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**ASSISTANCE
IN LEATHER
PRODUCTION
AND MARKETING**

IL/PDY/75/008

**DEMOCRATIC
YEMEN**

**Technical report:
EXPANSION AND MODERNIZATION
OF THE NATIONAL TANNING FACTORY**

**Prepared for the Government of Democratic Yemen by the
United Nations Industrial Development Organization,
executing agency for the
United Nations Development Programme**



United Nations Industrial Development Organization

United Nations Development Programme

ASSISTANCE IN LEATHER PRODUCTION
AND MARKETING
IS/PDY/75/006
DEMOCRATIC YEMEN

Technical report: Expansion and modernisation
of the National Tanning Factory

Prepared for the Government of Democratic Yemen
by the United Nations Industrial Development Organisation,
executing agency for the United Nations Development Programme

Based on the work of T.S. Krishnan, expert in
leather tanning and finishing

United Nations Industrial Development Organisation
Vienna, 1977

Explanatory notes

References to dollars (\$) are to United States dollars, unless otherwise stated.

The monetary unit in Democratic Yemen is the dinar (YD). During the period covered by the report, the value of the dinar in relation to the United States dollar was \$US 1 = YD 0.350.

One fil is YD 0.001.

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousands and millions.

The following forms have been used in tables:

Three dots (...) indicate that data are not available or are not separately reported

A dash (-) indicates that the amount is nil or negligible

NTF refers to the National Tanning Factory.

The following technical abbreviations are used in this report:

Bf Baumé
o.f. cost and freight
c.i.f. cost, insurance, freight
hp horsepower
kVA kilovolt-ampere
kW kilowatt

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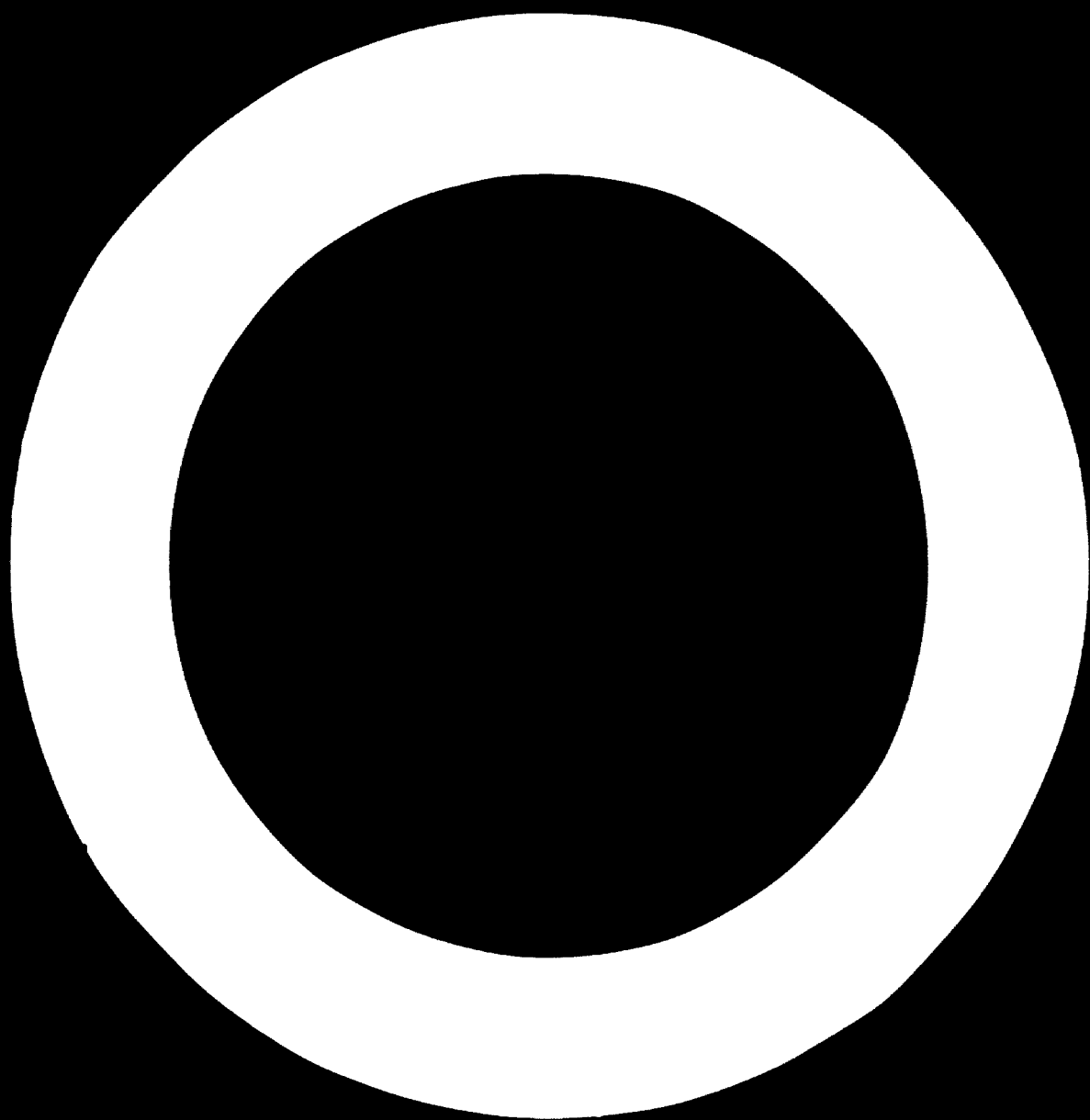
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ABSTRACT

This is the report of the expert on tanning and finishing leather assigned to the project "Assistance in Leather Production and Marketing" (IS/PDY/75/006). The project called for the assignment of two experts to work in part as a team; the report of the second expert, a specialist in the marketing of leather, appears under separate cover.

T.S. Krishnan, the expert in tanning and finishing leather, made an extensive study of the feasibility of expanding the production of leather in Democratic Yemen. His conclusions are that some basic problems need to be resolved to increase and improve this production, among them, the absence locally of good quality raw materials; the obsolescence of machinery and equipment; insufficient repair and maintenance; inadequate water pressure and supply; and a low level of technology.

Among the expert's recommendations are: measures for improving the quantity and quality of raw materials, such as importing live animals from neighbouring countries; the phased expansion and modernization of the tannery; the diversification and improvisation of products; outside technical and managerial assistance; and on-the-job and formal training with United Nations assistance.



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INTRODUCTION

The project "Assistance in Leather Production and Marketing" (IS/PDY/75/006) was requested by the Government of Democratic Yemen in January 1975. It was approved by the United Nations Development Programme (UNDP) and by the United Nations Industrial Development Organization (UNIDO) as executing agency in October 1975.

Democratic Yemen has one tannery using primarily sheepskins and goatskins and a few cattle and camel hides. Its capacity in 1975 was 20,000 skins a month. Most of the output is pickled skin; a smaller amount is wet blue and finished processed skins. The goal of the Government in requesting the project was to increase the production of leather for export to neighbouring countries and to meet the needs for leather of a Training and Demonstration Centre for Leather Footwear and Leather Goods, a UNDP/UNIDO project initiated prior to the present one.

The project document called for the assignment of an expert in tanning and finishing of leather for six months and an expert in marketing leather for four months. The experts were attached to the Department of Industry of the Ministry of Economy and Industry and worked under the supervision of the Team Leader of the Industrial Advisory Unit of the Ministry.

This is the report of the expert in tanning and finishing, whose duties were to study the conditions prevailing in the existing tannery with a view to making recommendations for its modernization and for doubling its present installed capacity. A further objective was to introduce improved technology in tanning and finishing leather.

The expert, who entered on duty 25 January 1976, was obliged to interrupt his assignment for four months for reasons of health. He returned to Democratic Yemen in July 1976 and his contract was extended to January 1977.

I. FINDINGS

The findings and conclusions of the expert are based on the observations and studies made in the National Tanning Factory (NTF), on the data and information made available, on the visits and discussions held with the leather-consuming units such as the footwear centre, canvas belting factory, co-operatives etc., and on the discussions held with the officials of the Ministry of Industry of the Government of the People's Democratic Republic of Yemen.

The National Tanning Factory, a state-owned enterprise located at Sheikh Othman, is the only organized tannery in the country; it has been functioning since mid 1972. Its main activity has been to process pickled goatskins and sheepskins for export and small quantities of finished leathers made from hides and skins for domestic consumption.

In addition, more than 100 cottage tanning units exist in the various other Governorates. Each is operated by a single individual and produce mainly vegetable tanned leathers from hides and skins for cheaper types of sole and sandal leather and for water bags for local consumption.

Until recently the country has been importing footwear and leather goods for domestic use and for sale to tourists. Finished leathers have also been imported in small quantities for the needs of local manufacturers of footwear and leather goods.

The Government has established a Training and Demonstration Centre for Leather Footwear and Leather Goods, aided by UNDP/UNIDO, which is the main consumer of finished leathers produced by the tannery. In addition, finished leathers are required by other consuming units such as co-operatives for making sandals, a canvas belt factory which uses upper leather from hides for straps and pouches and private consumers for making footwear and leather goods. There is also some demand for chamois leather for cleaning purposes and also for suede garment leathers by the embassies and tourists. As the footwear centre plans to increase the production progressively, the requirement of finished leathers will be more in the future. The Government is also contemplating putting up another footwear unit by the middle of 1978 using the injection moulding process, and the target includes 75,000 pairs per annum with leather uppers.

The Government is anxious to expand and modernise the tannery in a phased manner, so that in the coming years it can fully utilise all the available raw materials in the country. The primary object of the expansion and modernisation is to increase the output of all kinds of leathers and to improve the quality of finished leathers to meet the local requirements, and to export finished leathers gradually in place of pickled skins in order to get more added value.

A. Prevailing conditions in the existing tannery

Production

The tannery produces mainly pickled goat skins and sheepskins for export to Italy. In addition, small quantities of finished leathers such as retan uppers, hunting suedes, sole and linings are made from cattle and camel hides as well as linings (natural chrome and vegetable tanned) from pickled rejects mainly for domestic consumption. Occasionally, small quantities of chamois and suede garment leather are processed for local sale. From the tannery records for the past 3 years (1973-1975), it may be seen that on an average the tannery has been processing about 400 skins per day into pickled for export and about 20 to 25 hides per day into finished leathers.

Quality of production, types of leathers for domestic demand and price structure

The retan upper leathers from hides are very firm and boardy in feel, loose and of uneven thickness.

Lining leathers are usually firm in feel since they are nailed wet and dried. No staking is done for upper or lining leathers.

The sole leathers processed are not of real sole-leather quality with the solidity and firmness that could be used in factory-made footwear. They are soft and spongy in the absence of full vegetable tanning, setting out, further finishing and machine rolling. There is a certain amount of local demand for their use in the country chappals and sandals since these are easy to cut and stitch.

Before the arrival of the expert the pickled goat and sheepskins had scud and short hair by which the quality was downgraded. Now in some of the lots, because of improper control in processing, the problem of scud and short hair remains.

The chamois leathers made by the pure Immergan tanning during last year were found to be poor in tear strength and did not have the soft chamois feel.

The small quantity of suede garment leathers produced from skins is good from the point of view of feel, softness and nap but because of shaving on the flesh side to level the substance, there is an unevenness in colour in the backbone regions.

Hunting suedes made from cattle and camel hides are satisfactory, except for the flay outs and the poor penetration of dye.

Local demand for upper leathers is mostly from cow and camel hides. A substance 1.6 to 2 mm is used both by the footwear centre for making unlined shoes (for men) and by the canvas belt factory. Hence many of the light substance hides and calfskins, even though they can be converted into uppers, are processed only for linings, fetching less returns.

In the pickle assortment, more emphasis is given to the sizes and short hair and scud. Though grading depends on an agreement between the buyer and the producer and on the price, it can be improved to bring a better price depending on the end use.

Prices of finished leathers for local demand seem to be high, particularly in the case of upper and sole leather. No grading is done in the case of upper leathers.

Availability and quality of raw materials

Until recently, out of the total procurement of skins by the tannery, more than 50% are from live animals imported from Somalia for meat. The hides and skins from the slaughterhouses of Aden are made available to the tannery in the green stage; in the curing department the raw materials are washed, cured by salt, dried and stored. The tannery has also set up a procurement centre in the III Governorate to cure the hides and skins from slaughterhouses. Less than 10% are obtained from the other Governorates (II, IV, V and VI) in the form of dry-salted and air-dried skins. Although a considerable quantity of skins is available in the V Governorate, both in slaughterhouses and from private killing, the collection and curing are not up to standard and the tannery is hesitant to buy them in the air-dried/dry-salted stage from other Governorates, for the obvious reason that the quality is not known until they are soaked and limed.

The slaughterhouse statistics indicate that appreciable quantities of kids, lambs, calf and female animals are slaughtered. The Government has recently enforced legislative measures to prevent the slaughter of such animals. The law can be largely enforced in slaughterhouses, but in private killing, which may be 2 to 3 times that of slaughterhouses, it can not be followed unless the concept of slaughtering the animals at a reasonable age is made law in order to get more in return for the meat and the skins.

Somalian skins (goat and sheep) are thicker, bigger in size and better in quality compared with the local breed. Local breeds of goatskins and sheepskins are fairly good in general from the point of view of structure, strength and grain pattern except for their thin substance flay outs and small sizes. The sheepskins are nearer to hair type (with short wool) which is advantageous from the point of leather processing, and they are practically free from natural fat. Most of the kid skins (less than 2 ft²) are not utilized by the tannery and are exported in the raw state.

Cattle hides and camel hides suffer mainly from flay outs and holes and from poor curing. Camel hides are available mostly in dry/dry-salted stages.

Of late, the Government has been importing live Australian sheep (Merinos and hybrids) with the wool clipped, instead of Somalian goat and sheep. The skins of Australian sheep, although large in size, are found to be poor in quality because the grain has been damaged severely in most skins from shearing. In addition, ribs and fat pockets which are typical of Australian sheep make them unsuitable. Generally, the Australian sheepskins fetch very low prices in international markets because of the fat pockets and ribs and also because of the poor stitch tear resistance. Most of them are suitable only for lining leathers.

The tannery has been for years processing pickled skins for export from both Somalia and of local origin approximately in the ratio of 1:1. By mixing, the tannery has been able to get all grades in the pickle for export in a workable percentage. With local grades alone the grades and sizes will decrease unless adequate husbandry measures are adopted such as prevention of damages caused by micro-organisms and parasites, proper flaying, curing and collection.

A few lots of Australian skins when pickled revealed only rejected and lower grades. It is doubtful whether such skins would have an export market and if so whether a workable export price could be obtained. It might be a

better idea to export them in raw dry-salted form since some fur tanners might be interested even in short wool skins. The local demand for lining leather is small; hence, converting them into lining leathers may not be feasible.

All these findings pose a problem whether the tannery will get enough raw materials for its present production and for stepping up production. One solution would be to export the Australian sheepskins in the raw and to import in their place raw materials from Somalia and neighbouring countries. This may be a temporary solution for the immediate future, since the other countries may also think of banning export of raw materials in due course. In addition, as the prices of the raw materials depend on the world demand, there will be frequent fluctuations and whether a workable price could be obtained has to be considered. As it is the country must try to be self-sufficient by improving the livestock and by mobilizing all the raw materials available.

More details about the raw material base are supplied in the report of the marketing expert.

Buildings

		Existing covered area (m ²)		
<u>Year</u>		<u>Works</u>	<u>Stores, office buildings, w.o. etc.</u>	<u>Total</u>
	1960	780	220	1,000
(addition)	1972	160	60	220
(addition)	1975	<u>220</u>	<u>25</u>	<u>245</u>
		1,160	305	1,465

There is a lot of open space on either side of the tannery. There is also a building with some covered area for curing and storage of raw materials and for storage of chemicals.

The tannery's capacity is limited in the prevailing conditions and the quality turned out is far from satisfactory. The constraints are many; they are listed below.

Lack of covered space and improper layout. As the bays are small in width with narrow passages, there is very little working space for movement of goods, piling, storage, weighing and preparation of chemicals etc. A huge stock of

pickled rejects may be seen simply dumped into a pit in a heap and left exposed to dry. Lack of covered space poses difficulties for drying and finishing. In the present area, it is difficult to step up production unless there should be additional buildings.

Poor performance of the existing machinery and imbalance in the machinery and equipment. As most of the machinery and equipment are old and as proper maintenance is lacking, there are frequent breakdowns with the result that even the little production that is being done now accumulates at various stages of processing. All of the three drums present leak since the doors cannot be repaired. The mechanical shaving machine, paddles, skin-fleshing machine, plating press, spray machine, all have frequent breakdowns affecting the production.

Lack of adequate machinery. For making finished leathers, certain machinery and equipment such as sammying machine, splitting machine, setting machine, brushing machine, hydraulic press with different plates, electrically hand operated setting machine (for sole), toggling unit etc. are essential and these are lacking. Certain sophisticated machinery such as a vacuum-drying unit, vibratory staker, fini-flex may also be necessary for improving the quality, particularly for exportable types of leathers.

Lack of adequate water pressure and supply. The water supply is from the Public Water Corporation and the charges are about 250 fils per 1,000 gallons. The present supply of water in the wet yards is very poor because the pressure in the main supply is inadequate. The water pipes in most of the yards are of 1 in. diameter and the tap points are not sufficient. There are no overhead tanks, and when beamhouse is drawing water, the tanyard supply is negligible, resulting in considerable delay in processing and no float control.

The temperature of water from water taps increases as the day advances. The temperature goes up to 38°-40°C during the noon hour in summer. Using water at such high temperature for certain operations such as soaking, liming, pickling, chrome and vegetable tanning may be harmful.

Water has a great deal of temporary hardness, though the exact chemical analysis is not available.

Lack of hot water supply. At present there are no facilities for hot water supply; water must be heated in iron drums. To have enough hot water for dyeing and fat-liquoring and for dissolving the dyestuffs and chemicals is a problem even for the present small production.

Poor drainage. Drainage channels in the wet yards are very narrow and not deep enough; hence drainage takes a long time. When soak, lime pits, paddles and drums are drained at the end of the operation, the whole yard is flooded and the leather that is piled nearby or that is draining from another drum gets contaminated and stained.

Lack of proper maintenance. As already mentioned, there are frequent breakdowns of machinery and equipment and proper maintenance is lacking. Periodical overhauling of the machinery, which is a must, is not being done. For example, the measuring machine gives different readings each time it is fed; the actual measurement is arrived at by adding the difference. Most of the time the area of leathers recorded appears to be less. Similarly the only spray gun often becomes blocked.

History sheets on the machinery and spare parts are not properly maintained. There is a lack of trained personnel in the repair and maintenance division for locating and identifying the defects and rectifying them.

Lack of simple equipment and tools. Weighing machines (platform and hook type) and thickness gauges show incorrect readings and they should be replaced. Similarly, other accessories required such as buckets, measuring cylinders, wooden horses, duck boards and trolleys are too few, causing delays in production.

Delay in procurement of chemicals and spare parts. All chemicals excepting salt and lime must be imported. The tannery was without stocks of some essential chemicals such as chrome and mimosa extracts for more than three months, and accordingly no production could be carried out during that time. As the chemicals are mostly imported from China, the Federal Republic of Germany, Spain and Switzerland, there are bound to be delays because of the long distance and inadequate shipping facilities. There is no planning to have on hand a minimum stock of chemicals and spare parts.

Low level of technology. The existing staff and foreman in the tannery have only a minimum understanding of:

- The objects of the various operations in leather processing
- The chemicals used and their functions
- Newer chemicals and auxiliaries
- Check controls to be adopted in the various stages of leather processing
- Process improvement
- Cost consciousness
- Programming and planning

The above are all necessary, not only for ensuring regular production and smooth flow but also for improving the quality and controlling the cost. Constant changes are taking place in tanning and finishing, both in the improvement of processes and in the development of newer auxiliaries and one has continuously to keep abreast of the developments.

Other findings and observations

Details such as the availability of raw materials, sizes, weight ranges, yield, assortment particulars, grades in finished leathers, stock, production figures, cost of production etc. are not given importance. No costing is being done for the various types of leathers. As the essential data are not recorded, it is difficult for management to follow up on production which would give insight into the cost of individual products. The results of activities are checked mostly by making a simple comparison of income against expenditure once in a year. The overheads appear to be high for the present production. In addition, the productivity of men and machinery is low.

The customs duty levied by the Government is as follows:

For imported raw materials, 30% on the value

For imported chemicals, 5-15% (depending upon the chemicals)

For imported finished leathers, 40%

The working hours of the tannery are from 7 a.m. to 3 p.m. with a weekly holiday on Friday. On Thursday, the tannery works until 1 p.m. There is no staggering of working shifts or the use of a skeleton staff on holidays for carrying out essential operations.

The working capital requirement of the tannery (until last year) was about 50,000 dinars (YD). It is drawn from the National Bank of Yemen at an interest of 5% per annum.

Effluent at present is simply let out for evaporation in an open space at the back of the tannery. The salt pans are very close to the area where the effluent is released. The salt industry people already object to the effluent disposal. If the production is stepped up, there will be more effluent and there is insufficient space at the back of the tannery to treat it.

B. Analysis and suggestions for technological, technical and other improvements in the present tannery

Grouping in size weight/ranges, classification and grading of raw materials should be followed in the curing and raw yard, so that raw materials of the same size/weight range etc. are taken for one lot. This will ensure uniformity and control in processing.

Lot numbers and cards should be introduced when a lot of raw materials is taken for processing. Lot cards should be filled in at various stages of the processing with details such as type of raw material, type of cure, origin, number of pieces, weight ranges and sizes, weights, assortment details and grades, substance, final yield and grading. Besides these, the dates on which the different operations have been carried out and the percentage and actual amount of chemicals used should be indicated. In time the data built up will be useful for the management in both technical and commercial planning. This system should be introduced for different types of raw materials and product mix without further delay.

Soaking of air-dried/dry-salted raw materials should be done well, so that they are softened well in regaining the moisture content. The present method of dumping too many skins in a pit overnight without sufficient water and taking them immediately for liming should be abandoned. Most of the skins, including hides, are undersoaked and carry an excess of salt to liming. This prevents easy removal of hair. Soak aids and preservatives should be used for accelerating the soaking. Breaking open in the fleshing machine will help in making soaking easy. Otherwise, dry drumming for 20 to 40 minutes, followed by soaking and washing, may be done. Too prolonged soaking in tropical countries should also be avoided when the temperature is high. Soak aids and preservatives must be used to accelerate soaking of dry-salted and air-dried raw materials.

In the addition of sulphide to the liming bath, it would be better if a stock solution of sulphide, containing a known amount of sulphide, were prepared the previous day by dissolving with boiling water. Depending on the weight of the skins in each paddle, the correct quantity of sulphide can be added by adding the required quantity of stock solution. In the present system, sodium sulphide lumps are taken and dissolved in hot water in iron drums and heated up prior to its use. An appreciable amount of sulphide lumps remains undissolved since dissolving sulphide lumps take time. As it dissolves, the supernatant

liquor is added to one paddle; more water is added and the solution is boiled. Besides the wastage of sulphide (undissolved lumps are thrown out), it is uncertain that the correct quantity is being used for the different paddles. Alternatively, sodium sulphide flakes may be procured and used.

The present weighing machine (platform type) does not record the correct weight; thus weighing skins and chemicals poses a problem. It is not certain that the correct quantity of chemical is being used; for example, from the records and from observations, the soaked weight is seen to vary from 1,000 to 1,400 kg for about 800 skins of the same size and cure. Similarly, the fleshed weight for the same size varies from 65% to 100% of the soaked weight. When chemicals are based on soaked and fleshed weights, it may happen that more or less chemicals are used for certain lots. Thus there cannot be any control in processing. Procurement of two weighing machines (platform type) to weigh up to 1,000 kg and two pan type of balances to weigh up to 20 kg is an immediate necessity.

The present method of liming skins in paddles for a day with 2% to 3% sodium sulphide and 4% to 5% slaked lime does not produce plumpness for fleshing. When fleshing is done at this stage, because of the insufficient plumping, more pressure has to be applied in the fleshing machine and there is a possibility of losing substance. Either the sulphide has to be increased, followed by brief rinsing, or after reliming in the pits fleshing has to be done when the skins are plumped up.

The skins after fleshing are relimed in pits for 2 to 3 days. Very often no handling is done. The handling of skins in lime pits should be done at least once if not twice a day to create movement.

Trimming of the skins to remove long shanks etc. has to be done in the raw as well as after fleshing, to prevent the knotting of skins in the drum and to avoid chemical wastage. At present no trimming is done in the raw or after fleshing. But finally, in the pickled stage, prior to packing for export long shanks are out because the buyers insist on their being out. On an average about $\frac{1}{2}$ ft² per piece of $4\frac{1}{2}$ ft² is out; this works out to 11%. Chemicals could be saved by trimming mostly in raw form and of any overlooked portion in fleshing.

Because of the poor supply and pressure of water, essential washing operations or the correct amount of float for treating with chemicals is never

followed. Washing before and after deliming with plain water not only cleanses the pelt but also reduces the alkalinity, whereby the consumption of chemicals in deliming and pickling is less.

The amount of deliming and bating agents and the duration of their use should be determined for different sizes/weight ranges and for different types of raw material. Small skins are overbated so that during manual soudding operations the grain is damaged. Though this is the cause of damage for certain lots, the damage is also attributed to poor cure.

Weighing the required quantity of chemicals and the preparation of chemicals like dissolving etc. should be done sufficiently early, and the amount should be kept ready for adding to avoid delay.

Check controls must be done for the various operations like soaking, liming, deliming and bating, pickling, chrome tanning, neutralization, dyeing and fat liquoring, so that, besides getting the desired effect in a lot, there may not be appreciable variation from lot to lot.

Tests for feel of the goods, testing the cross-section with indicator solutions and end-liquors with short-range indicator papers, boil tests and testing exhaust of the liquors should be done regularly for each lot, to ensure uniformity.

Presence of short hair and soud in pickled skins downgrades the quality; such defects can be avoided to a great extent by good soaking, liming with correct quantity of sulphide and lime, handling of lime pits, dry drumming of the bated skins with nonionic detergent, and supervision of the manual soudding operation. A few lots were done under the guidance of the expert. These lots were free of short hair and they were also cleaner than the normal lot. The method of hand soudding in the direction of the hair roots was also shown to the workers, for easy removal of soud. As the manual-soudding operation involves much skill, the expert suggested the conversion of the mechanical fleshing machine into a soudding machine. Action has already been initiated.

The preservative treatment followed at present for the pickled skins is not effective since most of the preservative is drained out. Preventol CMK (Para chloro meta cresol), which is being used, is soluble only in an alkaline medium or in spirit. It would be better if soluble sodium salts of preservatives like Preventol liquid 1, Preventol B (Bayer), Topane WS (ICI) or a similar

product were used. For the existing stock, stock solutions could be prepared by dissolving with caustic soda. The exact preparation may be found in Bayer's leaflet which has been given to the counterpart.

Dilution of sulphuric acid with water should be prepared sufficiently early so that the diluted acid is cooled prior to pickling. Moreover the temperature of the water supply during the noon period when pickling is done is about 38° - 40° C; it would be better for pickling and tanning if water were stored in pits during the night so that the temperature would not be so hot.

As the buyers of pickled skins want an end pH of 1.5 to 1.8, the optimum amount of acid required to get the correct pH in that range should be determined for the different sizes, so that the entire amount of acid after dilution may be added initially in feeds. The skins may be run with acid and salt for a time and left overnight in the bath to attain the median pH. pH should also be checked prior to leaving the skins in the bath overnight. The next day, after running for 15 or 20 minutes, the pH may be checked. Any correction in pH (if slightly high) may be done by adding a small quantity of acid and running for a time. In the present system about $1/2$ to $2/3$ of the total acid is added initially; the following day, because the pH is high, the remaining acid is added, the skins are run for 15 to 20 minutes, after which the pH is checked and the skins are taken out. This does not give the correct pH and a variation in pH may be seen in the pickled lots of from 1.8 to 3.5.

Pickled rejects should be piled to a reasonable height and always kept wet by covering with a plastic sheet, until they are taken for further processing. The pile should be frequently handled so that formation of heat is prevented. Any partially dried end portions may be wetted with used pickled liquor.

At present a huge stock of pickled rejects are dumped and left exposed without covering. During the afternoon they are even exposed to sun. Creases and folds, formed because of the pressure, will be difficult to get removed by normal processing. Furthermore, if skins are allowed to dry and are exposed to sun, the quality and tear strength will be poor. Because of a lack of drums, the skins cannot immediately be processed into lining leathers.

Looseness in the upper leathers made from cattle hides is one of the main problems faced by the tannery. Besides the inherent quality of the raw material, all operations from soaking to fat liquoring, and post fat liquoring operations

such as drying and staking, play an important part. To reduce looseness, good soaking, short liming with sulphide and less lime, deliming to $2/3$ extent, full tanning, keeping the tanned stock in moist condition before and after shaving, rechroming, proper neutralization, the optimum amount of retanning agents, and the proper blend of raw oil and sulphated oils in fat liquoring are generally necessary, with check controls at many stages. Proper attention is not paid to these factors at present. Reliming is sometimes done for two days which is too long. Bating may be dispensed with since it may increase looseness. A bating agent of not more than 0.2% may be used for a short duration. Looseness may largely be avoided if the chrome-tanned stock is not allowed to dry completely before and after shaving. Previously, there was only one mechanical shaving machine which frequently broke down. Recently, a double-width hydraulic shaving machine has been installed and shaving should not now be a bottle neck. Though a sammying machine may help in conditioning the tanned stock for shaving, until this machine is procured the tanned stock may be hooked up in a shady place watched by a worker; when it is ready to be removed, it should be wetted immediately on partially dried portions, if any, with moistened gunny cloth or a brush, taken for shaving or piled and covered with plastic sheet until it is removed for shaving. Control in neutralization is necessary since over-neutralization causes looseness. Vegetable tannins like mimosa extract should be used with other retanning syntans and resin tanning agents to fill up. Use of vegetable tannins will not only help in filling up but will also decrease the cost. Two lots were processed by the expert who demonstrated to the management the advantages of better filling up and reduction in cost of retanning. In fat liquoring, sulphated and sulphided oils with emulsifying agents and no raw oil are used, which again may cause looseness. It would be better if $1/3$ to $1/4$ of the total fat liquor contained raw oil such as neat's foot oil. On the suggestion of the expert, raw neat's foot oil has been imported.

In order to sort out upper, hunting suede, lining and sole leather, the hides are lightly chrome-tanned with about 4% chrome extract (Chromosal B). Pre-shaving is done to sort out upper, hunting suede etc. Because of insufficient tanning coupled with the drying of the stock, the shaving operation becomes difficult and considerable heat is produced, which affects the quality. If it is not possible to assort leather in liming, pre-chroming may be done and after assortment for chrome and vegetable, the chrome assortment may again be chrome-tanned fully and later shaved and assorted into upper and hunting suedes.

In the absence of a splitting machine, the substance has to be reduced by shaving only to the required thickness. There are sides of about 4.5 to 5 mm thickness, and considerable time is taken for shaving the substance to 1.8 to 2 mm. Chattering marks and cuts are caused when more pressure is applied by the worker. Recovery of the splits is also lost. Productivity of the machine is also less. In the opinion of the expert, confirmed by the findings of the footwear unit, the finished upper leathers are thicker than required. The supervision in shaving is inadequate for checking the correct substance. The only thickness measuring gauge is often under repair and gives incorrect readings. The procurement of two measuring gauges is an immediate necessity. It is essential that the tannery procure a mechanical splitting machine as soon as possible; not only will it help in easy shaving and in maintaining the required substance, but also in the recovery of splits. Splits form an important by-product in upper leather production the profitability of which largely depends on the recovery of splits and their conversion into finished leathers.

Some of the finished leathers from splits such as splits-suedes and splits-grain finish may supplement the upper leather for local demand. If the thickness in shaving is kept greater than the desired end-thickness, the chemical consumption is also greater. Based on the work done by the expert, about 20% to 25% less chemicals could be used in post-tanning operations if proper care were taken in shaving to the required thickness. Too much shaving in belly regions should be avoided and it is advisable to touch them lightly, to remove the loose flesh.

In the absence of a setting machine, the sides are hand set (just to remove water) and wet nailed to wooden boards. Though this method is not advisable, it has to continue until the setting machine is procured since growth marks, wrinkles etc. are removed to some extent by wet nailing. No doubt the wet-nailed leathers are firm and boardy in feel, but there is no better solution except to suggest that the drying be done in a shady place rather than in the sun. The tannery must procure a reversible hydraulic setting machine; meanwhile, a suitable machine that can be used for sides and skins should be used.

Hand-setting tables should be topped with formica since the present ones cause stains from the absorption of dye, oil etc.

Hand-setting and nailing departments have to be strengthened since fat-liquored lots lie for more than a week. More drying boards are necessary to step up the production. The unit has to procure a setting machine to overcome all these difficulties.

Hook drying of certain leathers such as hunting suedes, suede garments, vegetable tanned linings and soles etc. is done at present by introducing a pole through two slits made near the rear shanks and keeping the pole over two hooks near the ceiling of the roof; this practice is not advisable. It may save space but it consumes much time and often the dried leathers fall to the floor and get wet or stained. Because of the big slits made they must be trimmed, resulting in loss of area. Hook drying may be done by using wooden frames with brass hooks.

As no conditioning or staking is done, the upper leathers and lining leathers from skins lack roundness and suppleness.

Trimming at various stages such as during nailing, in crust and in finished leathers, is done to a great extent. Hides and skins have to be trimmed during their processing so that all unnecessary and useless parts of the leather are removed. This is normally done by workers who know where and how much to trim. But the practice of trimming excessively in the crust stage, using razor blades, should be halted immediately. The use of trimming knives should be introduced and minimum trimming should be done to remove the nail marks and any unnecessary portions. Supervision is quite necessary to avoid the huge loss. The expert observed that the excess trimming in the crust stage alone would amount to about 0.75 ft^2 per an average side of 11 to 12 ft^2 . Assuming that the daily production of uppers, hunting suedes, linings and sole is 40 sides, the loss may be about 30 ft^2 . If the entire quantity is upper leather, the loss to the factory per day is about YD 9.00 (YD 0.30 per ft^2). Strict supervision is also necessary in the nailing yard to see that the nailing is done at the edges as far as possible and not in the middle.

The finishing yard should be free of dust which is not the case at present. Buffing machines are not provided with dust collectors; hand brushing to remove the dust causes floating dust, which is not good while finishing (pad-coating and spraying). The floor in certain sections of the finishing yard is damaged to a large extent and the dust from the floor also causes difficulties; the floor needs immediate repairing. Buffing machines should be provided with long bags outside the tannery so that the dust is collected and emptied frequently. As hand brushing is not effective, a brushing machine is suggested for dust removal. Until it is procured, hand brushing may be done on a table near the wall with an exhaust fan fitted into the wall so that the dust is sucked out. It is advisable to remove the buffing machines to a closed room, away from finishing yard.

For impregnation to improve looseness, suitable impregnating resins such as Filler MS (Eamshaw) or Leather Ground FS (BASF) may be tried. Soft, medium and hard types of acrylic resin binders may be necessary for suitable finishing.

The present method of using local shearling wool pad for hand seasoning should be abandoned. After short usage the shearling pad gets knotted up, produces pad marks, and does not absorb the seasoning. Pads using plush cloth or the proper type of brushes should be used. The expert had brought plush pads along with him and demonstrated their advantage. The tannery has been asked to import 1 to 2 metres of plush cloth.

The spray gun often blocks and thus needs repair. One more spray unit is essential to cope with the production and also to speed it up.

The felt in the Gloria press should be replaced; the present felt is uneven and damaged. The plate should be cleaned with a cloth soaked in thinner after each colour; this is not now done and some of the previous colour is transferred from the plate to the leathers of the next batch. Sufficient pressure and temperature control are not possible since the machine is too old. There is only one embossing machine which is not being used. Even for printing, this machine may not be suitable for production because of the possibility of overlap in many portions when sides are printed.

It is essential that the tannery procure a hydraulic press as soon as possible. Besides the smooth plate and hair-cell plate, some other embossing plates such as Zug grain, shrunken grain, pig grain, baby crocodile grain, lizard grain, morocco and moon print may be purchased along with the hydraulic press. Grain-damaged sides, which are now found unsuitable for plain finish, and some of the very loose leathers could be upgraded by printing them with attractive designs and finishing them further into two-tone colour so that they could be used as uppers. Some of the sole leather selections could be diverted for printed leathers. In the future army uppers (Zug grain) can also be made since some of the cattle and camel hides are thick.

The measuring machine needs immediate repair. The tolerance of a measuring machine is generally $\pm 2\%$.

Periodical overhauling of the machinery, preferably on holidays, should be done to avoid breakdowns.

Spare parts for the various machinery and equipment should be stored in separate bins, so that they can be easily identified and orders for spares can be expedited.

Staggering the working shifts in some essential yards and employing a skeleton staff on holidays have to be introduced for carrying out certain essential operations in order to use the machinery to the maximum and to have a regular output.

The tannery may use the help of the UNIDO expert in cost accounting of the Industrial Advisory Unit in introducing systems for cost control. This expert indicated in his report on the leather centre the need for cost consciousness from the slaughterhouse stage to the final use of the leathers at the centre. His observations are borne out by the fact that there is no control in the slaughterhouses and tannery, and control in the centre has just started. He also feels that a thorough investigation is necessary for introducing systems.

Field work was done by the expert in the tannery. Improvements in processes of making retan uppers and chamois leathers were demonstrated. The retan lots that were processed showed better filling up and better grading at a lower cost, thereby proving the value of the process. The process of converting Australian sheep skins to vegetable crust was also demonstrated. Trials done in processing camel necks into insole demonstrated that but for poor curing and bad flaying, they could be converted into upper leathers which could supplement the upper leather for local demand.

For thin and defective skins, vegetable tannage may prove better since it would upgrade the skins. Pickled rejects and skins that are unsuitable for chrome tanning for wet blue export may be vegetable tanned and assortment made from the crust for further processing into different types of finished leathers, such as garment, upper, woven leathers, gas-meter leathers, linings and printed leathers. It may be better to make vegetable crust and export in the place of even wet blue, because of the following advantages:

- (a) Improved grade and substance;
- (b) Saving in freight charges;
- (c) Possibility of accurate measurement and weighing;
- (d) Wide scope for buyers to process into different kinds of finished leathers.

The addition of three more drums will help to a major extent in preventing goods from accumulating at the various stages and also in ensuring smooth flow. An experimental drum is also necessary for small-scale trials to standardise the processes.

Some of the lower quality skins can be converted to chamois leather by combination tannage of formaldehyde and fish oil and production can be stepped up since fish oil is available locally and there is internal demand. Export potentialities to neighbouring countries also exist.

Shaving on the flesh side of wet blue skins to level the substance, in processing suede garments, should be avoided since it causes uneven colour in the backbone regions. In the crust stage, after initial buffing, assortment may be done for suede garments; levelling if necessary, may be done at this stage on the grain side by buffing or dry shaving.

The amount of syntan used for sole leather can be reduced considerably to cut down the cost. Bleaching syntans, which are less costly than the other retanning type of syntans, can be used finally along with bisulphite and oxalic acid for bleaching. Treatment of sole leather with epsom salt (magnesium sulphate) finally before oiling will help in fixing the tannins. To improve the colour, sodium bisulphite (about 5% on the weight of mimosa solid extract) can be used along with the mimosa extract for tanning.

Spray-dried (bleached) mimosa extract may be used for the vegetable tanning of skins to give a lighter colour that may be preferred by buyers. Even for retanning of side leathers, spray-dried extract may be more advantageous.

Goat skins of thicker substance could be resin finished and used to substitute uppers by suitable retannage and grain correction.

By ensuring a regular input and output, by procuring machinery and by saving chemicals, it would be possible to reduce the local selling prices of upper leathers and sole sides, and to improve the quality.

II. PROCESSES DEMONSTRATED BY THE EXPERT IN THE NATIONAL TANNING FACTORY

A. Retan upper leather from cow hides

As the retan upper leathers made in the factory are generally loose and firm in feel, a lot was taken for processing. Raw materials: 50 pieces of dry-salted cow-hides of medium-weight range of local origin. (Dry-salted weight of 50 pieces = 320 kg.)

First day. Soak
(in pit): 800% water and 0.5% Gismollan BH. Duration, 18 h

Second day. Take out and dry drum with 50% water for 1 h, to soften.

Wash
(in drum): 500% water. Run for 45 min; check for proper soaking; drain. (Soaked weight of 50 pieces = 650 kg.)

Liming
(in drum): 60% water (on the soaked weight). Add 1.5% sodium sulphide solid (60%-62%) dissolved in hot water and cooled and 1.5% slaked lime powder. Run the drum for 10 min and stop for 50 min. Add 1% sodium sulphide (after dissolving) and 2.5% slaked lime. Run for 5 min and stop for 55 min. Flood with 200% water, run for 10 min and stop. For the remaining duration, run for 2 min once in 3 or 4 h. (Total duration 22 hours.)

Third day. Run for 5 min; drain the lime bath with lattice door.

Wash: 200% water. Run for 10 min and drain. Machine flesh; cut into sides; trim; weigh. (Fleshed weight of 50 hides = 615 kg.)

Wash: 150% water. Run for 25 min and drain.

Delime: 150% water. Add 0.5% sodium bisulphite as powder. Run for 15 min. Add 1% ammonium sulphate dissolved in 10% water in 2 feeds at intervals of 10 min. Run finally for 40 min. Check for 2/3 deliming with phenolphthalein. Drain.

Wash: 150% water. Run for 20 min. Drain.

Pickle: 60% water, 8% common salt, 0.5% calcium formate. Run for 10 min and check for B₆ (8 to 9 B₆). Add 1.5% sulphuric acid after diluting with 15% water, in 3 feeds at intervals of 15 min. Run finally for 75 min.

Fourth day. Run for 15 min. Check pH of the bath and cross section (pH 3.1 to 3.2). Drain half the pickle float. Add 10% Chromosal B as powder. Run for 75 min. Check penetration. Add 40% water and run for 15 min. Basify by adding 1% soda ash dissolved in 15% water in 5 feeds at intervals of 15 min. Run finally for 5 to 6 h. (As there was no time after running finally for 3 h, the goods were left in the tan bath overnight. pH showed 3.7.)

Fifth day. Run for 20 min. Check pH and boil test for 2 min (pH 3.5 after boil test). Drain the bath and horse up for 2 days.

(In the absence of a sammying machine or hook-drying facilities for conditioning prior to shaving, it took about a week for proper conditioning of the sides.)

Assort the tanned sides for retan upper and hunting suedes: 71 sides for retan upper and 29 sides for hunting suedes. (In the absence of a splitting machine, the sides have to be shaved to a substance of 1.8 to 2 mm since finished leathers of such thickness are in demand by the footwear unit for making unlined shoes for men.)

Shave retan upper sides to 1.8 to 1.9 mm. (Initially, under the expert's supervision, about 10 sides were shaved to 1.8 mm. Belly portions were lightly touched to remove loose flesh without undue shaving. The shaver was instructed to shave the remaining sides in the same way, but he did not since the finished crust sides showed thicknesses of 3 mm and more.) There is no proper supervision of the shaving yard.

In general, one of the criticisms of the upper leathers besides looseness is that they are thicker than the required substance and uneven. The only leather-thickness measuring gauge available gives a faulty reading which sometimes deceives the shaver. Proper allowance is not given for the substance built up in retanning. If the shaving is not proper for the same number of sides the shaved weight will be more when the thickness is greater. As chemicals in post-tanning operations are based on the shaved weight, more chemicals are being used. In the opinion of the expert about 20% to 25% of chemicals could be saved if proper care were taken in keeping the desired correct thickness in the shaved sides.

It appeared that for the lot, the shaving was done to 3 mm instead of 1.8 mm. (Shaved weight of 71 sides = 250 kg.)

If correct substance of 1.8 mm is kept, the shaved weight will be 200 kg instead of 250 kg.

Eighteenth day. Wash: 150% water. Run for 10 min. Drain.
Reochrome: 60% water. Add 2% Chromosal B, 0.3% calcium formate and 0.2% soda bicarb as powder. Run for 90 min. Drain. Horse up.

Nineteenth day. Wash: 150% water. Run for 15 min. Drain.
Neutralize: 150% water. Add 1% calcium formate and 0.5% Tanigan P2 as powder. Run for 20 min. Add 0.5%

soda bicarb dissolved in 8% water in 2 feeds at intervals of 10 min. Run finally for 20 to 30 min. Check out edge from butt portion with bromocresol green indicator for proper neutralization. (Colour, greenish blue, pH about 4.3 to 4.6.) Drain.

Wash: 150% water. Run for 10 min. Drain.

Retan: 40% water. Add 1% Tanigan P2, 1% Tannigan OS and 1% Retingan R7, as powder. Run for 20 min. Add 4% mimosa extract (as small lumps of solid). Run for 30 min. Add 60% water. Run for 10 min. Drain.

(Owing to lack of hot water facilities, hot water rinsing and correct float and temperature in fat liquoring were not possible.)

Fat

liquoring: 80% hot water (warm water only used) at 55°C. Add 1% Lipoderm liquor 1, 3% Lipoderm liquor 2 and 1% Nutrex 31 (raw neat's foot oil) emulsified with hot water (1:3) in 2 feeds at intervals of 10 min. Run finally for 35 min. Add 0.4% formic acid (85%) diluted with 5% water in 3 feeds at intervals of 5 min. Run finally for 10 min. Check exhaust. Add 0.75% Aminex (cationic fat liquor) emulsified with hot water (1:3) and run for 20 min. Check exhaust. Drain. Rinse briefly for 5 min. Drain and horse up overnight.

Twentieth day. Without a setting machine, the sides were hand set once and nailed on boards for drying.

Twenty-first and Twenty-second day. Because of the lack of drying boards, 2 days were taken for nailing the sides.

Twenty-third day. Trim.

The sides in the crust stage were found to be good in general appearance and better than the normal lots from the point of view of looseness.

Buff on flesh with 180 grit paper and snuff the grain side with 240 grit paper. Hand brush.

These lots were finished in the normal way as for finishing the regular lots.

Saving chemicals in reprocessing was explained to the staff, and the details are mentioned in the mid-term report.

Another lot was also processed from their regular wet blue lot in the same way, taking care to see that the shaving was done to the desired extent (1.6 - 1.8 mm).

B. Chamois leather from goat skins

Locally there is demand for chamois leather and the tannery made some chamois leather for local consumption. The users have complained that the leathers are not strong and that they tear easily when the wet leathers are squeezed. On examination of some leathers made by the tannery, it was seen that Immergan tanning was done without shaving the grain and because of acidity developed by Immergan and improper tanning the skins did not have good strength. Water absorption was also poor. The tannery wanted the expert to make a lot. Two experimental lots were made by him in a tub in the absence of experimental drum, using aldehyde and fish-oil combination tannage. In the absence of formaldehyde, glutaraldehyde (samples received by the tannery) was used and for one lot Indian fish oil (small quantity left over in the tannery) was used. For the other lot, chamotan (cod oil) from the United Kingdom (sample received by the expert) was used. Though fish oil is available locally from the fish industry, the expert could not obtain the oil or details about the suitability of the oil such as iodine value etc. If the oil is available in plenty and if it is found suitable for chamois tanning, it could be used and no import of oil for tanning would be necessary.

Raw materials: Dry-salted goat skins of large size. Weigh. Soak in pit with 800% water and 0.6% cismollan BH overnight. Next day, give two more changes of water; check for proper soaking; horse up for draining; weigh.

Painting: Paint composition:
2% sodium sulphide on soaked weight. Dissolve to make up to 10° Bé. Add 12% slaked lime powder to make 28° Bé. Apply the paint on flesh side with a mop, pile flesh on flesh and cover the pile with a wet gunny. Leave for 5 hours. Unhair over a beam with unhairing knife.

The rest of the operations from deliming followed the process mentioned for chamois leather, except that the process was done in tubs and glutaraldehyde was used in the place of formaldehyde.

C. Camel neck pieces into insole and belting leather

Camel necks are available separately along with camel hides. Camel hides are purchased by the tannery on a piece basis, and as such camel necks are available free. The tannery has been accumulating the neck pieces without knowing what to do with them. The problem was posed to the expert and a lot was taken for processing. On examination of the raw pieces, it was observed

that the neck pieces were fairly thick and that they could be processed as insole leather. The curing and flaying were poor. In many pieces there was damage of grain owing to bad curing, and no piece was without deep flay outs. The area of the pieces varies from 2.5 to 4.5 ft². In the expert's opinion, if properly cured and flayed, camel necks may prove to be good even for uppers since they are tight in texture and looseness is not visible. A few pieces of insole leather from camel necks were finished after shaving the thickness to 2 mm to explore their usefulness and marketability on the local market.

The belting factory, which manufactures canvas belts, is one of the main consumers of retan uppers of camel and cow made by the tannery. In the belts for leather straps, upper of 2 mm thickness is used and for leather pouches upper of 1.6 mm thickness is used. The expert and his counterpart went to the belting factory with a few finished pieces of camel necks to see whether they could substitute the upper leathers. The belting factory personnel, though they approved of the quality, were reluctant to use them because of the deep flay outs and the small area. However, they would be interested if fairly big pieces without flay outs were supplied to them at a cheaper price than retan upper.

The footwear factory was also given samples of insole leather to determine their utility.

Raw materials: 200 pieces of dry-salted camel necks. (Dry salted weight = 240 kg.)

Soak (in pit): 800% water and 0.6% cismollan BH; duration, 18 h. Take out and dry drum intermittently for about 1 h with 50% water, to soften.

Wash (in drum): 600% water. Run for 1 h. Drain. Weigh. (Soaked weight of 200 pieces = 500 kg.)

Lime (in drum): 60% water. Add 1.5% sodium sulphide (after dissolving) and 1.5% slaked lime. Run for 10 min. Stop the drum for 50 min. Add 1% sodium sulphide and 2.5% slaked lime. Run for 5 min. Stop for 55 min. Run for 5 min. Stop for 55 min. Flood with 200% water. Run for 10 min. Stop. Later run for 2 min once in 3 or 4 h. (Duration, 22 h.) Run 5 min. Drain the bath.

Wash: 200% water. Run for 10 min. Drain.

Relime in pits: 300% water (on soaked weight). Add 8% slaked lime and 0.5% soda ash. Duration 3 days with daily handling. Take out; machine flesh; weigh. (Fleshed weight of 200 pieces = 455 kg.)

- Wash (in drum):** 150% water (on fleshed weight). Run for 25 min. Drain.
- Delime:** 75% water. Add 0.5% sodium bisulphite as powder. Run for 15 min. Add 1.25% ammonium sulphate and 1.5% water in 2 feeds at intervals of 10 min. Run finally for 60 min. Check for 2/3 delimiting. Drain. (As the delimiting was not to the desired extent, added 0.25% ammonium sulphate and ran for 30 min. Checked again.)
- Wash:** 150% water. Run for 15 min. Drain.
- Pickle:** 60% water. Add 8% salt and 0.5% calcium formate. Run for 10 min. Check B₆ (8°-9° B₆). Add 1.5% sulphuric acid and 15% water in 3 feeds at intervals of 15 min. Run finally for 75 min. Next day, run for 20 min. Check pH (pH 3.1-3.2).
- Prechrome:** Add 3% chromosal B as powder. Run for 75 min. Check penetration. Add 0.3% soda ash and 3% water. Run for 15 min, 15 min and 30 min. Add 0.2% soda bicarb and 2% water. Run for 10 min, 10 min and 60 min. Check pH. (pH 3.4-3.5.) Drain. Horse up.
- Wash:** 100% water. Run for 10 min. Drain.
- Pretan:** 50% water. Add 2% Tanigan CH as powder. Run for 45 min. Add 9% mimosa solid extract and sodium bisulphite (1/20 of the weight of extract). Run for 3 h. After 1 h, after the addition of extract, add 0.25% lipoderm liquor 2. After 3 h, add 6% mimosa extract and sodium bisulphite (1/20 of the weight of extract). Run intermittently for 2 h. Leave overnight in the drum. Next day, run for 10 min. Add 15% mimosa extract and sodium bisulphite (1/20 of the weight of extract). Run intermittently for 4 h. Check penetration and absorption. Drain. Horse up for 36 h.
- Bleach:** 60% water. Add 0.5% Tanigan BL and 0.2% sodium bisulphite. Run for 15-20 min. Drain.
- Fat liquor:** 50% water. Add 1% lipoderm liquor 1, 1% lipoderm liquor 2 and 1% raw oil emulsified with hot water. Run for 50 min. Check exhaust. Drain. Horse up. Next day, hand set, apply a little cotton-seed oil on the grain and hook to condition. Hand set again, hook to dry. Remove. Smooth plate in Gloria press. Few pieces were given to footwear unit for trials.

As the insole pieces were found to be ideal for belting leathers, a few pieces were wet back, conditioned, shaved to 2 mm and dried. They were again cold-ironed in the Gloria press. The grain side was buffed with 240 grit paper and brushed. Yellow coloured upper leathers are usually purchased by the belting factory and hence the pieces were finished in same colour. Finishing was done as follows:

Eukanol pigment to match the shade	150 g
Binder IM	175 g
Eukanol glanz NJ	50 g
Eukanol filter	30 g
Water	600 g

Filter. Apply a pad coat. Dry. Smooth plate in Gloria press. Apply a pad coat. Dry. Spray one full cross coat. Dry. Spray again to cover. Dry. Check for coverage.

Top coat with lacquer

Isoderm glanz lustre	1 part
Thinner	3 parts

Spray one full cross coat. Dry. Smooth plate in Gloria press.

D. Vegetable tanning of Australian sheepskins

The Government of Democratic Yemen of late has been importing live Australian sheep for meat purposes instead of Somalian goats and sheep. About 50,000 to 80,000 animals have been imported up to now. After the slaughter the skins are made available to the tannery. The skins, though big in size, after liming were found to be of poor quality:

- (a) Grain had been damaged in most skins because the shearing knives were used to remove the wool to the maximum extent possible;
- (b) Ribs and fat pockets, which are common for Australian sheepskins;
- (c) Holes and flay cuts owing to improper flaying.

Generally, the Australian sheepskins, though big in size, fetch lower prices in the international market because of ribs and fat pockets and also because of poor strength and stitch tear resistance. Most of them are used only for cheap linings. The limed lots at the tannery were processed further into pickled skins and the assortment showed that only lower grades and rejections were prevalent. It is doubtful whether they will fetch a workable export price in a pickled stage in view of the many defects. The possibility of exporting in raw rather than in the pickled stage has to be explored, since in raw they may fetch a workable price if few fur tanners are interested in such skins.

The problem of how to utilize the pickled lots was posed to the expert. A drum lot was processed into vegetable-tanned leathers and the rest of the lots were processed in a similar manner.

Processing: Number of pickled pieces: 250. Pickled weight (the lot was stored for some time) was multiplied by 1.25 to arrive at the fleshed weight.

Degrease: 10% kerosene and 1.5% sandozin N1. Run for 30 min. Add 100% of 10% salt solution (on volume basis). Run for 30 min. Drain.

Wash: 100% of 10% salt solution (on volume basis) and 0.25% sandozin N1S. Run for 30 min. Drain.

Wash: 100% of 7.5% salt solution (on volume basis). Run for 30 min. Drain. (As the wash water was clear, no further washing was done.)

Prechrome: 60% water and 5% salt. Run in salt solution for 5 min. Add 0.25% sulphuric acid and 2.5% water. Run for 20 min. (pH 3.5.) Add 2% chromosal B as powder. Run for 45 min. Check penetration. Add 0.2% soda ash and 2% water. Run for 10 min, 10 min and 30 min. Drain.

Pretan: Add 2% Tanigan CH as powder. Run for 45 min. Add 9% mimosa extract and sodium bisulphite (1/10 of the weight of extract). Run for 2 h. Add 0.25% lipoderm liquor 2, 30 min after the addition of extract. Leave in the drum overnight.

Next day, add 9% mimosa extract and sodium bisulphite (1/10 of the weight of extract). Run for 2½ h. Take out and pile.

Next day, bleach- 60% water. Add 0.4% Tanigan BL and 0.10% sodium bisulphite. Run for 15 min. Drain.

Fat liquor: 60% water. Add 1% lipoderm liquor 1; 1% lipoderm liquor 2 and 1% raw oil emulsified with hot water. Run for 40 min. Check exhaust. Drain. Take out. Horse up overnight.

Hand set, apply little raw oil by hand. Hook to dry. When dry, remove, stake lightly, trim, buff on flesh, brush, measure and assort.

Subsequent lots were processed in the same way by the tannery, but degreasing was omitted.

Better grades of lining leathers were picked out from stores and after slight correction on the grain, they were finished into different colours by resin (plated) finishing. Such leathers could be used for sandals and children's shoes. The leathers fetched a price of 240 fils per ft² instead of the lining leather price which is about 80 to 108 fils per ft² depending on the grades. A suitable finishing recipe was formulated using casein-free black pigment paste, which the tannery had imported in bulk, and a dyeing recipe for hunting suedes was used.

III. RECOMMENDATIONS

1. It is of primary importance that the measures suggested for improving the quantity and quality of local raw materials be carried out as soon as possible for the successful development of the leather industry in Democratic Yemen.
2. The tannery should be expanded and modernized in stages, i.e. (a) short-term and (b) long-term, of two phases each. The additional infrastructure required for short-term programme may be met by the Government. The planned capacities of the phases are based on the assumption that the required raw material resources would be built up progressively, and the skills and know-how would be upgraded to the required levels.
3. During the interim period, until measures are taken for collection in sufficient quantities to achieve the targets envisaged, the Government should waive the 30% import duty on imported raw materials. The Government should also explore the possibilities of importing livestock from neighbouring countries for meat purposes, which would yield better quality skins.
4. Local raw materials can be used both for domestic consumption and for exploration of export potentialities only by diversifying and improvising products; this would require additional machinery and equipment.
5. Close collaboration and co-operation between the tannery and the footwear centre is necessary to achieve maximum use of the materials processed by the tannery.
6. Reorganization and relocation of the tannery is essential; the present tannery should be shifted to the Al-Mansura area, the proposed site by the Government for a new industrial complex, or alternatively to the Caltex Pier area.
7. For the efficient functioning of the tannery, it is necessary to obtain outside technical and managerial assistance of expatriates/specialists under bilateral agreements, for a period of 2 to 3 years or until the local staff is experienced enough to take over.
8. The existing tannery personnel would require fairly extensive on-the-job and formal training for the early upgrading of skills. For the long-term programme, suitably qualified personnel should be recruited and given about a half year job orientation in the tannery before being sent abroad for advanced specialized training and studies in leather technology.

9. A reappraisal of the long-term objectives and plans should be carried out at the end of Phase II of the short-term programme. The implementation of the long-term programme would naturally depend on the progress made in achieving short-term objectives.

10. United Nations assistance is envisaged for (a) training of personnel under United Nations fellowships (b) reviewing the progress of short-term objectives and implementing the long-term programme (c) financial assistance to the extent possible to cover the capital cost of the long-term programme, in the absence of technical collaboration with other countries.

11. If suitable expatriate/bilateral assistance cannot be obtained for the immediate needs, United Nations assistance is also required for (a) provision of a flaying-cum-curing expert, and (b) provision of specialists to assist the tannery in management, production and repair and maintenance of machines.

12. The assistance of a flaying-cum-curing expert would be necessary, and might be obtained either through the assistance of United Nations agencies or under bilateral agreement for a period of not less than one year, for field work, demonstration, training and for establishing collection and curing centres in the various parts of the country.

13. As an immediate stopgap measure until the local raw material base is built up in quantity and quality, raw materials may have to be imported to meet the shortfall, if any, to achieve the production targets as envisaged by the Government. In this connexion, the following measures are suggested:

(a) Waiving the customs duty of 30% levied on imported raw materials at present;

(b) Export of Australian sheepskins from animals slaughtered in Democratic Yemen in raw stage to fur tanners abroad with a view to importing more suitable raw materials which can be processed locally;

(c) Import of livestock as before from neighbouring countries instead of Australian sheep to supply better quality skins locally.

IV. MODERNIZATION AND EXPANSION OF THE TANNERY

The expansion programme is recommended in two stages: (a) short-range programme and (b) long-range programme.

A. Short-term expansion: phase I and II

This consists of two phases (phase I and phase II) extending two to three years or more and may be carried out in the present location of the tannery with additional infrastructural facilities.

The objectives of the short-term programme envisaged are:

- (a) Emphasis on import substitution to meet the increasing local demand for improved quality of finished leathers;
- (b) Increased production of the various types of leathers made at present;
- (c) Improvisation of goat upper and finished splits for supplementing the upper leathers required for domestic consumption;
- (d) To cater to the export market by:
 - (i) Stepping up the production of pickled skins
 - (ii) Partial conversion of pickled skins into wet blue and/or vegetable crust skins for increasing the added value
 - (iii) Building up necessary know-how for processing lower grades of skins into lining leathers (glazed and resin finished) with a view to exploring the possibility of their export
 - (iv) Increased production of chamois leather by using inferior quality skins and locally available fish oil for local consumption and for export to neighbouring countries
- (e) More co-operation and understanding between tannery and footwear centre (the major consumer of leather from tannery) are necessary so as to maximise the utilization of the leather.

1. Production target (table 1)

	<u>Present</u> daily <u>production</u>	<u>Phase I</u> daily <u>production</u>	<u>Phase II</u> daily <u>production</u>
Cattle and camel hides	25	50	60
Goat and sheep skins	400	800	1,000

Table 1. Projected production. (1977 and 1978)

Type of leather	1977				1978			
	As % of total	Number of pieces produced	Average yield per piece	Total yield per annum	As % of total	Number of pieces produced	Average yield per piece	Total yield per annum
			ft ²				ft ²	
A. Cow hides								
Retan upper (plain and printed)	67.6	8,112	18.61	150,924	67.6	10,140	18.61	188,655
Hunting suede	13.1	1,572	20.81	32,712	13.1	1,965	20.81	40,870
Lining	6.4	768	12.19	9,360	6.4	960	12.19	11,700
Sole leather	12.9	1,548	12.61	19,251	12.9	1,935	12.61	24,401
Splits								
Suede								44,880
Grain finish								14,934
Lining								14,933
Total	100.0	12,000			100.0	15,000		
B. Camel hides								
Retan upper (plain and printed)	53.1	1,593	21.13	33,656	53.1	1,593	21.13	33,656
Hunting suede	14.9	447	22.56	10,085	14.9	447	22.56	10,085
Sole leather	32.0	960	13.78	13,230	32.0	960	13.78	13,230
Splits								
Suede								10,935
Grain finish								3,645
Lining								3,645
Total	100.0	3,000			100.0	3,000		

Table 1 (continued)

Type of leather	1977				1978			
	As % of total	Number of pieces produced	Average yield per piece	Total yield per annum	As % of total	Number of pieces produced	Average yield per piece	Total yield per annum
			ft ²				ft ²	
C. Goat skins								
Goat upper	5	7,200	4.5	32,400	10	18,000	4.5	81,000
Goat lining (plain and printed)	10	14,400	3.75	54,000	10	18,000	3.75	67,500
Suede garment	2.5	3,600	4.50	16,200	2.5	4,500	4.50	20,250
Chamois leather	2.5	3,600	4.25	15,300	2.5	4,500	4.25	19,125
Pickled (for export)	80.0	115,200	3.98	458,100	50	90,000	3.91	352,125
Wet blue or vegetable crust (for export)					25	45,000	4.00	180,000
Total	100.0	144,000			100.0	180,000		
D. Sheep skins								
Lining leather and printed leather	10	9,600	4.25	40,800	10	12,000	4.25	51,000
Suede garment	5	4,800	4.75	22,800	5	6,000	4.75	28,500
Pickled (for export)	85	81,600	4.51	368,400	60	72,000	4.31	310,500
Wet blue or vegetable crust (for export)					25	30,000	5.00	150,000
Total	100.0	96,000			100.0	120,000		
Local requirements							Upper Lining (ft ²)	
Production planned							347,500	64,000 ^{a/}
							391,413	148,778

^{a/} Lining requirement will be more, particularly if shoe factory and co-operatives have to use uppers of thinner substance (from goat and light-substance cattle hides).

2. Implementation

(a) Phase I

The successful implementation of phase I would have the following pre-requisites:

Procurement of the following equipment and accessories:

- 3 wooden drums
- 1 experimental wooden drum
- 2 platform weighing machines (to weigh up to 1,000 kg)
- 2 pan type of balances (to weigh up to 20 kg)
- 1 brushing machine (1,500 mm)
- 2 leather thickness-measuring gauges
- Drying boards
- Wooden frames with brass hooks, for hook drying
- 2 hand-seasoning tables
- 1 spray unit with two booths and other accessories
- Flush cloth and brushes
- Simple equipment and tools like basins, buckets, measuring cylinders, mugs, hygrometers, trolleys, wooden tubs

Repair, maintenance and replacement:

- Repair of the existing three drums to prevent leakage; motors of 7.5 hp to be put in the place of 5 hp
- Conversion of mechanical fleshing machine into scudding machine
- Top of the hand-setting tables to be replaced with formica top
- Buffing machines to be provided with long sacks to collect the buffing dust
- Repair of the floor in the finishing yard
- Replacement of felt in the Gloria press
- Repair of the measuring machine
- Repair and maintenance of the machinery and equipment to be ensured by proper programming to avoid breakdowns

Water supply and pressure should be improved immediately, to cope with the production and to avoid delay, by putting up a booster. The water pipes in the wet yards should be changed to 2.5 in. diameter and additional tap points should be installed near drums and paddles.

Drainage channels in the wet yards should be widened and deepened.

A system of staggering the working shifts and of having skeleton staff on holidays should be introduced in order to have the maximum use of the machinery and to ensure regular output.

There should be additional work sheds^{1/} of at least 576 m², i.e. two bays of 24 x 12 m for the two phases.

(b) Phase II

For the implementation of phase II, the following machinery and equipment have to be imported:

- 1 hydraulic sammying machine (1,800-2,100 mm)
- 1 mechanical splitting machine (1,800 mm)
- 1 hydraulic reversible setting machine with felt-covered roller at the top, suitable for sides and skins (1,800 mm)
- 1 vibratory staker, through-put (1,500 mm)
- 1 electrically hand-operated setting machine for sole sides
- 1 hydraulic press (600-630 tons, plate size 1,370 x 660 mm)
- 8 plates for the press (1,370 x 660 mm)
- 1 pneumatic stamping machine
- 1 oil-fired boiler

Miscellaneous equipment and tools

3. Investment for short-term programme, phase I and phase II

	Existing	Additional requirement for phase I (YD)	Additional requirement for phase II
Fixed assets			
Buildings	9,008	25,920	
Machinery	26,810	12,000	
Repair and accessories		7,500	89,000
Vehicles	1,105		
Furniture	<u>731</u>	<u> </u>	<u>342</u>
	37,654	45,420	89,342
Working capital requirement, based on present costs		99,000	124,000
Value of output (1975)	99,737	212,000	277,000

^{1/} These sheds may be properly planned and put so that when the tannery is shifted to a new place, they could be dismantled and used.

The additional infrastructure required for both the phases under the short-term programme may be met by the Government.

(a) Phase I

Fixed assets

	<u>Existing</u>	<u>Additional expenditure (YD)</u>	<u>Projected total</u>
Buildings	9,008	25,920	34,928
Machinery	26,810	12,000	
Repair and accessories	-	7,500	46,310
Vehicles	1,105	-	1,105
Furniture	<u>731</u>	<u>-</u>	<u>731</u>
	37,654	45,420	83,074

Details of additional expenditure

Buildings

	<u>Cost (YD)</u>
2 bays of 24 x 12 m (for phases I and II), i.e. 576 m ² at 45 YD per m ²	25,920

Machinery and equipment

Provision already made under 1976 budget for 3 wooden drums, 1 experimental drum, 1 brushing machine	12,000
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Repair and accessories

2 platform weighing machines	800	}	7,500
2 pan type balances	150		
2 measuring gauges	50		
1 spray unit	2,000		
3 motors, 7.5 hp	700		
Change of fleshing machine to scudding machine	800		
Drying boards, hooking frames, seasoning tables, plush cloth, brushes, felt in Gloria press, booster for water supply, drainage repair, change of water pipes, floor repair, simple tools and equipment such as trolleys, horses etc.	3,000		

Annual raw material requirements and their cost

	<u>Scheme I</u>	<u>Scheme II</u>
	(YD)	(YD)
Cowhides - 12,000 pieces		
10,000 pieces at YD 0.60 per piece, local	6,000	6,000
2,000 pieces at YD 2 (c.f.) per piece, imported	4,000	4,000
Camel hides - 3,000 pieces at YD 0.30 per piece	900	900
Goatskins - 144,000 pieces^{a/}		
77,000 pieces at YD 0.25 per piece, local	19,250	19,250
55,000 pieces at YD 0.25 per piece, imported livestock	13,750	-
or		
55,000 pieces at YD 0.50 per piece, imported	-	27,500
Sheepskins - 108,000 pieces^{b/}		
63,000 pieces at YD 0.25 per piece, local	15,750	15,750
45,000 pieces at YD 0.25 per piece, imported livestock	11,250	-
or		
45,000 pieces at YD 0.50 per piece, imported	-	<u>22,500</u>
	70,900	95,900
Total (foreign currency)	4,000	54,000
Total (local currency)	66,900	41,900

a/ Shortfall of 12,000 pieces can be substituted by sheepskins.

b/ Including shortfall in goatskins.

Cost of chemicals and consumables

<u>Type of leather</u>	<u>Total yield</u> <u>(ft²)</u>	<u>Cost of chemicals</u>	
		<u>Per unit</u> <u>(YD)</u>	<u>Total</u>
Retan upper (cow)	150,924	0.065	9,810
Retan upper (camel)	33,656	0.065	2,188
Hunting suede (cow)	32,712	0.055	1,799
Hunting suede (camel)	10,085	0.055	555
Goat upper	32,400	0.040	1,296
Lining (cow)	9,360	0.025	234

<u>Type of leather</u>	<u>Total yield</u> <u>— (ft²) —</u>	<u>Cost of chemicals</u>	
		<u>Per unit</u>	<u>Total</u>
		(YD)	
Lining (goat)	54,000	0.025	1,350
Lining (sheep)	40,800	0.025	1,020
	<u>— lb —</u>		
Sole leather (cow)	19,251	0.105	2,021
Sole leather (camel)	13,230	0.105	1,389
	<u>— ft² —</u>		
Garments suede (goat)	16,200	0.040	648
Garments suede (sheep)	22,800	0.040	912
Chamois (goat)	15,300	0.023	352
Pickled goat skins (115,200 pieces)	458,100	0.006	2,749
Pickled sheep skins (81,600 pieces)	368,400	0.006	<u>2,210</u>
			28,533
		Say	28,500
	Cost of consumables at 5%		<u>1,425</u>
			29,925
		Say	30,000
	Customs duty at 10%		<u>3,000</u>
		Total	33,000

Of which YD 28,500 in foreign currency (95% of 30,000)

Production cost

As no data are available regarding the existing cost of production, a rough projection only could be made, based on the budget prepared for 1976.

	<u>1976 budget</u>	<u>Additional expenditure</u> <u>(YD)</u>	<u>Total</u>
Wages, salaries and benefits	35,368	3,537	say 39,000
Factory expenses, such as electricity, water, repair, fuel, packing materials	8,975	4,988	say 13,500
Office and administration expenses	11,390	1,139	say <u>12,500</u>
			65,000

With an increase of 10% in manpower, it is possible to achieve the target envisaged in phase I as:

(a) There is nearly 50% of idle manpower capacity because of lack of programming and planning, inadequacy of the raw materials and frequent break-downs;

(b) The manpower employed for manual scudding operations can be diverted for other work, when the scudding machine replaces the manual operation;

(c) Cost for outside specialists, if recruited, has not been taken into account.

Depreciation

	<u>YD</u>
At 5% on building value of 34,928	1,746
At 10% on machinery value of 46,310	4,631
At 20% on vehicles value of 1,105	221
At 10% on furniture value of 731	<u>73</u>
	6,671
	Say 6,700

Annual cost of production, excluding interest and depreciation

	<u>Scheme I</u>	(YD)	<u>Scheme II</u>
Raw materials	70,900		95,900
Chemicals and consumables	33,000		33,000
Wages and salaries	39,000		39,000
Factory expenses	13,500		13,500
Office and administration expenses	<u>12,500</u>		<u>12,500</u>
	168,900		193,900

Working capital requirement

	<u>Scheme I</u>	(YD)	<u>Scheme II</u>
Raw materials for three months	18,000		24,000
Chemicals for six months	16,500		16,500
Goods in process (one month stock) ^{a/}	14,000		16,000
Goods in warehouse (one month stock) ^{a/}	14,000		16,000

	<u>Scheme I</u> (YD)	<u>Scheme II</u>
Bills receivable		
Export sales (3 months) ^{b/}	26,600	26,600
Local sales (1 month) ^{b/}	8,800	8,800
Provision for 1 month interest for total investment at 5% per annum	<u>750</u>	<u>800</u>
	98,650	108,700
Say	99,000	109,000

^{a/} Value based on cost of production excluding depreciation and interest (table 3).

^{b/} Value based on net sales realization (table 2).

Total investment

	<u>Scheme I</u> (YD)	<u>Scheme II</u>
Fixed assets	83,000	83,000
Working capital	<u>99,000</u>	<u>109,000</u>
	182,000	192,000

Interest

	<u>Scheme I</u> (YD)	<u>Scheme II</u>
Interest at 5% per annum on total investment	9,100	9,600

(b) Phase II

Fixed assets

	<u>Existing value</u>	<u>Additional expenditure (YD)</u>	<u>Projected total</u>
Buildings	33,182	-	33,182
Machinery	41,679	89,000	130,679
Vehicles	884	-	884
Furniture	<u>658</u>	<u>342</u>	<u>1,000</u>
	76,403	89,342	165,745

Table 2. Phase I: Sales and net sales realization

Type of leather	Total production	Local sales			Export sales		
		%	Quantity sold	Price per unit	Total value	%	Quantity sold
	-- ft ² --		-- ft ² --	(Yr)	(Yr)		(Yr)
W-tan upper (cow and camel)	184,500	100	184,580	0.250	46,145	-	-
Hunting suedes (cow and camel)	42,797	100	42,797	0.400	17,118	-	-
Goat upper	32,400	100	32,400	0.250	8,100	-	-
Lining (cow)	9,360	100	9,360	0.120	1,123	-	-
Lining (goat and sheep)	94,800	100	94,800	0.096	9,101	-	-
	-- lb --		-- lb --				
Sole leather (cow)	17,326	90	17,326	0.660	11,374	-	-
Standard grade	1,925	10	1,925	0.350	674	-	-
Sole leather (camel)	11,907	90	11,907	0.540	6,437	-	-
Standard grade	1,323	10	1,323	0.350	463	-	-
	-- ft ² --		-- ft ² --				
Garment suedes (goat and sheep)	39,000	100	39,000	0.400	15,600	-	-
Chamois leather	15,300	100	15,300	0.280	4,284	-	-
	-- pieces --		-- pieces --				
Pickled goatskins	115,200	-	-	-	-	100	115,200 0.550 63,360
Pickled sheepskins	81,600	-	-	-	-	100	81,600 0.600 48,960
					120,412		112,320
				Say	120,000		112,000

Table 2 (continued)

	Local	Export (YD)	Total
Sales realization	120,000	112,000	232,000
Less 5% allowance for quality downgrading because of raw material variation, processing defects etc.	<u>6,000</u>	<u>5,600</u>	<u>11,600</u>
	114,000	106,400	220,400
Less 10% discount for 75% of local sales	<u>8,550</u>	<u>-</u>	<u>8,550</u>
	105,450	106,400	211,850

Table 3. Phase I: Profitability statement
(YD)

Item	Scheme I		Scheme II			
	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency
Sales realization	211,850	106,400	105,450	211,850	106,400	105,450
Raw materials	70,900	4,000	66,900	95,900	54,000	41,900
Chemicals	33,000	28,500	4,500	33,000	28,500	4,500
Wages and salaries	39,000	-	39,000	39,000	-	39,000
Factory expenses	13,500	4,500	9,000	13,500	4,500	9,000
Office and administrative expenses	12,500	2,500	10,000	12,500	2,500	10,000
Cost of production, excluding interest and depreciation	168,900	39,500	129,400	193,900	89,500	104,400
Profit, before depreciation and interest	42,950	66,900	23,950 (-)	17,950	16,900	1,050
Depreciation	6,700	-	6,700	6,700	-	6,700
Profit, after depreciation but before interest	36,250	66,900	30,650 (-)	11,250	16,900	5,650 (-)
Interest	9,100	-	9,100	9,600	-	9,600
Profit, after depreciation and interest	27,150	66,900	39,750 (-)	1,650	16,900	15,250 (-)
Depreciation	6,700	-	6,700	6,700	-	6,700
Cash accruals	33,850	66,900	33,050 (-)	8,350	16,900	8,550 (-)
Cost of production, including depreciation and interest	184,700	39,500	145,200	210,200	89,500	120,700

Details of additional expenditure

Machinery (approximate c.i.f. cost)

	Value (£)	Value (YD)
1 hydraulic sammying machine, 1,800-2,100 mm	30,000	-
1 mechanical splitting machine, 1,800 mm	25,000	-
1 hydraulic reversible setting machine with felt cover (suitable for sides and skins), 1,800 mm	30,000	-
1 vibratory staker (through-put), 1,500 mm	26,000	-
1 electrically hand operated setting machine for sole sides	3,000	-
1 portable pneumatic stamping machine	1,500	-
1 hydraulic press, 600-630 tons, plate size 1,370 x 660 mm	26,000	-
8 plates for above, 1,370 x 660 mm	8,000	-
1 oil fired boiler, 600 kg/hv	35,000	-
Miscellaneous equipment and tools	<u>4,500</u>	<u>500</u>
	189,000	500
Spares at 10% (for 2 years)	<u>19,000</u>	
	208,000	500
Allowance for price escalation at 10%	<u>20,800</u>	<u>50</u>
	228,800	550
Say	230,000	550

In dinars that would be YD 81,050. To this should be added YD 8,100 (10%) for handling charges, transport to site, erection etc. Thus, the total amount for additional expenditures would be YD 89,000.

Annual raw material requirements and their cost

	Scheme I	Scheme II
	(YD)	(YD)
Cowhides - 15,000 pieces		
Local availability - 11,800 pieces at YD 0.60 per piece	7,080	7,080
Camel hides - 3,000 pieces		
Local availability - 6,400 pieces		
Requirement - 6,200 pieces <u>a/</u> at YD 0.30 per piece	1,860	1,860

	<u>Scheme I</u>	<u>Scheme II</u>
	(YD)	
Goatskins - 180,000 pieces		
Local availability - 178,000 pieces (55,000 pieces from imported livestock) at YD 0.25 per piece	44,500	-
In the absence of the skins from imported livestock:		
123,000 pieces at YD 0.25 per piece, local	-	30,750
55,000 pieces at YD 0.50 per piece, imported	-	27,500
Sheepskins - 120,000 pieces		
Local availability - 145,000 pieces (45,000 pieces from imported livestock)		
Requirement - 22,000 pieces ^{b/} at YD 0.25 per piece	30,500	-
In the absence of the skins from imported livestock:		
77,000 pieces at YD 0.25 per piece, local	-	19,250
45,000 pieces at YD 0.50 per piece, imported	-	<u>22,500</u>
	83,940	108,940
Say	84,000	109,000
Foreign currency	-	50,000
Local currency	84,000	59,000

a/ Including the shortfall of 3,200 in cattle hides.

b/ Including the shortfall of 2,000 goatskins.

Cost of chemicals and consumables

<u>Type of leather</u>	<u>Total yield</u> — (ft ²) —	<u>Cost of chemicals</u>	
		<u>Per unit</u>	<u>Total</u>
		(YD)	
Retan upper (cow)	188,655	0.065	12,263
Retan upper (camel)	33,656	0.065	2,188
Hunting suede (cow)	40,890	0.055	2,249
Hunting suede (camel)	10,085	0.055	555
Goat upper	81,000	0.040	3,240
Splits suede (cow)	14,934	0.025	373

<u>Type of leather</u>	<u>Total yield</u> <u>— (ft²) —</u>	<u>Cost of chemicals</u>	
		<u>Per unit</u> <u>(YD)</u>	<u>Total</u>
Splits suede (camel)	3,645	0.025	91
Splits grain (cow)	14,933	0.030	448
Splits grain (camel)	3,645	0.030	109
Lining (cow)	11,700	0.025	292
Lining (goat)	67,500	0.025	1,688
Lining (sheep)	51,000	0.025	1,275
Splits lining (cow)	14,933	0.015	224
Splits lining (camel)	3,645	0.015	55
<u>— lb —</u>			
Sole leather (cow)	24,401	0.105	2,562
Sole leather (camel)	13,230	0.105	1,389
<u>— ft² —</u>			
Garments suede (goat)	20,250	0.040	810
Garments suede (sheep)	28,250	0.040	1,140
Chamois (goat)	19,125	0.023	440
Wet blue and/or vegetable goat - skins (45,000 pieces)	180,000	0.012	2,160
Wet blue and/or vegetable sheep- skins (30,000 pieces)	150,000	0.012	1,800
Pickled goatskins (90,000 pieces)	352,125	0.006	2,113
Pickled sheepskins (72,000 pieces)	310,500	0.006	<u>1,863</u>
			39,327
		Say	39,500
	Cost of consumables at 5%		<u>1,975</u>
			41,475
		Say	41,500
	Customs duty at 10%		<u>4,150</u>
			45,650
		Say	45,600

Of which YD 39,425 in foreign currency (95% of 41,500)

Production cost

	Phase I	Additional expenditure (YD)	Total
Wages, salaries and benefits	39,000	3,900	say 43,000
Factory expenses	13,500	2,700	say 16,000
Office and administrative expenses	12,500	1,250	say <u>14,000</u>
			73,000

In case expatriates are recruited for technical assistance, the expenditure incurred must be taken into account.

Depreciation

	<u>YD</u>
At 5% on building value of 33,182	1,660
At 10% on machinery value of 130,679	13,068
At 20% on vehicles value 884	177
At 10% on furniture value of 1,000	<u>100</u>
	15,005
Say	15,000

Cost of production excluding interest and depreciation

	Scheme I <u>(YD)</u>	Scheme II <u>(YD)</u>
Raw materials	84,000	109,000
Chemicals	45,600	45,600
Wages and salaries	43,000	43,000
Factory expenses	16,000	16,000
Office and administrative expenses	<u>14,000</u>	<u>14,000</u>
	202,600	227,600

Working capital requirement

	Scheme I <u>(YD)</u>	Scheme II <u>(YD)</u>
Raw materials for three months	21,000	27,000
Chemicals for six months	22,800	22,800

	<u>Scheme I</u>	<u>Scheme II</u>
	(YD)	
Goods in process for one month ^{a/}	17,000	19,000
Goods in warehouse for one month ^{a/}	17,000	19,000
Bills receivable		
Export sales for three months	33,500	33,500
Local sales for one month	11,950	11,950
Provision for one month interest for total investment at 5% per annum	<u>1,200</u>	<u>1,250</u>
	124,450	134,500
Say	124,000	135,000

^{a/} Value based on cost of production excluding interest and depreciation.

Total investment

	<u>Scheme I</u>	<u>Scheme II</u>
	(YD)	
Fixed assets	165,745	165,745
Working capital	<u>124,000</u>	<u>135,000</u>
	289,745	300,745

Interest

	<u>Scheme I</u>	<u>Scheme II</u>
	(YD)	
Interest at 5% per annum on total investment	14,487	15,037
Say	14,500	15,000

B. Long-term project: phase III and IV^{2/}

The implementation of the long-term programme will naturally depend on the progress made towards full realization of the short-term objectives, including improvements in the infrastructural facilities such as the build up of the local raw materials base, upgrading of technical skills and know-how and effective marketing techniques.

^{2/} The figures given for long-term project are only rough estimates. Before accepting the feasibility of such expansion a cash flow statement should be made covering at least five years, showing interest and loan capital repayments and working capital available at monthly or three-monthly periods; also, machinery costs should be more specific and sales estimates more defined.

Table 4. Phase II: Sales and net sales realization

Type of leather	Total production	Local sales			Export sales		
		Quantity sold	Price per unit	Total value	Quantity sold	Price per unit	Total value
	— ft ² —		— (YD) —			— (YD) —	
Retan upper (cow and camel)	222,311	100	0.250	55,578	-	-	
Hunting suedes (cow and camel)	50,975	100	0.400	20,390	-	-	
Goat upper	81,000	100	0.250	20,250	-	-	
Splits suedes (cow and camel)	18,579	100	0.150	2,787	-	-	
Splits grain (cow and camel)	18,578	100	0.150	2,787	-	-	
Lining (cow)	11,700	100	0.120	1,404	-	-	
Lining (goat and sheep)	118,500	100	0.096	11,376	-	-	
Splits lining (cow and camel)	18,578	100	0.075	1,393	-	-	
Garment suedes	48,750	100	0.040	19,500	-	-	
Chamois leather	19,125	100	0.280	5,355	-	-	
	— lb —						
Sole leather (cow)							
Standard grade	21,961	90	0.660	14,494	-	-	
Low grade	2,440	10	0.350	854	-	-	
Sole leather (camel)							
Standard grade	11,907	90	0.540	6,430	-	-	
Low grade	1,323	10	0.350	463	-	-	

Table 4 (continued)

Type of leather	Total production	Local sales			Export sales		
		Quantity sold	Price per unit	Total value	Quantity sold	Price per unit	Total value
			(Yn)			(YD)	
	- pieces -						
Net blue (goat)	45,000	-	-	-	100	0.625	28,125
Net blue (sheep)	30,000	-	-	-	100	0.675	20,250
Pickled goatskins	30,000	-	-	-	100	0.550	40,500
Pickled sheepskins	72,000	-	-	-	100	0.600	43,200
							141,075
							Say 141,000
Sales realization							
					Local	Export (YD)	Total
					163,000	141,000	304,000
					8,150	7,050	15,200
					154,850	133,950	288,800
					11,614	-	11,614
					143,236	133,950	277,186
Less 5% allowance for quality downgrading because of raw material variation, processing defects etc.							
Less 10% discount for 75% of local sales							
Less							

Table 5. Phase II: Profitability statement
(Yr)

Item	Scheme I		Scheme II			
	Total	Foreign currency	Local currency	Total	Foreign currency	Local currency
Sales realization	277,186	133,950	143,236	277,186	133,950	143,236
Raw materials	84,000	-	84,000	109,000	50,000	59,000
Chemicals	45,600	39,425	6,175	45,600	39,425	6,175
Wages and salaries	43,000	-	43,000	43,000	-	43,000
Factory expenses	16,000	6,000	10,000	16,000	6,000	10,000
Office and administrative expenses	14,000	2,500	11,500	14,000	2,500	11,500
Cost of production, excluding depreciation and interest	202,600	47,925	154,675	227,600	97,925	129,675
Profit, before depre- ciation and interest	74,586	86,025	11,439 (-)	49,586	36,025	13,561
Depreciation	15,000	-	15,000	15,000	-	15,000
Profit, after depreciation but before interest	59,586	86,025	26,439 (-)	34,586	36,025	1,439 (-)
Interest	14,500	-	14,500	15,000	-	15,000
Profit after depreciation and interest	45,086	86,025	40,939 (-)	19,586	36,025	16,439 (-)
Depreciation	15,000	-	15,000	15,000	-	15,000
Cash accruals	60,086	86,025	25,939 (-)	34,586	36,025	1,439 (-)
Cost of production including depreciation and interest	232,100	47,925	184,175	257,600	97,925	159,675

The objectives are to mobilize all the raw materials available in the country and to convert the bulk of them gradually into finished leathers in order to meet the increasing local demand and to export the surplus.

It must be emphasized in this connexion that in a least developed country such as Democratic Yemen, it is highly problematic to forecast accurately progress in the development of the industry which would enable planning for periods exceeding two to three years. It would have been more rational and realistic to undertake the long-term projections contained in this report on the basis of the progress achieved in the short-term development of the tannery.

1. Capacity

The planned capacity is about 100 hides and 1,600 skins per day. It is expected that the capacities would be built up in two phases (phase III and phase IV), extending over a period of two to three years.

A minimum economic requirement is necessary for the successful operation of the unit, particularly when the cost of infrastructure will be high by way of new buildings and machinery. It would be possible to increase the output by 20% to 25% if some of the machinery were used for the second shift.

However, any shortfall in the local raw material availability would involve restricting the maximum capacity, as in phase II, and this may require reworking the machinery.

2. Location

In view of the many shortcomings in the existing tannery, primarily the problem of effluent disposal, the following places are suggested for the relocation and reorganization of the tannery as early as feasible.

The following factors should be taken into consideration for the location of the new tannery:

Copius and abundant supply of good water

Availability of power

Availability of labour

Easy transport facilities

Effluent disposal

Nearness of market for raw materials, chemicals, finished leathers

Other social amenities like communication, education, hospital

The Al-Mansura area, where the Government is planning to put up many industries including an industrial estate, would be ideal for the location of the new tannery. The second alternative may be near to Caltex Pier, but if the salt industry is going to diversify its activities there, the Al-Mansura area would be a better choice.

Data on the availability of raw materials, quality, sizes, weight ranges, yields, conversion efficiencies in regard to quality and grades, cost etc. and the productivity indicated are all based on the information made available and on very limited samplings of lots in raw, semi-processed and finished leathers. Factors of error in these deductions may therefore be high and would have to be adjusted over a long period of actual operations of raw selection and processing in order to arrive at a reasonably accurate analytical observation.

2. Raw materials

According to the report of the marketing expert, adequate raw materials (except cattle hides) are available for the short-term and long-term programmes, but only if there is high proportion of non-utilization of the raw resources. He has also indicated that by setting up procurement centres effective collection is possible as follows:

	<u>Available raw materials (pieces)</u>	<u>Requirement of the tannery</u>	
<u>Short term</u>			
<u>Phase I</u>			
Goat	107,000	144,000	} 41,000 (deficit)
Sheep	92,000	96,000	
Cattle	10,100	12,000	} 500 (surplus)
Camel	5,400	3,000	
<u>Phase II</u>			
Goat	178,000	180,000	} 23,000 (surplus)
Sheep	145,000	120,000	
Cattle	11,800	15,000	} 200 (surplus)
Camel	6,400	3,000	

	<u>Available raw materials (pieces)</u>	<u>Requirement of the tannery</u>	
<u>Long term</u>			
<u>Phase III</u>			
Goat	245,000	234,000	} 52,000 (surplus)
Sheep	197,000	156,000	
Cattle	13,300	18,000	} 2,300 (deficit)
Camel	8,400	6,000	
<u>Phase IV</u>			
Goat	257,000	268,000	} 14,000 (deficit)
Sheep	209,000	192,000	
Cattle	14,300	22,500	} 7,200 (deficit)
Camel	8,500	7,500	

From the hides (cattle and camel), it is expected that upper leathers like retan uppers (plain and printed) and hunting suedes will be produced. Lower grades will be processed into linings and sole leather. Finished leathers from splits like suedes, grain finish (plain and printed) and linings will supplement the upper leathers from hides, purely for domestic demand. The sole leather processed by the tannery at present cannot be used in factory-made shoes. For genuine sole leather, fuller tanning, further finishing and machine rolling are necessary. A rolling machine has to be procured since no provision has been made in the list of machinery suggested.

From the goat skins, production is envisaged of glace kid, goat upper (corrected grain), suede garment, chamois, fancy and other miscellaneous leathers, export-grade lining leathers and lining and printed leathers for domestic consumption. As sheepskins are a luxury material, it would be better to convert a certain quantity into vegetable crust leathers and/or wet blue and export them since there is a ready market for such leathers.

A certain quantity of the undersized and better grades of goatskins and sheepskins which are suited for glove leather will be exported in the pickled stage because glove processing requires special machinery and skills.

For thin and defective skins vegetable tanning is suggested so that the skins could be assorted for various types of finished leathers.

4. Land

The Government should provide free land (levelled) of about 40,000 to 50,000 m², for the proposed new tannery (see table 6).

Table 6. Phase III and IV: Cost of land and development (YD)

Land: 40,000 to 50,000 m ² (levelled land, free of cost to be provided by the Government)	5,000
Development charges and cost of laying internal roads, compound wall, gates etc. (Ad-hoc provision)	<u>10,000</u>
Total	<u>15,000</u>

5. Buildings

The total covered area works out to approximately 4,284 m² (see table 7). It consists of work sheds and service sheds roofed with asbestos sheets on fabricated steel trusses with provision for skylights. The floor will be concrete. Offices will be housed in the administrative buildings. Bays of not less than 12 metres width will be necessary for work sheds since, besides putting up the machinery on both sides, there will be sufficient space in the centre for working and the movement of goods. The distance between the columns may also be 12 metres since too many columns will be a hindrance in laying the machinery. The heights of the roof in the centre and the sides may be about 6.1 m (20 ft) and 4.9 m (16 ft) respectively.

6. Plant and machinery

Tables 8 and 9 list machinery and equipment needed, their specifications and cost details. Czechoslovakia, the Federal Republic of Germany, France, Italy and the United Kingdom are the main countries from which the machinery has to be imported. Great caution has to be exercised in the selection of the right type of machinery for the end-product envisaged. Before finalizing the quotations and list, it is suggested that the sponsors plan to visit the country suppliers to choose the right type of machinery and to negotiate the price with machinery manufacturers.

While working out the additional machinery requirements for the long-term project, the installed machinery at the end of phase II (short-term programme) must be taken into consideration. The funding for such additional machinery and other capital costs may require outside assistance in the way of long-term credits or supply of machinery on credit. The possibility of United Nations assistance may also be explored.

Alternatively, technical collaboration may be sought with foreign private sectors/Governments for help and assistance for machinery, know-how and marketing surplus leathers.

Table 7. Phase III and IV: Construction cost of factory and administrative buildings

Building	Area (m ²)	Cost per m ² (YD)	Total cost (YD)
Work shed (60 m x 60 m, 3,600 m ²)	3,744	45	168,480
Work shed (12 m x 12 m, 144 m ²)			
Workshop (12 m x 12 m, 144 m ²)	396	45	17,820
Cloak room (12 m x 6 m, 72 m ²)			
Canteen (12 m x 5 m, 72 m ²)			
Transformer house (6 m x 6 m, 36 m ²)			
Boiler house (6 m x 6 m, 36 m ²)			
Generator (6 m x 6 m, 36 m ²)	144	50	7,200
Office and administrative buildings (2 (12 m x 6 m))			
Miscellaneous construction such as pits, garage etc.			<u>6,500</u>
		Total	200,000

Of which YD 100,000 in foreign currency

7. Water

The water requirement of the proposed unit will be approximately 40,000 gallons per day. Prime consideration should be given to ensure abundant and copious supply of good water. It cannot be emphasized enough that water plays an important part in leather processing, particularly in dyeing and fat liquoring.

Table 8. Phase III and IV: Machinery required

Description	Size	Number	Price per unit (thousand \$)	Imported (thousand \$)	Local (YD)
Pneumatic stamping machine	Portable	1	2.5	2.5	-
Hydraulic unhairing machine	About 1,500 mm	1	25	25	-
Hydraulic sammying machine	1,800-2,100 mm	1	30	30	-
Mechanical splitting machine	1,800 mm	1	25	25	-
Wide width shaving machine	1,200-1,500 mm	1	20	20	-
Hydraulic reversible setting machine (suitable for cattle sides and skins)	1,800 mm	1	30	30	-
Hydraulic reversible setting machine	1,500 mm	1	27	27	-
Vacuum drying unit	(Maximum size, with 2 plates)	1	50	50	-
Vibratory staker (throughput)	1,500 mm	1	26	26	-
Jaw staker (Slocum)		1	6	6	-
Toggling unit (frames and toggles)	50-75 frames	1	40	40	-
Feed through buffing machine	1,500 mm	1	25	25	-
Leather brushing machine	1,500-1,800 mm	1	5	5	-
Dust collection and extractor		1	10	10	-
Polishing stone machine	250 mm	1	5	5	-
Plush wheel		1	5	5	-
Wheel stakers					
Narrow width		1	2.5	2.5	-
Wide width		1	2.5	2.5	-
Hand spray booth, compressor and spray guns			10	10	-

Table 8 (continued)

Description	Size	Number	Price per unit (thousand \$)	Imported (thousand \$)	Local (ID)
Hot room for drying		2	2	2	
Glazing machine		2	5	10	
Hydraulic press (600-630 tons)	1,370 mm x 660 mm	1	26	26	
Plates for hydraulic press	1,370 mm x 660 mm	8	1	8	
Hydraulic automatic ironing cum plating machine (like finiflex)	1,500 mm	1	45	45	
Tanning drums		7	9	63	
Experimental tanning drums		1	3	3	
Electrical hand operated setting machine (for sole leather)		1	3	3	
Leather thickness measuring gauges	12 in. 18 in.	1 2	0.125 0.125	0.125 0.25	1 2
Pan-type balance	20 kg	2	0.25	0.5	
Platform-type weighing machine	1,000 kg	2	1.5	3	
Misc. equipments and tools for tannery				<u>30</u>	
				540.375	5,040
Spare parts				<u>50.650</u>	
Allowance for price escalation at 10 %				591.025	
				<u>59.103</u>	
			Total	650.128	
			Say	650	

Table 9. Phase III and IV: Total cost of machinery and equipment (YD)

Item	Foreign currency	Local currency	Total value
Additional machinery required (including spares, c.f.)	227,500	5,040	232,540
Value of existing machinery	-	26,810	26,810
Provision already made to acquire 3 drums, experimental drum etc, as per 1976 budget including installation charges	10,000	2,000	12,000
Clearing, unloading, transport to site insurance etc. at 5%	-	11,375	11,375
Installation charges at 10%	-	22,750	22,750
Ad hoc provision for dismantling, transport and erection of existing machinery, in the new location at 10%	-	3,681	3,681
Total	237,500	71,656	309,156
		say:	310,000

As the unit has been planned to make sophisticated types of finished leathers, geared to export, the water should be soft. While locating the unit, top priority should be given the water supply, both the quantity and quality. Water pipelines in the unit should be sufficiently large in diameter (about 2.5 to 3 in. diameter) and more tap points should be provided near the drums, paddles and other machinery. There must be adequate pressure in the main supply of water, which will be furnished by municipal corporation.

An overhead tank with a capacity of at least one third the daily requirement of water may be helpful in case there is any difficulty in the flow of water from the main supply during certain periods of the day.

If the water is not soft, a water-softening plant may have to be installed for the post-tanning and finishing operations.

The temperature of water increases during the day and sometimes goes even as high as 38° to 40°C which may be harmful for some of the operations such as soaking, liming, pickling, vegetable and chrome tanning. It may be necessary to provide a cooling unit to bring down the temperature of water for certain operations.

On an average for processing 1 kg of wet-salted raw material into pickled, wet blue and finished leather, the consumption of water, including miscellaneous uses such as dissolving chemicals, washing, the floor and machines, water supply to machines and equipment and boiler, and other physical requirements will be in places where water is scarce:

	<u>Litres</u>
Up to pickling	40
Up to wet blue (chrome tanning)	45
Up to finishing	65

Ultimate target for daily production is as follows:

Cowhides, 75 hides, average wet-salted weight per hide 9.7 kg, into finished leathers (727 kg)

Camel hides, 25 hides, average wet-salted weight per hide 73.5, kg into finished leathers (335 kg)

Goatskins and sheepskins, 1,600 skins, average wet-salted weight per skins 1 kg

Pickled, 224 skins (224 kg)

Finished leathers, 1,436 skins (1,436 kg)

Total daily water consumption would be 171,330 litres (38,073 gal), of which 162,370 litres for finished leather and 8,960 litres for pickled skins.

The water consumption is mainly for processing raw materials which are already cured. In case curing is also done, washing of slaughtered (green) raw materials with water is necessary. Provision is not made for the consumption mentioned above.

Water charges are YD 0.25 per 1,000 gallons. The cost of water for 40,000 gal daily consumption would be YD 10 per day; YD 250 per month and YD 3,000 per year.

8. Power

The power requirement of the unit is placed around 637 kW and two transformers of 400 kVA each may be sufficient (see table 10). A standby generator of 100 kVA capacity is also included; it will be useful in case of a sudden breakdown of the power supply to keep some of the operations going. The generator should be capable of meeting at least the demand of power load required for drums.

It is assumed that the necessary power supply will be provided by the government electricity power authorities. The power tariff rates charged for industrial units are as follows:

- From 23.30 to 17.30, 8 fils per kWh
- From 17.30 to 23.30, 12 fils per kWh

As certain machinery and equipment will be working even after 17.30, the tariff rate has been assumed at 10 file per kWh.

Assuming 25% of machinery idling time, the actual daily consumption of power will be 2,340 kWh (including the power for fans, lights, coolers and miscellaneous uses). The cost of power will be YD 23.4 per day, i.e. YD 7,100 per year.

9. Fuel

Steam is mainly required for:

- Preparing hot water for bating, dyeing, fat liquoring etc.
- Dissolving dyestuffs, fat liquors, finishes etc.
- Toggle-drying unit
- Vaccum-drying unit
- Drying chamber

Table 10. Power requirements and consumption

Description	Number	Power per unit per hour (hp)	Total required power (hp)	Working time (hours)	Total power consumed (hp)
Pneumatic stamping machine	1	0.75	0.75	5	3.75
Paddles	4	5	20	2	40
Soak and lime drums (skins)	3	15	45	2	90
Soak and lime drum (hides)	1	15	15	2	30
Skin unhairing machine	1	15	15	7	105
Skin fleshing machine	1	17	17	7	119
Hide fleshing machine	1	18	18	2	36
Skin scudding machine	1	10	10	7	70
Deliming, pickling and tanning drums	3	15	45	12	540
Hydraulic sammying machine	1	20	20	7	140
Mechanical splitting machine	1	20	20	2	40
Wide width shaving machine	1	42	42	7	294
Double width hydraulic shaving machine	1	16	16	7	112
Mechanical shaving machine	1	10	10	7	70
Dyeing and fat liquoring drums	3	10	30	7	210
Experimental drums	2	2	4	5	20
Vegetable tanning drums	2	15	30	4	120
Oiling drum	1	7.5	7.5	2	15
Dry drum	1	7.5	7.5	3	22.5
Hydraulic reversible setting machine (hides)	1	20	20	10	200
Hydraulic reversible setting machine (skins)	1	15	15	10	150
Vacuum drying unit	1	15	15	8	120
Vibratory staker	1	12	12	4	48
Jaw stakers	2	6	12	7	84

Table 10 (continued)

Description	Number	Power per unit per hour (hp)	Total required power (hp)	Working time (hours)	Total power consumed (hp)
Wheel stakers	1	3	3	4	12
Toggling unit		15	15	8	120
Feed through buffing machine	1	20	20	7	140
Double width buffing machine	1	10	10	7	70
Single width buffing machine	1	6	6	7	42
Brushing machine	1	3	3	7	21
Dust collector	1	10	10	7	70
Polishing stone machine	1	7.5	7.5	4	30
Plush wheel	1	3	3	6	18
Spray booth, compressor, exhaust	2	7.5	15	8	120
Hot chambers		7.5	7.5	8	60
Hydraulic press	1	20	20	6	120
Gloria press	1	10	10	2	20
Glazing machine	3	4	12	8	96
Finiflex	1	25	25	6	150
Measuring machine	1	1	1	7	7
Electrical hand operated setting machine	1	1	<u>1</u>	5	<u>5</u>
			Total		3,780.25
Laboratory			10	2	20
Boiler			3	7	21
Workshop			20	4	80
Water pump, effluent pump			<u>20</u>	4	<u>80</u>
			Total		3,981.25

When the unit envisages procuring an automatic sprayer at a later stage, steam will be required for the spray unit. From experience a minimum of about 2,000 kg steam per day may be required at a pressure of 35 lb/in.² and an oil-fired boiler with a capacity of 600-1,000 kg/h will be sufficient. Oil-fired boilers are generally preferable since they are cleaner and save space.

The cost of fuel will be as follows:

Furnace oil required for 2,000 kg of steam, 160 kg at YD 0.045 per kg

	<u>YD</u>
Cost of 160 kg	7.2
Cost of preheating at 10%	<u>0.72</u>
	7.92

As the boiler's efficiency will be only 75% the cost of fuel per day will be YD 10.56. The cost of fuel per annum will be YD 3,168.

10. Effluent

The system will consist of eight tanks of size 36 ft x 20 ft each with a depth of 4.5 ft. Six tanks will be used and the other two will be held in reserve until they are required when any of the other tanks are cleaned. The effluent tanks will be situated at a distance of 100 ft minimum from the back of the tannery, thus providing space for the expansion of the tannery. In treating the effluent, it may be necessary to add sufficient alkali to chrome and dye-bath liquors after mutual precipitation, so that chrome salts will be completely precipitated and filtered off by means of sand filters. The sulphide lime liquor is allowed to settle.

11. Chemicals and consumables

Provisions have been made for wastage and additional chemicals required, if any, fluctuation in prices, customs duty etc. Most of the prices are assumed and based on the current prices of the chemicals purchased by NTF. About 5% of the total cost of chemicals have been assumed for consumables for the production. But for lime and salt, all other chemicals have to be imported and the import content, as such, has been taken as 95% of the total cost of chemicals and consumables.

12. Requirement of personnel

The unit is expected to provide employment for 221 people for the full target; the distribution is furnished below:

<u>Department</u>	<u>Administration</u>	<u>Managerial</u>	<u>Supervisory</u>	<u>Skilled</u>	<u>Semi-skilled</u>	<u>Others</u>
Production	-	4	20	50	25	-
Auxiliary	-	1	2	10	10	-
General administration	<u>21</u>	<u>=</u>	<u>=</u>	<u>=</u>	<u>=</u>	<u>8</u>
	21	5	22	60	105	3

The Government is expected to take all necessary steps to provide the tannery with the right personnel for production and administration. For long-range objectives, the training programme for managerial and supervisory cadre in production, maintenance etc. are broadly indicated in table 11.

Outside assistance of qualified and experienced technical personnel for production as well as for repair and maintenance is essential until the local staff has gained adequate experience and training for efficient management and operation of the tannery. The assistance may be obtained through the recruitment of suitable expatriates or under bilateral agreement.

The following incumbents are suggested:

A senior tanner with at least 12 to 15 years of production experience in tanning and finishing of hides and skins in reputed tanneries

A junior tanner with 5 to 8 years of production experience in tanning and finishing of hides and skins

A qualified engineer or a foreman with a minimum of 8 to 10 years of experience in installation, operation, repair and maintenance of tanning and finishing machinery and equipment

(a) Labour

Normally, the output per man-day in tanneries, equipped with essential machinery, in developing countries, where the tanning industry has been in existence for sometime and where skilled labour is available is as follows:

	<u>ft²</u>
Finished leathers	80 to 200
Dyed crust (ready to finish)	110 to 125
Wet blue skins	250 to 300
Pickled skins	300 to 350

Table 11. Training programme for the long-term project

Minimum educational qualifications of the candidate	Grade/Category	Number of persons	Type of training required	Place	Period
Graduate in chemistry or equivalent	Managerial cadre (for production and management)	3	Degree or diploma in leather technology followed by inplant training in tanneries	Abroad - in leather institutes	Depending upon the curriculum
Secondary grade with chemistry or minimum qualification required for diploma course in leather technology	Supervisors for production (tanning and finishing, quality control etc.)	4	Diploma course in leather technology followed by inplant training in tanneries	Abroad - in leather institutes	Depending upon the curriculum
Graduate in chemistry	Laboratory, in charge of research and development	1	Analytical leather chemistry, physical and chemical testing of leathers, chemicals etc.	Abroad - where training facilities are available	2 to 8 months
Graduate in mechanical engineering	Leather trades: operator, in charge of tanning, repair and maintenance, training of workers in operation of machinery	1	Installation, operation, repair and maintenance of tanning machinery	Abroad - preferably in tanning machinery firms	2 to 12 months

The productivity will be less for the proposed unit as the workers have to be trained, even though the unit is planned to be equipped with essential machinery. The initial productivity is assumed as follows:

	<u>ft²</u>
Finished leathers	65
Dyed crust	80
Wet blue skins	200
Pickled skins	230

The ultimate target planned, with a daily output of 100 cattle and camel hides and 1,600 skins, is 8,247 ft² of finished leathers, including vegetable tanned leathers and splits, and 768 ft² of pickled skins. The labour requirement to achieve this target is as follows:

Labour for 8,247 ft ² of finished leathers	127
Labour for 768 ft ² of pickled skins	3
Labour	say 132
Absenteeism at 10%	<u>13</u>
Total labour required	145

The ratio of skilled labour to semi-skilled labour is approximately 1:2, i.e. skilled personnel, 50; and semi-skilled personnel, 95.

Wages and benefits per annum will amount to:

	<u>YD</u>
Wages	40,680
Benefits	14,880

Salaries and benefits per annum will amount to:

	<u>YD</u>
Salaries	11,640
Benefits	4,020

(b) Supervisory and managerial (production)

General manager - 1

Works manager - 1

Assistant works managers (AWM) - 2 (wet yard, 1) (dry yard, 1)

	<u>Junior foreman (JP)</u>	<u>Senior foreman (SP)</u>
Raw yard	1	-
Beam house	1	1
Tan yard (chrome)	1	1
Tan yard (vegetable)	1	-

	<u>Junior foreman (JP)</u>	<u>Senior foreman (SP)</u>
Retanning and dyeing	2	1
Post dyeing operations (setting, drying, staking, buffing)	1	-
Crust assortment	1	-
Finishing	1	2
Finish mixing	1	-
Warehouse	1	1
Laboratory	-	1
Shift work	1	1

(c) Auxiliary staff (labour and supervision)

	<u>Skilled</u>	<u>Semi-skilled</u>	<u>JP</u>	<u>SP</u>	<u>A/M</u>
Mechanic	1	1	-	-	-
Plumber	1	-	-	-	-
Electrician	1	-	-	-	-
Carpenter	1	1	-	-	-
Workshop	2	2	-	1	1
Boiler house	1	1	-	-	-
Pumphouse, effluent	1	1	-	-	-
Transformer house	1	-	-	-	-
Helpers (miscellaneous)	-	2	-	-	-
Stores (engineering)	-	1	1	-	-
Stores (chemical)	1	1	-	1	-

Salaries and benefits per annum will amount to:

	<u>YD</u>
Salaries	7,740
Benefits	2,760

(d) Office and administration personnel

	<u>Persons</u>
Administration:	
Office manager	1
Office assistant	1
Stenotypist	1
Clerks and typists	3
Time keeper	1
Telephone operator cum receptionist	1
Drivers	2
Sweepers	2
Watchmen	4
Commercial section:	
Purchase officer	1
Sales officer	1
Purchase assistant	1
Sales assistant	1
Clerk cum typist	2
Planning section:	
Planning officer	1
Assistant	1
Clerk cum typist	1
Accounts section:	
Accounts officer	1
Assistant	1
Cashier	1
Clerk cum typist	1

Salaries and benefits per annum will amount to:

	<u>YR</u>
Salaries	11,040
Benefits	3,900

14. Economics and profitability

(1) Assumptions

Land (levelled) required for the tannery will be provided by the Government at a nominal rate

Construction cost of buildings:

Works and service sheds: YD 45 per m²
Administrative buildings: YD 50 per m²

Water will be provided by the municipal authorities at the rate of YD 0.25 per 1,000 gal

Power will be supplied by the government electric supply authorities at the tariff rates mentioned

The right type of raw materials and the quantity required will be available at the price mentioned for the product-mix planned

Repair and maintenance charges have been provided at 2.5% on cost of buildings, 5% on machinery and equipment, 10% on office equipment and 20% on vehicles (table 12)

Packing cost has been provided at 1% on total net sales

Selling expenses such as sales commission at 3% on export sales and 1% on local sales, and sales promotion expenses at 0.75% on total sales

The selling prices of leathers for local demand have been taken as the current prices of NTF. For export sales, the prices indicated (f.o.b.) are the ruling prices prevailing in some of the developing countries. A discount of 10% for 75% of the local sales has been provided in accordance with the policy of the Government for supplying leathers to new units such as the footwear units. About 5% on the sales value has been assumed for downgrading in the quality owing to raw material variations, processing damages etc.

Miscellaneous other income has not been taken into account since this amount is reserved for meeting any unforeseen contingencies in processing

Depreciation charges have been calculated at 5% on building, 10% on machinery and office equipment and 20% on vehicles (table 13)

Interest charges have been calculated at 5% per annum for the fixed assets and working capital

For the supervision and office staff, slightly higher salary has been taken than the salaries prevalent, on the assumption that qualified personnel will be recruited for the tannery

Working capital requirements have been computed on the basis mentioned in table 14

Ad-hoc provision and approximate prices have been indicated only for the miscellaneous fixed assets

Wages are indicated as per the prevailing rates

Benefits for labour, supervision, auxiliary staff and office and administration are based on the present rates

No customs duty has been provided for the imported raw materials, on the assumption that any shortfall in the quantity of raw materials met by imports will not be subject to customs duty

The project will exploit fully the local raw materials, the quality of which will be improved in course of time by the necessary steps to be taken by the Government on the suggestions of the marketing expert and tanning and finishing expert

The economics have been worked out on the above basis. The estimated net sales realization is given in table 15, the profitability statement is given in table 16 and the break-even point in table 17.

(b) Limitations

The success of the project depends largely on the following factors:

Mobilization of the various raw materials available in the country, without depending on the import of raw materials

Immediate steps taken by the Government to improve the breed, sizes, flaying, curing and collection so that not only the right quality of raw materials but also the necessary quantity will be made available to the tannery

Proper product-mix and optimum utilization of the rejects

Optimum utilization of the machinery and equipment

Availability of trained qualified leather technologists, managerial personnel, skilled operators and maintenance men to run the tannery

Introduction of quality control, cost control, material and process control

Proper planning and programming

Market intelligence

Table 12. Yearly repair and maintenance cost
(YD)

Item	Cost
For buildings (value, YD 222,950) at 2½%	5,574
For machinery and equipment (value, YD 412,928) at 5%	20,646
For office equipment (value, YD 11,500) at 10%	1,150
For vehicles (value, YD 7,000) at 20%	<u>1,400</u>
	28,770
Foreign currency 50% = YD 14,385	
Local currency 50% = YD 14,385	

Table 13. Fixed costs, depreciation and interest
(YD)

	Buildings	Machinery and equipment	Office equipment	Vehicles	Total
Land development	10,000	-	-	-	10,000
Buildings	200,000	-	-	-	200,000
Water supply and effluent	12,950	3,050	-	-	16,000
Machinery and equipment	-	310,000	-	-	310,000
Miscellaneous fixed assets	-	<u>99,878</u>	<u>11,500</u>	<u>7,000</u>	<u>118,378</u>
	222,950	412,928	11,500	7,000	654,378
				say	654,400
Depreciation at 5% on buildings					11,148
Depreciation at 10% on machinery and equipment					41,293
Depreciation at 10% on office equipment					1,150
Depreciation at 20% on vehicles					<u>1,400</u>
					54,991
Interest charges at 5% per annum					
For fixed assets of YD 659,400					32,970
For working capital of YD 286,000					<u>14,300</u>
					47,270

Table 14. Working capital requirements
(YD)

	Total	Foreign currency	Local currency
Raw materials (3 months stock)	38,250	9,000	29,250
Chemicals and consumables (6 months stock)	55,125	49,875	5,250
Goods in process ^{a/} (1 months stock)	32,758	12,892	19,866
Goods in warehouse ^{a/} (1 months stock)	32,758	12,892	19,866
Bills receivable ^{b/}			
Export sales ^{c/} (3 months)	94,693	94,693	
Domestic sales ^{d/} (1 month)	19,192		19,192
Cash expenses for administrative and selling expenses (2 months)	8,823		8,823
Provision for 1 month interest (at 5%) payable on total investment	<u>3,938^{e/}</u>		<u>3,938</u>
Total	285,537	179,352	106,185
Say	286,000	179,500	106,500

a/ Based on packed cost.

b/ Based on selling price.

c/ For export sales, three months have been assumed for realizing the value because of the possible delay in shipping facilities, and also for accumulating a minimum quantity in the various types of exportable types of leathers.

d/ For local sales, one month has been assumed because of possible delays in deliveries, collection of bills and realization in banks.

e/ YD 2,748 for fixed assets and YD 1,190 for working capital.

Table 15. Estimated net sales realization per annum
(YD)

Item	Local sales	Export sales	Total
Leather from:			
Cowhides	143,444	-	143,444
Camel hides	56,167	-	56,167
Goatskins	49,446	226,098	275,544
Sheepskins	<u>13,018</u>	<u>172,608</u>	<u>185,626</u>
	262,075	398,706	660,781
Less 5% allowance for quality downgrading because of raw material variation, processing defects etc.	13,104	19,935	33,039
Less 10% discount for 75% of local sales	<u>18,673</u>	-	<u>18,673</u>
Total	230,298	378,771	609,069

*Miscellaneous income from sales of used containers, trimmings, hair, if recovered, could be about YD 5,000 to YD 7,000 per annum. This is not included, as the amount may be required for any contingency in processing.

Table 16. Profitability statement
(YD)

Item	Total	Foreign currency	Local currency
Estimated sales realisation	609,069	378,771	230,298
Raw materials	153,000	36,000	117,000
Chemicals and consumables	110,250	99,750	10,500
Wages and salaries	96,660	-	96,660
Water	3,000	-	3,000
Power	7,100	-	7,100
Fuel	3,168	-	3,168
Repair and maintenance	28,770	14,385	14,385
Packing	6,091	4,568	1,523
Office and administrative expenses	20,000	2,000	18,000
Selling expenses	18,000	14,400	3,600
Cost of production, excluding interest and depreciation	446,039	171,103	274,936
Profit, before depreciation and interest	163,030	207,668	44,638 (-)
Depreciation	54,991	-	54,991
Profit, after depreciation but before interest	108,039	207,668	99,629 (-)
Interest (5% of total investment)	47,270	-	47,270
Profit, after depreciation and interest	60,769	207,668	146,899 (-)
Depreciation	54,991	-	54,991
Cash accruals	115,760	207,668	91,908 (-)
Cost of production, including depreciation and interest	548,300	171,103	377,197

Payback period = $\frac{\text{Total investment}}{\text{cash accruals}} = \frac{945,400}{115,760} = 8.18$ years; say 8 years

Percentage of profit on total investment = $\frac{60,769}{945,400} \times 100 = 6.43\%$

Percentage of profit on total sales = $\frac{60,769}{609,069} \times 100 = 9.98\%$

Percentage of profit on cost of production = $\frac{60,769}{548,300} \times 100 = 11.08\%$

Percentage of profit on working capital = $\frac{60,769}{286,000} \times 100 = 21.25\%$

Table 17. Break-even point

Fixed costs		Variable costs	
Wages and salaries	96,660	raw materials	153,000
Repair and maintenance	28,770	Chemicals and consumables	110,250
Office and administrative expenses	20,000	Water	3,000
Depreciation	51,991	Power	7,100
Interest	<u>47,270</u>	Fuel	3,168
		Packing	6,091
		Selling expenses	<u>18,000</u>
Total	247,691	Total	300,609

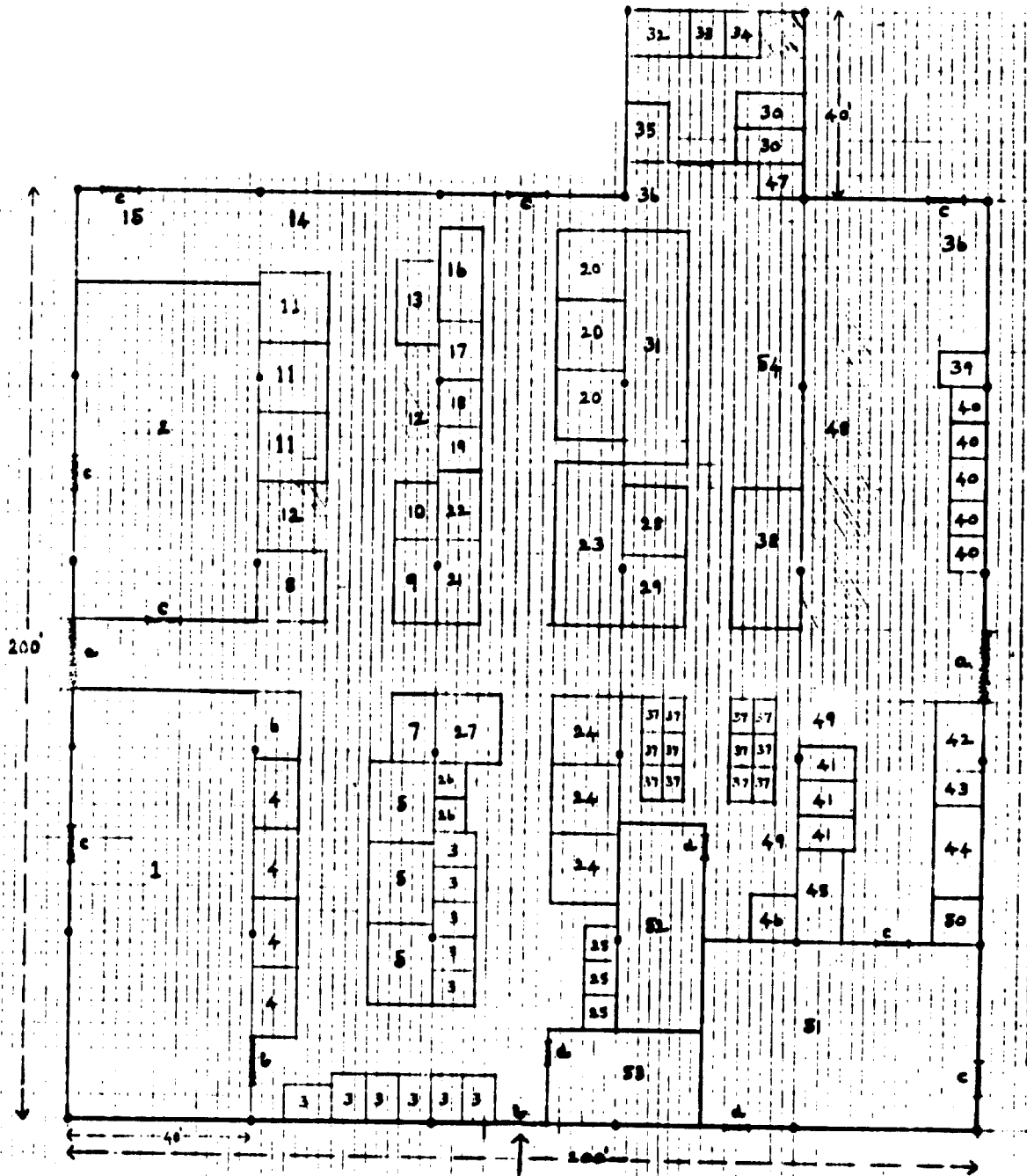
Estimated sales realisation = 609,069
 Variable cost = 300,609 (-)
 308,460
 Break-even point (capacity) = $\frac{247,691}{308,460} \times 100 = 80\%$

Table 18. Summary of the project cost (YD)

	Total	Foreign currency	Local currency
Fixed assets			
Land and development	15,000	-	15,000
Building	200,000	100,000	100,000
Water supply and effluent	16,000	8,000	8,000
Machinery and equipment	310,000	237,500	72,500
Miscellaneous fixed assets and utilities	<u>118,378</u>	<u>94,525</u>	<u>23,853</u>
	659,378	440,025	219,353
Say	659,400		219,375
Working capital	286,000	179,500	106,500
Total	945,400	619,525	325,875
Estimated value of output	609,000	379,000	230,000

Annex

MACHINERY LAYOUT OF A TANNERY PROCESSING 100 HIDES AND 1,600 SKINS PER DAY INTO FINISHED LEATHERS



Legend:

	<u>Space required (ft)</u>
1. Raw storage	92.5 x 40
2. Chemical and engineering stores	72.5 x 40
3. Soak and lime pits	11 (7.5 x 10)
4. Paddles	4 (15 x 10)
5. Soak and lime drums, diameter 8 ft x 10 ft width	3 (17.5 x 15)
6. Hydraulic unhairing machine (skins), 1,500 mm	15 x 10
7. Hydraulic fleshing machine (skins), 1,500 mm	15 x 10
8. Lime drum (hides), 8 ft x 8 ft	15 x 15
9. Hide fleshing machine	18 x 10
10. Scudding machine (skins), 1,500 mm	12.5 x 10
11. Deliming, pickling and tanning drums, 8 ft x 8 ft	3 (15 x 15)
12. Storage place and future expansion	
13. Sammying machine	18 x 10
14. Piling and assortment space for tanned leathers	
15. Pickle assortment and packing	
16. Splitting machine (hides)	20 x 10
17. Wide width shaving machine	12.5 x 10
18. Hydraulic double width shaving machine	10 x 10
19. Mechanical shaving machine	10 x 10
20. Retanning and dyeing drums, diameter 8 ft x 8 ft width	3 (15 x 15)
21. Hydraulic reversible setting machine (hides and skins)	18 x 10
22. Hydraulic reversible setting machine (skins)	15 x 10
23. Vacuum drier	35 x 15
24. Vegetable tanning drums, 8 ft x 8 ft	3 (15 x 15)
25. Hand setting tables	3 (7.5 x 7.5)
26. Experimental drums	2 (7.5 x 7.5)
27. Dry drum	15 x 15
28. Saw dusting pit	15 x 15
29. Vibratory (throughput) staker	15 x 15
30. Slocum (jaw) staking machine	2 (7.5 x 15)
31. Toggling (cabinet) unit	50 x 15
32. Feedthrough buffing machine	15 x 10
33. Double width buffing machine, 800 mm	7.5 x 10
34. Single width buffing machine, 250 mm	7.5 x 10

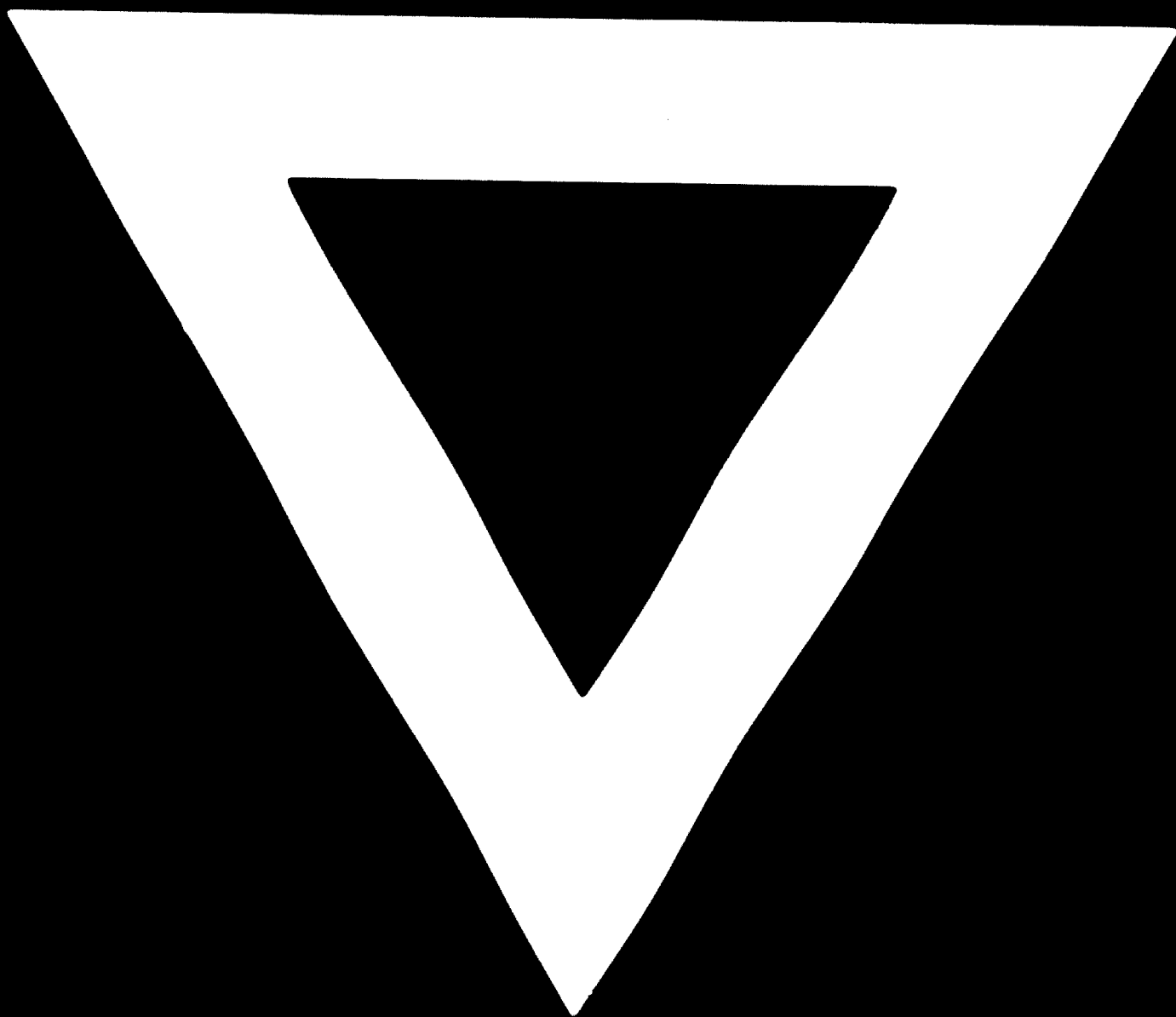
	<u>Space required (ft)</u>
35. Brushing machine	12.5 x 10
36. Crust storage and assortment	
37. Hand seasoning tables	12 (7.5 x 5)
38. Hot chamber (for hand-seasoned and hand-sprayed leathers)	30 x 15
39. Compressor for spray	7.5 x 10
40. Hand spray units	5 (8 x 7.5)
41. Glazing machine	3 (7.5 x 12.5)
42. Hydraulic press	15 x 10
43. Storage for plates	7.5 x 10
44. Finiflex	20 x 10
45. Gloria press (Schageter)	20 x 10
46. Plush wheel	7.5 x 10
47. Polishing stone machine	7.5 x 10
48. Space for auto sprayer (future expansion)	80 x 15
49. Storage for piling leathers	
50. Pin-wheel measuring machine	10 x 10
51. Warehouse	60 x 40
52. Finish storage and mixing room	45 x 20
53. Laboratory	35 x 20
54. Loft drying	

Width of the gates: (a) 15 ft; (b) 10 ft; (c) 7.5 ft; and (d) 5 ft.

The space indicated for the machinery and equipment includes working space, provision of 3 feet from the back and in between the machinery etc.



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