Trade Organization and to Mr. Ahmed A. HAMMAMY, Director of the Tractor and Engineering Co., and the members of his staff.

LITERATURE

(1) Albert, A., 19[illegible]: Selective Toxicity, Methuen and Co. Ltd., London

(2) Aluminiumwerke Tscheulin GmbH's Offer, 1973: Aluminium Strip for Packaging of Peanuts, Teningen, Germany

(3) Ashton Food Machinery Co. Inc.: Whole-Nut Blancher F B-4 Bulletin Newark, N.J., USA

(4) Barth, G.W., 1970: Snacks und Knabberartikel: Automatisch gesteuerte Erdnuss-Verarbeitungs-Anlage Lebensmittel-Technik No. [illegible]

(5) Barth, G.W., Maschinenfabrik: MENADO-Rapid Roasting Machine D.L. 610308.3 leaflet, Ludwigsburg, Germany

(6) Barth, G.W., Maschinenfabrik's Offer, 1973: Production Plant for Roasted and Salted Peanuts, Ludwigsburg, Germany

(7) Barton, L.V., 1961: Seed Preservation and Longevity, Leonard Hill (Books) Ltd., London

(8) Bauer Bros. Co; Bauer Whole Nut Blancher, No. 340 G-1 Leaflet, Springfield, Ohio, USA

(9) Bauer Bros. Co: Industrial Fans, G-23 Leaflet

(10) Bauer Bros. Co: Nut Roasting and Cooling System, 4-63 Leaflet

(11) Hamac-Höller GmbH's Offer, 1973: Deep Drawing Press, Filling and Sealing Machine, Viersen, Germany

(12) Hassia Verpackung AG's Offer, 1973: Hassia-Packaging Machine, Type TA-I/P, Ranstadt, Germany

(13) Hassia Verpackung AG's Offer, 1973: Hassia-Packaging Machine, Type TA/VAC, Ranstadt, Germany

(14) Neumunz, M. and Sons Inc.'s Offer, 1973: Roasting and Packaging of Peanuts, New York, USA

(15) Pattee, H.E., Singleton, J.A., Johns, [illegible], 1971: Effects of Storage Time and Conditions on Peanut Volatiles, Journal of Agricultural Food Chemistry, 19, 134-137.

(16) Pitman, J.C. and Sons Inc.: Automatic Continuous Deep Fat Frying Equipment, 2 5M1066 Leaflet, Concord, N.H., USA

(17) Probat-Werke's Offer, 1973: Roasting Peanuts, Emmerich, Germany

(18) Pyke, M., 1968: Food and Society, John Murray, London

(19) Woollen, A., 19[illegible]: Food Industries Manual, Leonard Hill, London

* * * * *

76. 02. 09