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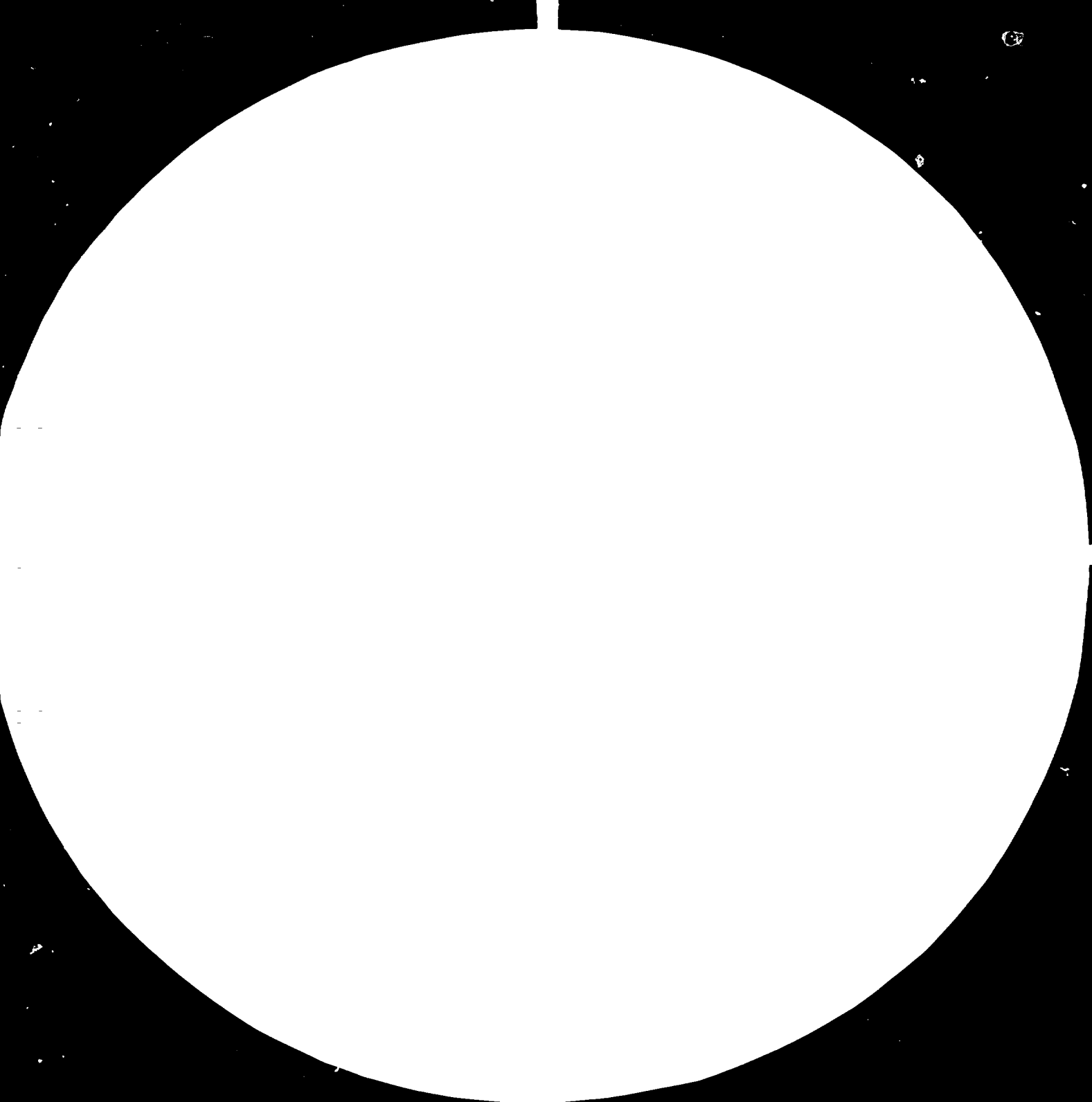
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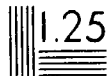
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ESTABLISHMENT OF A TANNERY

SI. JAM. 79-80\*

THE GAMBIA

Feasibility Study\*

Prepared for the Government of The Gambia by the  
United Nations Industrial Development Organization

Based on the work of David Winters, Consultant

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Note: Throughout this report the following have been employed:

Exchange rate:

1 Pound Sterling = 4.0 Dalasis

1 US\$ = 1.85 "

1 DM = 1.00 "

## I Summary and Conclusions

### A Executive Summary

Following an indepth study of local conditions, raw material available and market demand it is shown that an export oriented tannery, fully mechanised, but with small capacity, could be established in The Gambia.

It is envisaged that the tannery will be able to process all the hides and skins produced in The Gambia which are now exported raw. The majority of the products of the tannery will be initially exported in a semi processed state but over 20% will be finished in various forms to satisfy local demand.

Due to the low volume of availability of Gambian hides and skins, it has been necessary to proposed the employment of reconditioned machinery to achieve a balanced capital input. A total capital requirement of 1.4 million Dalasis should yield profits rising from D216,000 in year 3 to D408,000 in year 8. The cash flow would suggest that a long term loan of 1.2 million Dalasis, at current interest rates, could be amortized by year 7.

In addition to the profit which will be generated by the tannery it must be accepted that the availability of a range of leathers will catalyse the development of the Gambian Leather Products Industry and subsequently allow a domestic footwear industry to be developed. (Possibly a semi mechanised unit now under consideration by the Gambia Commercial and Development Bank).

The study details the treatment of the waste tannery effluent and if the tannery is sited as suggested near G.P.M.B. at Denton Bridge, minimal environmental nuisance will be created.

It is strongly urged that if the tannery is to be commercially successful, a new parastatal company must be found - GAMTAN (?) - possibly directly controlled by Ministry of Economic Planning and Industrial Development, with the active participation of the Livestock Marketing Board (L.M.B.), and the Animal Husbandry and Production Division of the Ministry of Agriculture and Natural Resources. It may be necessary to remove the monopoly in the hide and skin sector given LMB or ensure that LMB license the tannery to act as its Agents (for a commercial consideration?). To fully exploit available skills many of the Hides and Skins Officers and assistants of the Ministry of Agriculture and Natural Resources (MANR), must be incorporated into the tannery and its hide buying network.

The Tannery will require one expatriate Technical Manager until a Gambian is available but due to the low thruput suggested, the tannery project will not be able to bear the full cost of such expert and it is suggested that external aid is sought to "top up" such person. (The expatriate must have executive authority not an advisory role.



B Summary

1 Background

In response to a request from the Government of the Republic of The Gambia for special Industrial Services, UNIDO fielded David Winters, a United Kingdom Leather Industry Consultant to execute two assignments (SI/GAM/79/801/11-01 & 02).

Shortly after arrival at the duty station, the consultant's two job descriptions were amalgamated and reoriented (with the agreement of the office of the Resident Representative, UNDP, Banjul).

The revised duties were:-

"The expert will be attached to the Ministry of Economic Planning and Industrial Development and will in particular be required to:-

- (1) Prepare a Feasibility Study for an export oriented "Wet Blue" tannery ensuring as far as possible the commercial viability of such project is of paramount importance;
- (2) Advise the Government in drawing up the organizational and technical requirements of such a tannery and prepare public tenders for the equipment needed;
- (3) Advise the Government on the need for training in the proposed tanning techniques;
- (4) Advise the Government on possible means by which the existing artisanal leather products industry may be upgraded.

The expert will also be expected to prepare a final report, setting out the findings of his mission and his recommendations to the Government on further actions which might be taken."

This feasibility study completes the obligations at 1, 2 and 3 above. Item 4 and general are the subject of a separate report.

With the approval of MEPID, the consultant co-opted a technical counterpart from MANR - Mr. R.M. Taylor, Senior Livestock Officer (Hide & Skins). It being evident that if a tannery were to be established, this officer, the only Gambian to have any formal training in Tannery Technology must logically be part of the management team and thus should be closely associated with pre project activities.

## 2 Raw Material

Based on an analysis of LMB, hide and skin sales and discussions with relevant authorities, a brief visit upcountry it would appear that a tannery could expect to obtain some 22,000 Hides p.a. and at least 22,000 Skins p.a. (sheep and goat).

## 3 Market Demand

There is a huge unsatisfied global demand for semi-processed hides and skins in the "wet blue" state and it is suggested that this be the major production. With regard to hides it is suggested that 80% be "wet blue" for export - the balance being finished to satisfy current Gambian demand and stimulate new and improved leather products and pave the way for a future leather footwear industry. With regard to skins a balance of 50:50 wet blue (export) Finished (local) is thought feasible as tourist requirements are high for these products. It is suggested that appreciable market for hair-on-skins may be developed as a substitute for gameskin no longer available.

It would be realistic to expect the expatriate technical manager to have suitable contacts in the World market and thus ensure sale of product.

## 4 Input - Output Values

The study assumes purchases of Hides and Skins will be:-

From Abulo Abbatair at LMB current export prices (subject to an index based on market prices).

From other sources at approximately double current prices being offered by LMB [in order to create incentive for improved recovery rate].

The study assumes conservative sales value some 15% below the levels now existing in other African countries.

## 5 Machinery - Technology - Purchases

The available raw material at 2 above is only some 25% of the volume normally justifying a fully mechanized unit. To mitigate this it is suggested that AI reconditioned machinery is purchased for the wet blue department and "serviceable" machinery only for the finishing section (where utilization will be below 10% of capacity). AI Reconditioned machinery is available from several reputable companies and such equipment carries guarantees equivalent to new M/C.

Although tender requirements of plant and M/C are detailed in the study (Annex VII), the consultant feels that more profitable approach may be to proceed by Private Treaty negotiation with the reputable companies listed later. On the basis of Public Tender, there may be no one available in The Gambia to evaluate the offers and certainly there exist a number of machinery suppliers who one cannot recommend.

The plant and machinery suggested will allow the production of a wide variety of finished leathers for which local demand may be expected.

#### 6 Site

The site proposed has been cleared with all relevant local authorities - Planning, Health, Fisheries, etc. It was evaluated with special emphasis on the economic discharge of the tannery waste waters and the avoidance of environmental degradation.

It is proposed to remove the majority of toxic materials from these industrial effluents, the resultant homogenized liquors will then receive massive marine dilution.

It is suggested that a factory of some 723 M<sup>2</sup> will be erected on a quarter or a half hectare site.

In the event that the tannery was open for tourist visits, landscaping would be necessary and perhaps a sub branch of GAMCO could be established.

#### 7 Management

Although LMB have a monopoly position with regard to hides and skins purchases it is not felt that LMB have the necessary industrial orientation to direct the project and accordingly it is suggested that a new parastatal company - GAMSTAN be formed. This must harness the specialised expertise available in the country - The hide and skin personnel at MANR, Abuko and possibly one or two of the GAMHIDE staff from LMB.

The tannery should be able to effectively control the preparation of the hide in the field, collection and buying as well as processing in the tannery.

#### 8 Total Capital Requirement

It is calculated that capital requirements will be:-

Fixed Capital	969,508
Working Capital	411,972
Start up Capital	18,520
Total Capital	<u>1,400,000 D</u>

As a new parastatal body will operate the project the question of equity and loan capital may not arise. The study assumes a long term loan of 1.2 million Dalasis and a Bank overdraft of 0.2 million D. Both at 11%, the long term loan being amortized over years 3 - 7 of the project.

### 9 Profitability

Following losses in the first 2 years one may expect profits to be:-

	<u>Profit</u>	<u>Profit as % of Long Term Loan</u>
Year 3	D216,207	13.0
rising to Year 3	D407,983	34.0

It may also be noted that the Internal Rate of Return (economic) is

some 32 % and  
the breakeven point = 60 %.

However of more long term benefit may be the spin off with improved and expanded leather products and even footwear production possibly due to the availability of a full range of leathers.

### 10 External Aid/Training

The project being so small cannot be of interest to foreign commercial partners thus no joint venture expertise is available.

Initially an expatriate technical manager must be employed. (Possibly also acting as General Manager). The project may not be able to fund the necessary highly experienced specialist and thus external aid must be sought. A Gambian is due to depart soon to receive formal training in Lether Technology and must eventually replace the expatriate. Other training requirements can be arranged via the machinery suppliers or funded directly by the project capital.

### C Conclusion

A mechanised tannery is shown to be commercially viable in the Gambia provided the guidelines detailed in this study are closely followed.

## II Hide and Skin availability/Quality/Value World Markets & Proposed Product Mix

In recent years, most countries in Africa have taken action to develop their tanning sectors in order to maximise the value added obtained from their indigenous raw material. As a consequence, the number of marketed hides and skins from Africa has greatly declined. Thus, today, it would be unsound to develop a tanning industry if it were reliant on imports of hides & skins from elsewhere and for this reason in this feasibility study only domestic resources are assumed to be available.

### A Gambian Hide & Skin availability

#### 1 Hide Production/Recovery

With a live bovine herd of some 300,000 one could conservatively estimate slaughterings at 24,000 pa. (8% OFF TAKE) (yielding a similar no. of hides). However in the (early 70's) there was some significant under-collection or under-recording of this material.

Export statistics from 1972/3 - 1976/7 show export volumes of 60 - 30 M.T. pa. Assuming an average wt. of 6 Kg./hide this represents 10 - 13,000 hides pa. The low volume reported could be due to non-recovery, unofficial exports to Senegal or statistical errors due to transit shipments via Dakar not being recorded.

An analysis of L.M.B.'s export invoices relating to 1977/8 and 1978/9 show exports of hides at 141 and 124 M.T. pa. This could represent 22,000 hides pa. (i.e. 38 hides/day for 250 working days).

(N.B. The analysis of L.M.B. sales invoices over the 2 year period did not include any balancing for stock fluctuation).

Discussions with informed parties suggest that the availability of hides is most likely to be as suggested by the L.M.B. data, and accordingly it is assumed in this study that 22,000 hides pa. will be available.

#### 2 Skin Production/Recovery

The 600,000 odd petty ruminants could be expected to yield some 180,000 skins pa. (30% offtake is found in other countries with similar pastoral, social and religious traditions). However data from L.M.B. export sources suggest that from 1972/3 - 1978/9 only 8-10 m.t. of skins have been commercialised annually. At an average of 0.45 Kg this would represent 13-22,000 skins pa. and it would be realistic to initially assume that this volume only would be available for the tannery input.

#### 3 Improvement in Hide & Skin Recovery/growth of tannery input

##### a. Hides

The current availability of 22,000 hides pa. suggest relatively high recovery assuming the offtake rate of 8% (26,000 hides pa.). In many other African countries the offtake rate is circa 11% which may in the near future be achieved in The Gambia. Such offtake would yield 33,000 hide pa. i.e. an increase of 50% over the volume available currently.

#### 4 Skins

For several reasons the recovery rate for skins falls far short of that for hides. From a possible slaughter of 130,000 petty ruminants pa. only 18-22,000 are commercialized (10%) in The Gambia. Thus in this sector there is great scope for improvement in recovery rate. The reasons for this low skin recovery rate are varied. Two major reasons must be:-

- (i) The non collection of the large number of skins from animals domestically slaughtered at the Eids.
- (ii) The extremely low price paid by L.M.B. to the producer which gives no incentive to commercialize this product.

Indeed at a time when the World price for similar raw skins is approx. 4.3 US dollar, skin F.O.B. (D8.00 skin) it appears that L.M.B. is only offering less than D1.0 per dry skin. When one assumes that the labour to dry such skin must be 25 or more bututs it is quite clear incentive for recovery of skins does not exist.

A dynamic tannery management could rapidly increase the skin availability by:-

- (i) Paying a more realistic price for the raw material - sufficient to be an incentive.
- (ii) Ensuring that at the Eids sufficient salt is available (even crude marine salt) at all major towns to allow a short term cure to be effected. With a tannery available it will not be necessary to frame dry the skins (unlikely to be bothered with during the Eid festivities) but it would be quite realistic to expect a handful of salt to be sprinkled on the skin even at festivals.

In the event that the volume of skins available did double it would still be possible to process them within the plant later suggested. The hides will only occupy the drums for 5 days week and skins could be processed during the weekends - 200/1000 per drum. Thus capacity will exist for some 30,000 skins pa.

At the Eids it could prove sensible to employ the hide drums for some weekdays giving an increased thruput. (dependant on the management it could take from 2-10 years to obtain significant growth in skin supply and thus it is not realistic to allow for this growth in the financial projections included in this study).

#### 3 Quality/Volume of Gambian Hides & Skins

Value of hides & skins, and the subsequent leather (an essential for a feasibility study), varies from country to country and even from district to district and sometimes includes seasonal fluctuation. Value of this material is partly based on the breed, age and character of the animals but is even more influenced by animal husbandry conditions and ante and postmortem defects.

In the case of Gambian hides it was not possible to obtain first hand knowledge of the potential leather making quality as no industrial tanning is practised and the few pot tanners were only utilising low grade skins.

The consultants own view based on visual examination of raw hides & skins seen, is that Gambian hides ought to be a little better quality than Nigerian hides especially taking into account the fact that Gambian hide derives from Ndama cattle whereas most Nigerian hides are humped Zebu. Unfortunately Nigerian butcher hides are no longer quoted in Trade Journals. However East African hides are quoted monthly and used to be  $\pm 2\%$  of Nigerian Products.

With regard to skins it may be suggested that Gambian quality is not equal to Northern Nigerian (Red Sokotos or Kano Browns) and are more akin to the mixed breeds found in Kenya. A discussion on this point with the Tannery Manager of Bata Tannery, Senegal, confirmed that these views were realistic. based on the Gambian Hides & skins, Bata had tanned in Senegal in the past.

In most situations a good guide to value of hides & skins and subsequent leather is the export price obtained on free World markets. It is in this respect that some doubt is raised. As may be seen at Fig. I overleaf export prices obtained for Gambian hides was less than 50% of prices ruling for Kenyan hides. This low return may be due to:-

- (i) Small volumes available.
- (ii) Poor/expensive freight facilities Gambia/Europe
- (iii) Lack of specialist expertise at L.M.B.
- (iv) Inherent defects in the material not visible to the consultant.

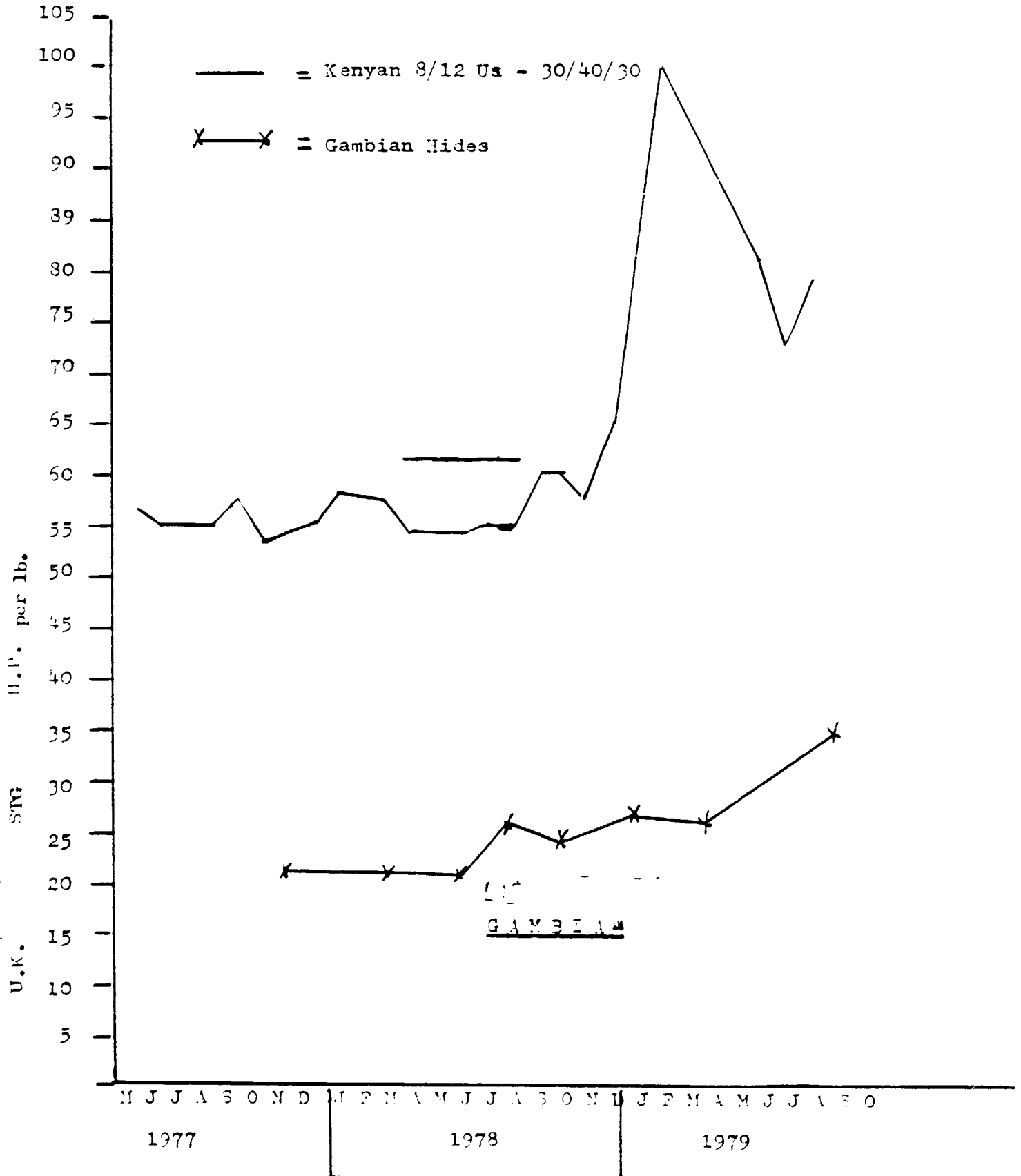
The consultant however feels that (ii) and (iii) above are the most likely causes and would suggest that with a virile tannery management, with the specialized expertise available it would be realistic to expect sales values of Gambian semi-processed export product to reach 80% or more of the values obtained in East Africa - from which area export values are known to the consultant.

The situation regarding Gambian skins is somewhat similar. L.M.B. buy at less than D1.0 per piece, exports at D4.0 per piece (Sept. 1979) yet the export returns in East Africa, at the same time, were equivalent to D8 per piece, raw.

FIG I Export Values of Africa Hides in STG. N.P. per lb.

Sources Kenya - "Leather"

Gambia - L.M.B. invoices





### C World Markets

1. It is suggested that initially the Gambian Tannery would produce wet blue products (a semi-processed form) for export. The World Market for this product is wide open and the minute Gambian volume would have no effect on the market.

Most other developing countries have now advanced to processing and attempting to export Crust or Finished leathers and in these states the market is becoming competitive (with most countries having to subsidise their exports). This advance in other countries has created a vacuum in the primary semi-processed state (i.e. Wet Blue) and no difficulty should be experienced in export marketing the output.

2. The Gambian domestic market for leather is an unknown quantity. Currently it appears that much of the leather utilized in leather goods production in The Gambia is purchased from Senegalese pot tanners. On a short trip up country the consultant only saw one operational Gambian tanner. All of the artisanal leather goods producers (with one exception) reported that their skin leathers were purchased from Senegalese sources at from 5 - 7 Dalasis per skin. They further reported that such leather was difficult to obtain and lack of supply was one of the major production constraints.

Currently only sheep and goat skins - vegetable tanned (albeit crudely) - are available on the local market. The absence of tanned hide means that suitable materials are not available for many end-products. Thus there must exist a local demand for all leathers and in particular for improved quality material.

Certainly the availability of hide and skin leather in various forms, well processed should catalyse the production of novel and improved leather products in The Gambia, both for domestic consumption and tourist purchase.

In other African countries (Kenya) it has been found that following the ban on gameskin production, tourists have been prepared to purchase, in significant quantities "Hair-on" sheep and goat - The major requirement for such product is freedom from holes, good shape and interesting hair pattern - They are retail at 7 - 8 US dollars (D13) and one could think in terms of D10 ex factory. Such product seems suitable to exploit in The Gambia for Tourist Trade.

### D Proposed Product Mix

#### 1. Hides

It is suggested that the major product would be Wet Blue (unsplit) for export. However 20% or so may be found not suitable for such export purpose and there should be sufficient domestic market to absorb this volume of lower quality material in one three states:-

- a. Vegetable tanned sole leather 3 - 6 mm or so for sandals/chappals (currently 1 mm skin is employed with cardboard packing yielding an inferior product);
- b. Vegetable tanned 2 mm softer leather, suitable for sandal uppers and heavier type ladies handbags/briefcases etc.;
- c. Chrome tanned, 1.6 mm, dyed and pigmented corrected grain type leather (same end uses as b.).

The actual proportions of a/b/c for local market may only be determined when the real characteristics of the Gambian hides is discovered and local demand supplied and analysed.

For the purposes of this feasibility study it has been assumed that 30% of Hides are exported in the Wet Blue State. The balance is costed as chrome tanned pigmented leather (c) (the most expensive to process). Assuming efficient tannery management, one could conservatively expect hide leather sales to be:-

22,000	}	30% Wet Blue Exports = 528,000 ft <sup>2</sup> @ 0.60 US\$ ft <sup>2</sup> (f.o.b.)	
at	}	(Dalasi 1.11) = 586,080 D (1)	
30 ft <sup>2</sup> hide	}	20% Pigmented = 132,000 @ D3.0 ft <sup>2</sup> = 396,000 D (2)	
Hide leather sales			= D982,080

- Note: (1) Kenya Wet Blue Leathers in 1979 were valued at 0.75 US\$ ft<sup>2</sup>  
 (2) Kenya Pigmented Leather in 1979 was equivalent to 3.60 ft<sup>2</sup>

2 Skins 22,000 skins available p.a.

5% may well disintegrate during processing.

Thus 20,900 available - 50% export as Wet Blue.

10,450 skins at 48 US\$ dozen (7.4 D each) = D77,330 (f.o.b.) (3)

50% Domestic market:-

5,225 Vegetable tanned @ D7 each	D36,575
5225 "Hair on at D10 each	D52,250
Total Skin sales	D166,155
Total Projected Sales Hide & Skin Leather	D1,148,235

- (3) Kenyan Wet Blue Skin 1979 exported at US\$ 56 dozen.

E Cost of Raw Hides & Skins

Subject to the settling of management/monopoly structure, (see next chapter) it is assumed that Hides & skins are purchased by the tannery at the following prices:-

Hides 50% from L.M.B., Abuko at D3.1/Kg (current export price)  
50% collected from "up country at D1./Kg average  
i.e. graded from D2/Kg - 0.5 D/Kg according to quality  
(possibly double prices currently paid).

Input cost = 22,000 @ 5.9 Kg 64,900 Kg @ 3.1 = 201,190 D  
64,900 Kg @ 1.0 = 64,900 D  
266,090 D

Skins 50% from L.M.B, Abuko at D4 skin  
50% up country at D2 skin (double current price)

Input cost = 22,000 x D3 = 66,000  
Total Hide & Skin Input cost = D332,090  
Freight on Hide & Skin (see Table VII) = 12,907  
Total cost of Hide & Skin delivered = D344,997

F Buying Price Structure

In addition to paying extremely low prices for hides and skins, possible causing some measure of non recovery, LMB also have an irrational price structure for hides. As an example:-

LMB pay up to 1.00D per lb for a 6 lb hides (2.72 kg) this may yield 13 ft<sup>2</sup> of leather. Thus effective cost of raw material = 0.33 D ft<sup>2</sup>.  
but LMB only pay 0.4D per lb for a 13 lb hide (5.9 kg) which should yield 30 ft<sup>2</sup> of leather. Thus effective cost of raw material is = 0.17D ft<sup>2</sup>.

It may be seen that a producer will receive up to D6.0 for a 6 lb hide and only D5.2 for a 13 lb hide !

Certainly a premium is usually payable for the better quality smaller hide, usually this is of the order of 10-20% not 100% as above.

A realistic buying price structure may be calculated when the tannery has proven the weight/area yields.

### III Management Structure, Technical Assistance, Training

#### A Management

Under the Gambia Livestock Marketing Act 1975, the LMB have a monopoly position in hides and skins destined for "mechanized processing in The Gambia" (para. 23 and the annexed schedule).

Governmental authorities originally suggested to the consultant that accordingly LMB should operate any tannery proposed. However, the consultant after viewing LMB's hide and skins activities (see previous chapter), feels strongly that for an efficient commercially oriented tannery operation LMB does not have the correct industrial discipline and orientation and certainly has only little expertise in this field and suggests that a new corporate body be formed to operate the tannery. Possibly GANTAN (Based like GAMCO at MEPID).

It is understood that LMB are reluctant to loose their monopoly as the hide and skin section is their only profitable activity. However it would be a short sighted development strategy to continue exporting raw hides and skins so that LMB may support its other loss making activities at the expense of a tannery with its great potential spin off.

The simplest approach would be to remove the LMB monopoly - this would merely require the deletion of hides and skins from the schedule of the Act (possibly a legal notice would suffice).

An alternate would be a quasi commercial agreement by which LMB would license GANTAN to act as its upcountry buying agent. In return for this LMB could receive % of the Tannery Profit (33%?).

In this study it has been assumed that some such proposal will be agreed [The hide buying agreement - yielding the input prices quoted earlier would be part of this agreement. An index of world price of hides being used to adjust price paid for Abuko raw material].

#### B Technical Assistance

1 As discussed later it may be seen that given the expertise available in the Hide and Skins section of MANR, only one major staff deficiency is clearly visible. The Technical Manager must be an expatriate - may be needed for up to 3 years. He must be in an executive position (not advisory) but will need "topping up" by an external aid source. He may need to act as General Manager (or Managing Director) in the early stages of the project.

The person appointed to this post must have had many years experience as tannery Technical Manager and General Manager and his major duties will be:-

- (1) In cooperation with appointed consulting engineers and/or P.W.D., finalise detailed engineering drawings for the tannery;
- (2) Assist in placing the purchase orders for the necessary plant and machinery and building;
- (3) Supervise the installation of the plant, machinery and services;
- (4) Arrange to commission the tannery;
- (5) Train the necessary staff in their duties;
- (6) Fulfil the normal functions associated with posts of Technical Manager/General Manager in a commercial tannery.

2 If it is decided to implement the project, it could be expedient if a consultant were appointed for some 3 - 5 weeks to conclude the Private Treaty negotiation with machinery suppliers in association with the Gambian authorities. This would allow rapid purchase of the plant and machinery when the project was finally funded and greatly shorten the pre-operational period and thus reduce initial losses.

Such consultancy would need:

- a) Unlimited telex - telephone facilities to liaise with potential suppliers;
- or b) Travel to Europe to visit the potential suppliers.

Possibly external aid could fund such consultancy.

### C Installation, Training

Normally one recommends that tannery machinery is purchased from several different sources in order to obtain the most cost effective machinery from specific specialised companies. In the present project, due to its small size and the necessity to employ reconditioned machinery it is however recommended that all plant be purchased from one source. If this approach is taken it should be possible to obtain the following two essential services on the best terms. The machinery tendering companies must be asked to supply installation and engineering training, in addition to the machinery and plant, on the following terms.

#### 1 Installation of Machinery

The company must supply free of charge, the services of a competent installation fitter for two months to ensure that plant and M/C is correctly assembled, installed and commissioned. It being agreed that the Gambian Tannery Project will cover direct expenses e.g.

Air fare, local subsistence allowance, (sufficient to cover 1st class hotel, food and incidentals) and supply transport, as necessary, as well as ensuring that sufficient Gambian fitters and labourers are available to assist the installation engineer.

In such case the cost of installing the tanning M/C should be:-

Expert Fitter - Air fare	D 3000
" " DSA @ 100 Dalasi/day	6000
2 Gambian Fitters (300D P.M)	1200
4 Labourers (4x50days @ 3.5D)	700
	<hr/>
	D10900
	<hr/>

## 2 Training

### a) Training for Prospective Maintenance Engineer

The tannery equipment supply company must also be prepared to supply 2 months training/practical experience for the prospective tannery maintenance engineer. Such training should be in the supplying companies own fabrication/reconditioning workshops and if possible should be augmented with service visits to European Tanneries. It being understood that the tannery equipment supply company will supply such service free of charge with the Gambian Tannery Project covering all direct costs.

In such case the cost for overseas training of the Gambian Maintenance Engineer should be:-

Air Fare	D 3000
Subsistence Allowance	
60 days @ 120 D/day	7200*
	<hr/>
	D10200
	<hr/>

### b) Additional Training Requirement

(i) Assuming that an expatriate tanner (technical manager) is employed, the requirements for external training should be drastically reduced as most personnel will be trained on the job. It may be that if the Senior Livestock Officer (Hides & Skins) is appointed commercial/Administrative Manager. (Must be the only logical appointee as he is the only Gambian with some formal training in leather manufacture) it would be expedient to give him a refresher course for 2-3 weeks in Europe visiting tanneries and chemical supply industries, laboratories (e.g Wattle Industries, (UK.) Bayer & B.A.S.F., (F.R.G.)).

\* Subsistence allowance suggested is dependent on country visited. The 120D/day may be too high for UK but too low in F.R.G.

Such programme could be arranged by the expatriate tanner who would use his own contacts to arrange a suitable itinerary.

The cost could be:-

Round Trip - Gambia/Europe	24,000
European Travel - Local Expense	1000
DSA 21 days @ 120D/day	<u>2520</u>
	<u>27520</u>

(ii) It is understood that the Ministry of Agriculture and Natural Resources are sending a student for a full diploma course in Leather Technology to Nene College, U.K. He would be the logical person to take over from the expatriate Technical Manager, as this training is being funded by Government sources no charge need fall on the tannery.

#### IV Selection of Location/Site

The four major factors in selecting a suitable location for a tannery are:-

- A. Availability of raw material
- B. Availability of water
- C. Possibility of economic disposal of effluent
- D. Availability of suitable infrastructure and in particular the availability of external engineering facilities as a small tannery cannot be self sufficient in this respect.

In the situation in The Gambia, it is evident that only in the Banjul area are the requirements of D. to be fulfilled.

One major problem of site selection is that many of the swampy areas, which seem suitable for effluent discharge, are adjacent to oyster collection/fishing activities and no responsible person would wish to cause contamination of these valuable local food products. It was this environmental factor which overrode most others in the discussion of possible sites.

Accordingly five sites were visited and evaluated by the consultant. A meeting was held with all interested Government parties. Brief details of the location, advantages and disadvantages of the various sites may be seen at Annex I where a minute of the above meeting is available, from where it may be seen that a concensus opinion was that Site E, immediately to the east of the G.P.M.B. factory at Denton Bridge (some 5 km. from Banjul Town Centre), appeared a suitable area (on the northern side of the road at grid Ref. Ck. 244 396 sheet 10/II. D.C.S. 315. 1978).

At a final meeting held on 4 February 1980 with Messrs. Bathcilly and Renner, (Planning Office and GPMB) it was agreed that to afford GPMB sufficient room for future expansion, the potential site should be moved some few hundred metres to the east (a plan is to be prepared by Mr. Bathcilly's office).

Initial basic land requirements are for:-

728 M <sup>2</sup>	Building
280 M <sup>2</sup>	Effluent treatment
<u>1,008 M<sup>2</sup></u>	

To house this, with scope for future expansion, a minimum site of  $\frac{1}{4}$  hectare could prove suitable 40x62.5m (= 2,500 M<sup>2</sup>). If land is freely available, a  $\frac{1}{2}$  ha site would allow good landscaping facility.



It has been suggested that the tannery should be open for an hour or so each day for tourist visits. In this event some kiosks and possibly a GAMCO sub branch could be established.

A Raw Material Availability

The site suggested is ideal for receipt of hides & skins from Abuko Abattoir as well as "up country" supplies.

B Availability of Water

A large main with pressure of 60 P.S.I. is on the south side of the main road. Thus only 3 - 4 hundred metres of connection will be necessary. (will have to be sunk under the road).

C Effluent Discharge (see Annex I and II)

This site is the most suitable of the five sites evaluated due to the high dilution which could be expected. The PWD architect envisages no serious problem in handling the treated effluent to the sea by way of a flexible pipe affixed to a buried tree trunk groyne.

D Infrastructure - Engineering/Facilities

Being only 5 km from Banjul the site is within reach of the best facilities that The Gambia has to offer. It is assumed that the tannery would have to arrange to use the facilities offered at the PWD and Ports Authority Workshops.

An analysis of the water has been requested from GUC but not yet received. When an analysis is available it should be sent direct to the Consultant or to UNIDO to obtain confirmation of suitability for tannery use.

V Fixed Assets/Capital Requirement, Cost of Land, Building, Plant and Machinery

A Land Requirement/Cost

It is understood that the land suggested for the project (see Chapter IV), will either be Government owned or if in other hands could be obtained for relatively small compensation payment as it has not been developed. Thus for the  $\frac{1}{4}$  or  $\frac{1}{2}$  ha proposed a reserve of D5,000 should be sufficient to cover all items including any legal fees,

B Site Clearance/Fencing

Assume  $\frac{1}{2}$  ha site obtained and cleared. Only  $\frac{1}{4}$  ha site fenced.

Assumed 40 x 62.5m

Site clearance	1D/M <sup>2</sup>	D 5,000
Fencing 205 linear m at D40/M		D 3,200
		<u>D13,200</u>

C Building Requirement/Cons.

The requirement for a tannery only calls for a light steel or timber frame with asbestos cladding. However, its floor must be acid proof and carefully sloped (see effluent). A 10 - 15 cm reinforced floor is required in general areas and specific foundations for certain plant. Possibly the lower 1 m of the walls will be of concrete block. PVC sheet could partially substitute the asbestos cladding to ensure adequate light.

Discussion with members of P.W.D. architects department, suggest that cost of building may be from 400 - 450D/M<sup>2</sup>, this seems rather high to the consultant and one would suggest further enquiries in this area to see if lower cost could be obtained. Commercial sources suggest 250D/M<sup>2</sup> should provide an adequate building. However in this study a cost of 425D/M<sup>2</sup> is employed (this includes preliminary and general cost. (P &G).

From Fig 2 overleaf, it may be seen that requirements are:-

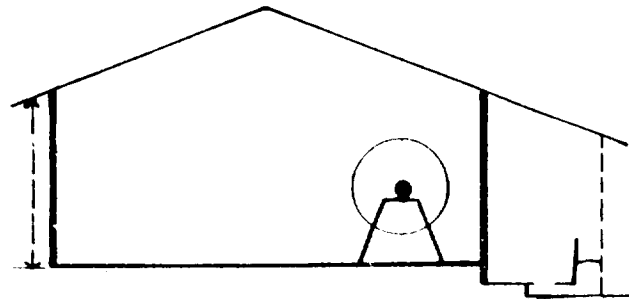
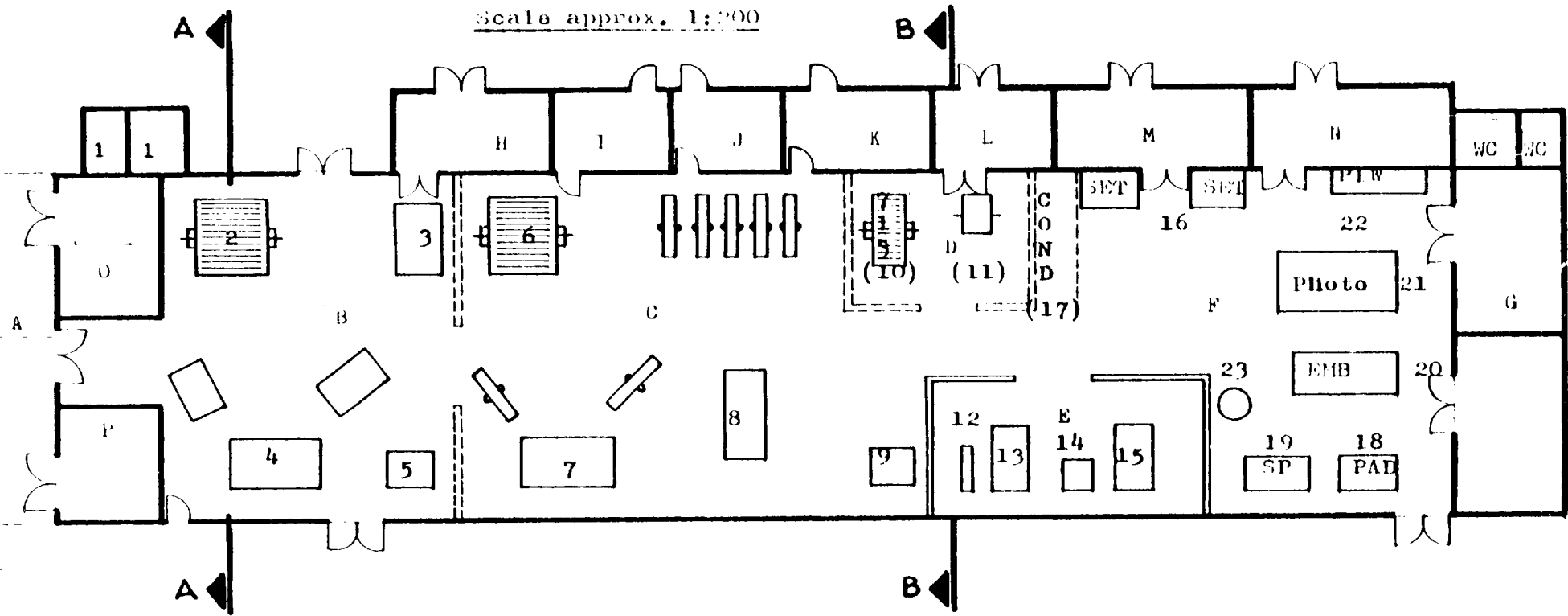
Main Building 52M x 12M	=	624 M <sup>2</sup>
Lean - to 36M x 3M	=	108 M <sup>2</sup>
		<u>728 M<sup>2</sup></u>
		at 425D/M <sup>2</sup> = <u>309,400 D</u>

In the event that it is decided to open the tannery for tourist visits it may be necessary to landscape the site and a reserve for this, of 10% of building cost, may be suitable = 30,940D

NB. No staff housing is visualized as the only expatriate is assumed to be "topped up" by an external aid source and this should allow normal personal commercial hire of accommodation.

FIG 2 Tannery - Outline Plane & Machine Layout

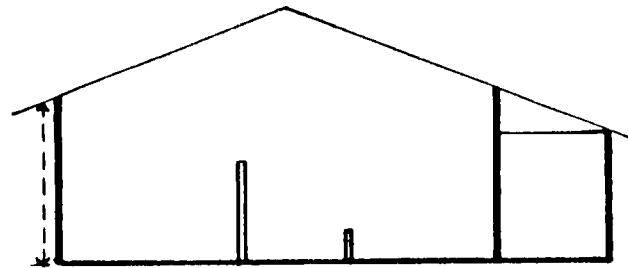
Scale approx. 1:200



Cross Section

A - A

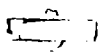

(See Key overleaf)



Cross Section

B - B

KEY TO LAYOUT OF FIG 2

A	=	Hardstanding for Vehicles	1	=	2 Soak Pits - 2.5M x 1.8M x 1.5M deep
B	=	Beam house	2	=	Lime Drum 2.4 x 2.4M (2 - 4 RPM)
C	=	Tan House	3	=	Fleshing Machine - Skins 1.6M
D	=	Retan/Dye Room	4	=	Fleshing Machine - Hide 1.8 or 2.1M
E	=	Stake/Buf Room	5	=	Platform Scale
F	=	Finishing Room	6	=	Tan Drum - 2.4M x 2.4M - 8/10 RPM
G	=	Finished Leather Store	7	=	Sammying M/C - Type Turner 234
H	=	Fitters Shop	8	=	Splitting M/C - Type Turner 35 - 1.8M
I	=	Technical Office/Laboratory	9	=	Single Width Shaving M/C
J	=	General Manager Office	10	=	Dye/Retan Drum 2.1M x 0.9M 10 RPM
K	=	Clerical Office	11	=	Perspex Experimental Drum (0.6M x 0.3M)
L	=	Pigment/Dye Mix Room	12	=	Wheel Stake - Skins
M	=	Hang Dry	13	=	Arm Stake - Croc
N	=	Board Dry	14	=	Single Width Buffer - With Dust Exhaust
O	=	Raw Material Store	15	=	Double " " " " "
P	=	Chemical Store	16	=	Setting Tables
WC	=	WC	17	=	Conditioning/Sawdust Bay
	=	Horses 1.8M	18	=	Pad Table
	=	Box Trucks 1.8M x 0.9M x 0.6M deep	19	=	Spray Booth
			20	=	Plate/Emboss Mechanical
			21	=	Photoscan
			22	=	Pinwheel Measuring M/C
			23	=	Compressor

D. Effluent Treatment Unit

A brief outline of the effluent treatment scheme proposed is given at Annex II.

The prime essential is the stream into four specific classes according to constituents. This is outlined at Fig. 3, a full schematic outline of the plant may be found at Figs. 4 & 5.

Specification and costs of the effluent are detailed at Annex III & IIIA from where it may be seen that estimated cost of treatment plant is:-

Civil	-	27,025D
Mechanical	-	19,800D
Total		<u>46,825D</u>

E Other Civil Engineering

Drum foundations - say 10M <sup>3</sup> at 500D/M <sup>3</sup>	D
Soak Pits (costed at Annex IV)	5,000
Reservoir ( " " " " )	3,268
	10,979
	<u>19,247</u>

F Services

Boiler/Calorifier (see Annex IV)	9,000
Head Tank (5M high) (10M <sup>3</sup> )	3,000
Main Electricity Supply (quote G.U.C.)	10,000
Internal Electricity	10,000
Water Connection (G.U.C.)	4,000
Internal Water connection and valves	5,000
	<u>46,000</u>

NB. No standby generator is costed as all sources say by 1981 GUC will be able to offer a continuous supply.

G Consulting Engineers

It is assumed that the final engineering drawings will be drawn up by consulting engineers in close cooperation with the expatriate technical manager. Such consulting engineers would also supervise the construction of the building and installation of services. It may be prudent to budget for 10%.

Of site, building, effluent treatment and other civil engineering and services i.e. (D465,612) 10% = 46,561D.



H Vehicles

1 - 1200 cc car (Duty free)	
1 - 1200 cc Pickup ( " " )	<u>26,000D</u>

FIG III

Separation of Tannery Effluent Flows

Approx. 1 : 200

-  - Internal drain channels - Possibly channels approx. 30 cm deep and 30 cm wide in flow with rebate to accept perforated wooden cover.
-  - Grude screens. Coarse screen of 25 mm grid followed by a 6 mm screen.

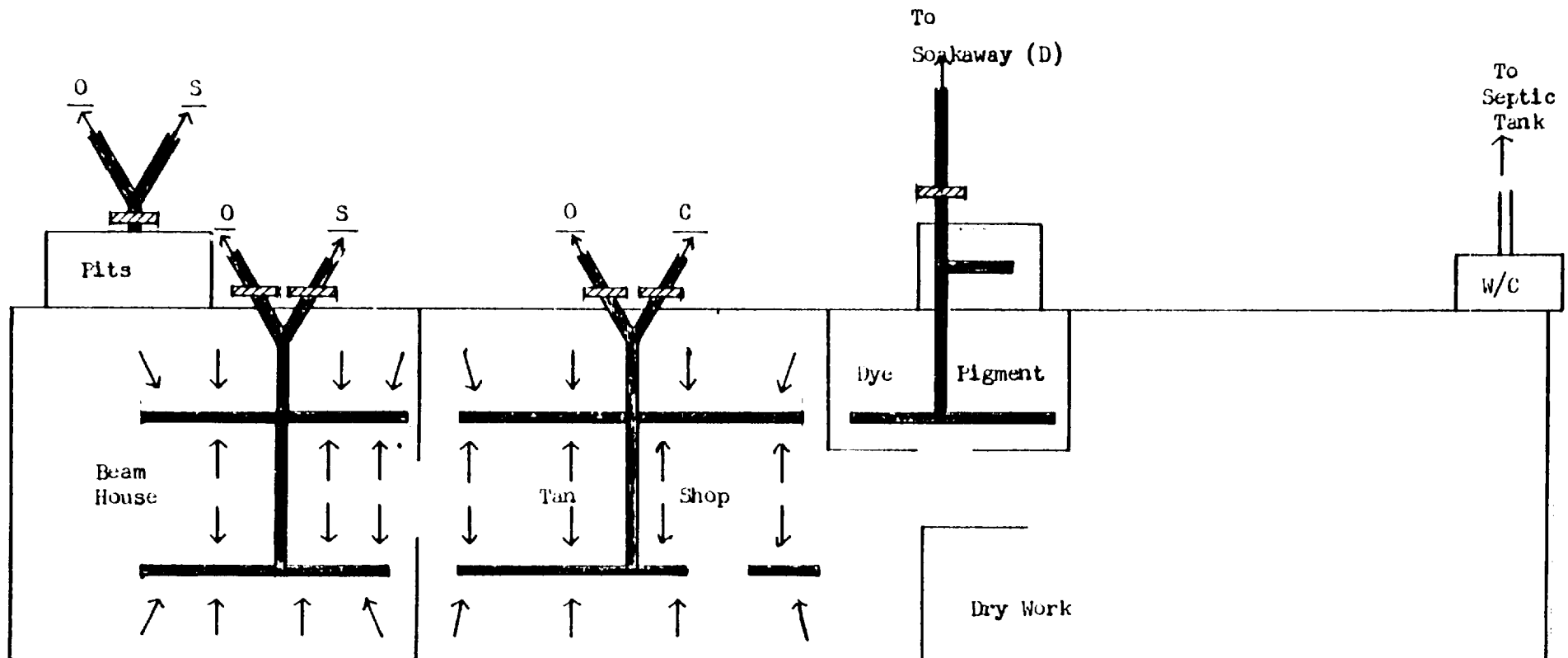
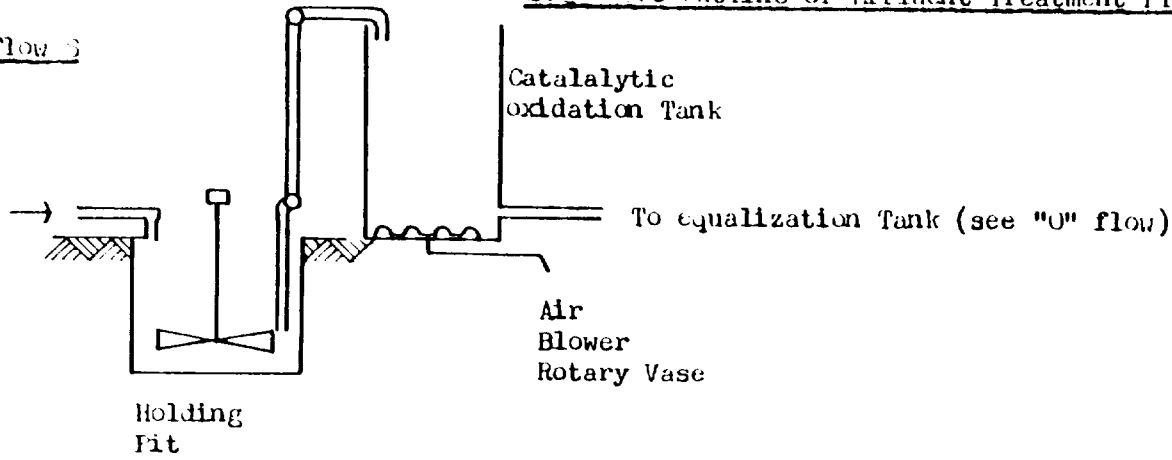


FIG IV

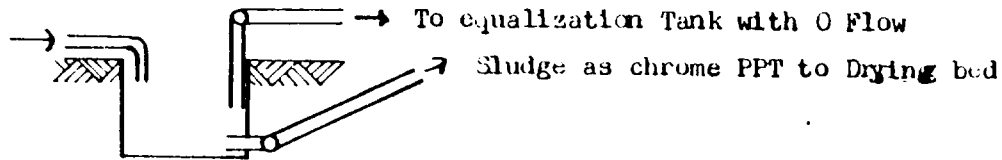
Schematic Outline of Effluent Treatment Plant

Approx. Scale 1:100

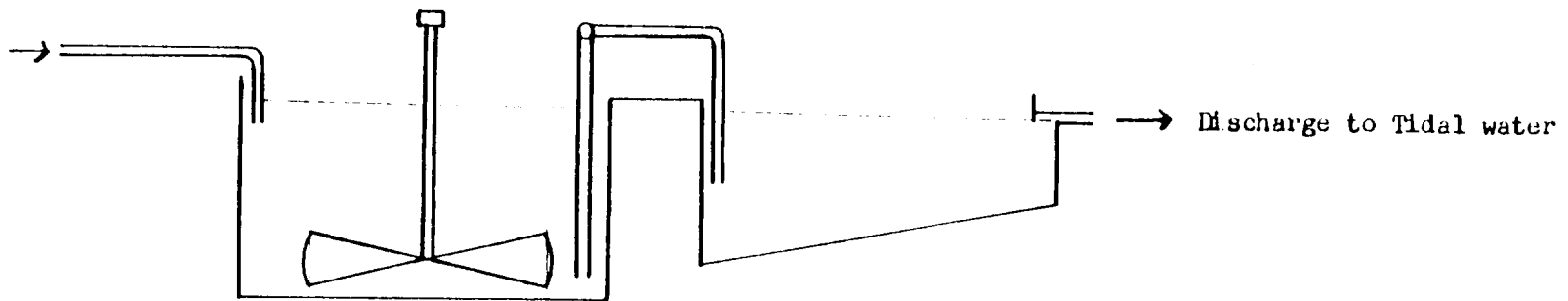
Flow B



Flow C



Flow O

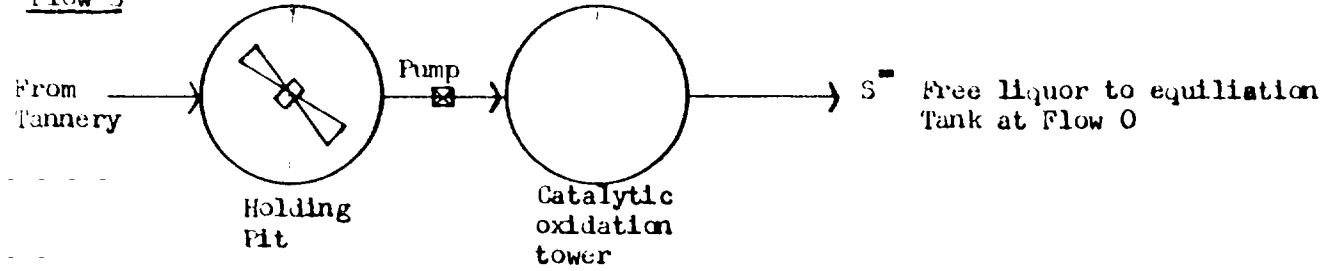


Plan of Effluent Treatment Plant

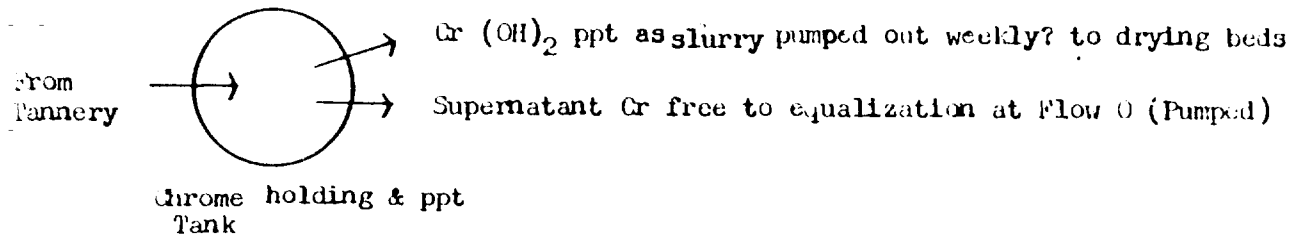
Approx 1 : 100

FIG V

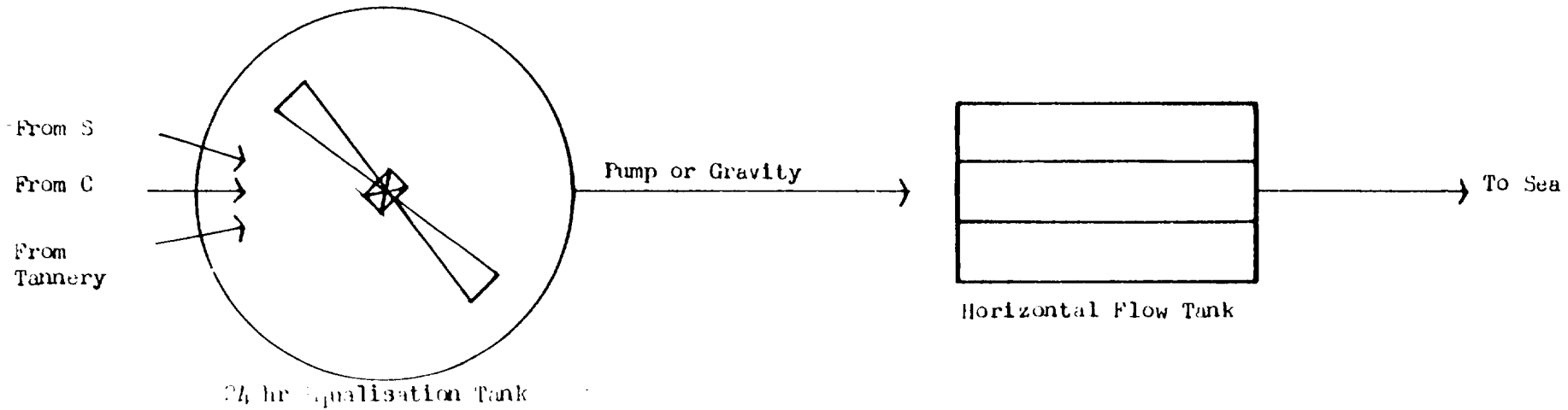
Flow S



Flow C



Flow 0





I Furniture

Furnitures for Offices

Typewriter etc:

10,000

J Laboratory

To have minimum facility only i.e. Bench/sink/pH meter/few flasks, test papers, Hydrometers, etc. should be well cared for 3,000 (delivered)

K Fitters Shop

It is assumed that all major engineering works will be subcontracted to P.W.D. or G.P.A. and thus only a basic set of electric hand tools and hoists and spanners, etc. will be needed 5,000 (delivered).

L Production Machinery

Detailed in Table I overleaf and qualified in the notes following the Table.

F.O.B. Cost of Plant & M/C	D288,904
Ocean freight & clearance (1)	24,310
Insurance (2)	4,334
Duty Free	-
Road Transport (3)	2,220
Hire of Crane	1,000
Installation (see Chapter III)	10,900
Local items - Drums	21,500
" " - Horses/box trucks/Drying Boards	4,000
Total cost Plant & M/C delivered and installed	<u>D357,168</u>

(1)  $80.0 \text{ M}^3$  at pound Stg.  $55 \text{ M}^3 + 19\% + 13.7\% + 7.25 \text{ D M}^3$  (Elder Dempster quote)

(2) 1.5% of F.O.B. value

(3) 37 M T at 10D MT/Km.

TABLE I

Production Machinery

Cost Dalasis

(See Annex VI & VII) F.O.B. costs except local items

<u>No. Required</u>	<u>Plant</u>	<u>Imported</u>	<u>Local</u>
1	Hide Flesher 1.3 or 2.1 m	31,200	
1	Skin Flesher 1.6 m	27,300	
1	Lime Drum 2.4 x 2.4 m	13,000	7,500
1	Platform Scale - 1 Ton	15,000	
1	Sammying M/C 1.3M	32,600	
1	Tan Drum 2.4 x 2.4M	12,000	7,500
1	Splitter	38,600	
1	Shaver 25 cms	5,980	
1	Dye Drum 2.1 x 0.9 m	9,400	6,500
1	Perspex Drum	2,000*	
1	Skin Staker	3,940	
1	Croc head Staker	2,680	
1	Buffing M/C 25 cm	5,500	
1	Buffing M/C 60 cm	3,600	
1	Plate/Emboss press	15,000	
1	Electronic Measurer	19,800	
1	Pinwheel "	14,400	
1	Set Compressor and Guns	5,140	
1	Bailer & Tank	(Included in V F Services)	
Sub Total		<u>262,640</u>	<u>21,500</u>
Spares	10% of the above	<u>26,264</u>	
Total M/C	F.O.B.	D <u>288,904</u>	D <u>21,500</u>

\* Consultant's estimate

Notes to TABLE I

Budget estimates were sought from four European specialists in reconditioned Tannery Machinery as well as a Brazilian source:-

- Messrs. (1) ARENDONK, Tilburgh, Holland;
- (2) Karl GLENK, Backnang, F.R.G.
- (3) G.L. MURPHY, Menston, Yorks, England
- (4) Edward WILSON, Bootle, Liverpool, England.

At the time of preparing this section of the feasibility study, quotes had only been received from two firms GLENK & MURPHY. Accordingly the cost estimates were accepted from such sources. Comparison may be seen at Annex VI.

However, the consultant would like to go on record as suggesting that Messrs. Edward WILSON whose quote is expected shortly, have a prime reputation as a M/C reconditioner, and if necessary their products, even if marginally more expensive, should give trouble free service.

Although it is suggested that all M/C be purchased from one source to obtain services. installation and training, in the cost estimates, one has taken in general the lowest cost quoted from the two available sources as it is felt that if the supplier knew the whole order was in jeopardy, he could meet the lower price of any one or two units.

In two areas the quotes are not directly comparable.

- (i) In the drum iron work quotes, Messrs GLENK do not quote for cast iron stands. Therefore it would be necessary to build at some expense concrete bearing plinths. In this case, the high cost of MURPHY has been accepted as it includes stands. MURPHY however, does not quote for drum door frame, but no doubt these could be obtained given some negotiation;
- (ii) With regard to the embossing M/C, it must be noted that MURPHY quote for a reconditioned M/C. GLENK quote for a "carefully checked M/C" (not such high standard). It is assumed that any supplier could match the GLENK quote for a checked M/C which should be acceptable technically.

With regard to the drums, the M/C supplier is expected to supply all metal parts and drive. The Gambia Ports Authority, having viewed a drum at Bata Factory in Senegal, and received specification from the consultant, have quoted to produce the drum using 7.5 & 5.0 cm hardwood (3" & 2") at the following price:-

2.4 m x 7.4 m	=	D7,500 (7.5 cm timber)
2.1 m x 0.9 m	=	D6,500 (5.0 cm timber)

<u>TABLE II</u>	<u>Fixed Capital Requirement</u>	<u>Cost Delasis</u>
Land VA	5,000	
Clearance/Fencing VE	<u>13,200</u>	<u>18,200</u>
Building VC	309,400	
Landscaping VC	<u>30,940</u>	<u>340,340</u>
Effluent Treatment Plant VD		46,825
Other Civil Engineering VE		19,247
Services VF		46,000
Consulting Engineers VG		46,561
Vehicles VH		26,000
Furniture VI		10,000
Laboratory VJ		8,000
Fitters Shop VK		5,000
Plant & Machinery Installed VL		<u>357,168</u>
Sub Total		923,341
5% Contingency		<u>46,167</u>
Total Fixed Capital Required		D <u>969,508</u>

## VI Tannery Operation

### A Operating Days

It is assumed, in general, that the tannery will operate five full days per week i.e. 250 days p.a. Due to the nature of tannery operations no "short days" can be effectively employed. Some additional days will also be necessary, when full production is reached, to process the skins.

However, as is normal with tannery operations, some weekend working will be necessary to ensure continuity of process. For the purpose of this study 1 month =  $\frac{1}{12}$  of annual activity.

### B Capacity Utilization

The capacity of the plant exceeds the 22,000 hides and skins apparently available. The drums have some 20% or so extra capacity. 100% of capacity is deemed to be the production of 38 hides and skins per day. The surplus drum capacity should yield lower stress on the drums and allow any production losses to be recovered.

### C Production Build up and Project Implementation

Is shown on Fig VI overleaf.

### D Outline Process Technology

#### Input

Daily Input - 38 Hides at	5.9 Kg/dry each
" " - 30 Skins at	0.45 Kg/dry each (see later)

Leather manufacture is still today, very much an "art" and no definitive process is available. However for costing and design purposes the typical process outlined below may be suitable. It must be realized however that each process may be appreciably modified by the technical staff who operate the tannery.

In the present situation up to 50% of the bovine hides will be received "green" (fresh) from the Abattoir at Abuko. It is imperative that these hides are not dried - processing green hides should yield a far superior leather, possibly 20% enhanced in value, as it will avoid the degradation due to the drying process and subsequent rehydration.

One operational problem will be whether to run mixed batches of fresh and green hides. This will entail soaking half a batch 2 days earlier and then completing the batch by adding the fresh hides prior to liming. The consultant's personal preference would be to run separate batches perhaps with slightly different chemical technology.

FIG. VI

ACTIVITY TIMING SCHEDULE

(TARGET)

ACTIVITY	YEAR 1						YEAR 2														
	Preoperational						Completion of Installation commissioning & Production												Build up		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19		
Employment of Expatriate Tanner	-----																				
Detailed Engineering Plans* (1)	-----																				
Site Clearance/Fencing			-----																		
Building			-----																		
Installation of Services							-----														
Purchase of Effluent Plant (MECH)			-----																		
Installation of " "							-----														
Purchase of M/C			-----																		
Delivery of M/C							-----														
Installation of M/C							-----														
Personnel Training Overseas (MECH)			-----																		
" " " (MANAGER)			-----																		
Commissioning of Tannery							-----														
Capacity Utilization %													10	10	20	20	40	60	80	100	100
* (1) Expert Tanner/PWD/Consulting Engineers																					

N.B. Although on the above timing schedule it is suggested that the majority of preoperational activities will be completed in 6 months. It must be recognized that with poor transport and communications in The Gambia this work may take 12 months and is so costed later

To achieve this aim it would be necessary to lightly salt the fresh hides for 1-2 days until a batch was formed. (Perhaps a Vantocil spray would be efficacious). However from the costing and design aspect it may be expedient to assume that all are dried hides. Originally in this feasibility study it was assumed that skins would be processed in batches of 250 skins every 3 days or so. This would require two special drums. (2.1M x 0.9M). However the capital cost of these two drums would unrealistically high (even if partly locally produced) and accordingly it is suggested that batches of 380 skins be processed every 2nd week or so (25 batches x 380 = 22,000 pcs), employing the larger hide drums. (If necessary the skins could be processed during weekends). It is further assumed that the skins are selected in lime or pickled condition for Wet Blue for export or vegetable tanned for local market (50:50?). Half the pack being held over in this state until the other half is processed.

#### Output

Although in the product mix for hides discussed earlier several end products were suggested, for costing purposes, it may be expedient if two products only are calculated :- 80% as Wet Blue for export  
20% as pigmented side leather for domestic market.

Similarly for skins the costing will be based on:-

50% as Wet Blue for export  
50% as Vegetable naturals or Hair-on for domestic market.

(Selection of skins may be made in raw limed or pickled condition and one selection must be held in a white lime or pickle liquor for a while).

#### Inter-operational Weights

##### Hides

88 Hides at 5.9 kg each dry = 519.2 kg day  
Expected limed weight = 280% = 1454 kg day  
Estimated yield = 30 ft<sup>2</sup> per hide (Ref. Bata Tannery, Senegal)  
Estimated split shaved (1.5 - 1.8mm) Weight = 0.26 kg/ft<sup>2</sup> = 8.32 kg/hide

##### Skins

skins at .45 kg trimmed  
Lime pelt yield = 1 kg/skin  
Estimated yield = 5.25 ft<sup>2</sup> per skin

#### Effluent Streams

O = Other (General Liquor)  
C = Chrome bearing liquor  
S = Sulphide bearing liquor  
D = Dye/Pigment liquor.

D Typical Processes (all chemical offers based on real or estimated lime weight)

1. Hides to Wet Blue

Input = 88 hides = 1454 kg estimated lime weight.

Process	Plant	Chemical Offer	Duration	Total Input	Effluent Stream	
<u>SOAK</u>	Pits	2 changes of water	2 days	14 M <sup>3</sup>	0	
	2 Reqd each	plus 0.2% Teepol		2.91 kg		
	2.5x1.8x1.7 M	plus 0.05% Bacteriacide		0.73 kg		
<u>DRY DRUM</u>	2.4x2.4 M Drum	-	1hr	-		
Side	On horse	-		-		
Green Flesh	Fleshing M/C	-		3 M <sup>3</sup>	0	
<u>LIME</u>	In Drum	30% water 20°C	20 hrs	1.2 M	S	
	2 - 4 RPM	2% Sodium Sulphide		29.1 kg		
	Periodically	1% " Sulphydrate		14.5 kg		
		2.5% Hydrated Lime		36.4 kg		
Wash	In Drum	100% Water	½ hr	1.5 M <sup>3</sup>	S	
<u>FLESH</u>	Fleshing M/C	-		3 M <sup>3</sup>	0	
Scud	If necessary by hand	-		-		
Trim	On Table	-		-		
Weight	Platform Scale	(Basis for further process)				
<u>DELIME</u>	In Drum:-					
	- a/washx2	3 - 10 RPM	150% Water	20 Mins	4.4 M <sup>3</sup>	0 (orS?)
			Drain	each		
			150% Water at 36°C	1 hr	2.2 M <sup>3</sup>	0
	- b/delime	" "	1.5% ammonium sulphate		21.8 kg	
- c/bate		add				
		0.3% Pancreatic Bate	½ hr	4.4 kg		
		0.3% Ammonium Chloride		4.4 kg		
		Drain				
<u>PICKLE</u>	In Drum	3-10 RPM	70% Water	2 hrs	1 M <sup>3</sup>	0
			7% Salt		108 kg	
			1.0% Sulphuric acid 96%		14.5 kg	
			0.2% of Formic acid 80%		2.9 kg	
			(to pH 3.0/3.2)			
<u>TAN</u>	" " " "	Add				
		9% Commercial	3 hrs	131 kg		
		Chrome Tanning	(till			
		Salt (26% Cr <sub>2</sub> O <sub>3</sub> )	penetrated)			
		0.1% Fungicide		1.5 kg		



Process	Plant	Chemical Offer	Duration	Total Input	Effluent Stream
Basify	In Drum 8-10 RPM	add 1.5% Sodium Bicarbonate (well diluted in 6 additions)	Till T.S. = 100°C	21.8 kg	
Haul	-	-	-	-	
Horse/Drain	In special area	-	2 days	-	C
Sammy	Sammying M/C	-		-	C
Grade	Select rejects for local finishing				
Measure	by Electronic M/C				

Now Known as "WET BLUE"

The above water utilisation/effluent production is based on a medium float technology. However due to extreme temperature a longer float may be needed, additionally tanners always over use water by some 40% due partially to housekeeping needs, etc. Thus it may be realistic to double these nominal water usages:-

To Wet Blue	Nominal Water Usage	Budget Water Usage
Flow O	26.6 M <sup>3</sup>	53.2
S	2.7 M <sup>3</sup>	5.4
C	1.0 M <sup>3</sup>	2.0
D	-	-
	<u>30.3 M<sup>3</sup></u>	<u>60.6</u>

Hides to Finish (assume initially 20% - Rejects - are finished for local market).

Process	Plant	Chemical Offer	Duration	Total Input	Effluent Stream
Split	Splitting M/C				
Shave	25 cm Shaver				
Weigh	(Basis for future process)				
<u>NEUTRALIZE</u>	In Drum 2.1x0.9 M	Assume 146 kg			
	8 - 10 RPM:-				
a) Wash	" " "	200% Water	20 Min	0.3 M <sup>3</sup>	0
b) Neutralize	" " "	200% Water	to B.C.G.	0.3 M <sup>3</sup>	0
		1.5% Sodium Bicarb		2.2 kg	
c) Wash	" " "	200% Water	20 Min	0.3 M <sup>3</sup>	0
<u>RETAN</u>	2.1x0.9 M drum	70% Water	30 Min	0.1 M <sup>3</sup>	0
	8 - 10 RPM	2% Tanigan BN		3 kg	
		Add 3% Mimosa G.S.	20 Min	4.5 kg	

Process	Plant	Chemical Offer	Duration	Total Input	Effluent Stream
		Add 2% Retan 540	Run till exhaust	3 kg	
<u>DYE AND F/L</u>	8 - 10 RPM	100% Water 10 C	½ hr	0.15 M <sup>3</sup>	D
		1% Dye		1.5 kg	
		Add 2% Sandolix O	½ hr	3 kg	
		1.5% Sandolix TWL		2.2 kg	
		1.2% Raw Neets foot oil		1.7 kg	
Wash	" " "	Drain			
		150% Water	5 min	0.22 M <sup>3</sup>	D

Haul - Horse - Sammy - set by hand - hand dry - sawdust condition - stake - board dry - select - buff (single and double width) - dust - impregnate - plate - pad - spray coat (twice) - plate or emboss - spray top - measure.

Note: Water consumption - wet blue finish for 20% of thruput =

	<u>Nominal</u>	<u>Budget</u>
Flow O	1.0 M <sup>3</sup>	2.0 M <sup>3</sup>
Flow D	0.4 M <sup>3</sup>	1.0 M <sup>3</sup>
Total	<u>1.4 M<sup>3</sup></u>	<u>3.0 M<sup>3</sup></u>

Note: Pigment and resin consumption are governed by type of leather being produced, Some typical usage is:-

	<u>Requirement for 1000 ft<sup>2</sup></u>	<u>Requirement for 132,000 ft<sup>2</sup></u>
Filler - eg. MS. 200	5 kg	0.44 MT
" eg. Tanofil A	5 kg	0.66 MT
Pigment Paste (P.P.E.)	6.5 kg	0.86 MT
Binder eg. Encryl	0.5 kg	1.25 MT
Paste Top	2.0 kg	0.26 MT
Laq. emulsion	5.0 kg	0.66 MT

2. Skin Tannage 880 pieces, 25 times P.A.

A = 880 pcs to delime, 440 pieces tan (chrome)

B = 440 pieces vegetable tanned from delime state

Assume lime weight = 880 kg.

Process	Plant	Chemical Offer	Duration	Total Input	Effluent Stream
Trim legs	Chopper on wood block				
<u>SOAK</u>	In hide pits	2 change of water 0.2% Teepol 0.05% Bacteriacide	2 days	14 M <sup>3</sup> 1.1 kg 0.44 kg	0
Dry Drum	In drum at 4 RPM		1 hr		
<u>LIME</u>	In drum at 2 RPM	200% Water 3% Hyd. Lime 2.5% Sodium Sulphide 1.0% " Sulphhydrate	20 hrs	1.76 M <sup>3</sup> 26.4 kg 22.0 kg 8.8 kg	S
Wash	"	200% Water	½ hr	1.76 M <sup>3</sup>	S
Haul					
Flesh	By machine				
Scud	By hand if necessary				
Weigh	Basis for future	Process (assume 1 kg pc.)			
<u>DELIME</u>					
a) Wash	In drum 3-10 RPM	Twice x 200% water	each ½ hr	3.52 M <sup>3</sup>	0
b) delime	" " "	100% water 30°C 1% Ammonium chloride	½ hr	0.9 M <sup>3</sup> 8.8 kg	0
c) bate		Add 0.5% pancreatic bate Drain	2 hrs	4.4 kg	
d) wash	" " " (Now only ½ pack	150% water 440 kg limed weight)	½ hr	1.32 M <sup>3</sup>	0
Pickle		70% Water 8% Salt 1.0% Sulphuric acid	1 hr	0.31 M <sup>3</sup> 35.2 kg 4.4 kg	0
<u>TAN</u>		Add 10% commercial chrome tanning salt 33% basic (.26% Cr <sub>2</sub> O <sub>3</sub> ) 0.1 fungicide	3 hrs	4.4 kg 0.4 kg	
Basify		Add up to 1% sodium bicarbonate to pH 3.6	Until boil Test O.K.	4.4 kg	

HAUL - pile 2 days (special area) - Sammy - Grade - Pack.

Note: Water consumption, skins to wet blue:-

Flow O	19.75
S	3.52
C	0.31
Total	<u>23.58</u>

Skins to veg. tanned finish - 440 pieces - lime weight = 440 kg as wet blue process until completion of delimiting then:-

Process	Plant	Chemical Offer	Duration	Total Input	Effluent Stream
Condition	Drum 8 - 10 RPM	60% Water	1 hr	0.26 M <sup>3</sup>	0
		6% Salt		26.4 kg	
		0.6% Sulphuric acid		2.6 kg	
		0.7% Chrome	½ hr	3.1 kg	
		Drain			
<u>TAN</u>	" " "	10% Water	1½ hrs.	0.04 M <sup>3</sup>	0
		15% Mimosa GS		66 kg	
		30% Water	2 hrs	0.13 M <sup>3</sup>	0
		0.2% Sodium bisuphite		0.88 kg	
		Drain			
Rinse	" " "	50% Water	10 mins	0.22 M <sup>3</sup>	0

Haul - Drain - set by hand - oil flesh and grain - hung to half dry - reset - dry - fluff flesh - seal flesh with mucilage - air off - measure (dependant on required end product whether stake or not).

NE: The small amount of chrome employed in this process is completely fixed.

E Chemical Requirement and Cost

May be seen at Table III.

F Personnel Requirement and Cost

May be seen at Table IV and Table V.

G Utility Consumption and Cost

May be seen at Table VI

H Freight on Hides and Skins

May be seen at Table VII but in the costing is included with raw hides and skins.

TABLE III

Typical Annual Chemical Requirement and Cost  
Based on Outline Process Technology at  
 (To process 22,000 Hide + 22,000 Skins p.a.)

	M.T. Annually	Cost D per M.T.	Annual Cost - D
Teopol-	0.77	1373	1057
Bacteriacide	0.13	2500	450
Common Salt	28.5	110	3135
Sodium Sulphide	7.8	852	6646
Sodium Sulphydrate	3.9	1500	5850
Hydrated Lime	9.8	560	5488
Ammonium Sulphate	5.45	750	4088
Pancreatic Bate	1.21	3710	4489
Ammonium Chloride	1.32	750	990
Sulphuric Acid	3.30	787	2991
Formic Acid	0.73	2000	1460
Chrome Tanning Salt	33.9	1695	57461
Fungicide	0.39	2500	975
Sodium Bicarbonate	6.1	560	3416
Tanigan EN	0.75	2560	1920
Mimosa GS	2.78	1500	4170
Retan 540	0.75	3444	2583
Dye	0.38	3000	3040
Sandoliz O	0.75	7216	5412
" TANL	0.55	6512	3582
Raw Neets Foot Oil	0.43	2000	360
Filler M.S. 200	0.66	3160	2086
" Tanofil	0.66	2724	1798
Pigment Paste	0.86	2880	2477
Binder - Encryl	1.25	2640	3300
Paste Top	0.26	2120	551
Laquer Emulsion	0.66	4880	3221
Sodium Bisulphite	0.02	1200	24
Sulph. Fish Oil (Hand oil Veg skins)	0.22	2065	454
Manganous Sulphate	0.12	2400	288 = 134,262 D
Total ( See over )			<u>3140975</u>

The above chemical costs were based on bulk discount orders for a large tannery. In the present case the requirements are much smaller so it may be that a further 5% cost must be allowed.

Prices months based on October 1979 actual prices on C.I.F. basis for another African country.

Where European prices employed have added freight of 280 Dalasis per M.T. to cover freight and surcharges and handling (Elder Dempster quote).

TABLE IV

Personnel Requirement and Cost

Management/Staff (1)

<u>Post</u>	<u>No. Req'd.</u>	<u>Grade</u>	<u>Annual Cost in D</u>
General Manager (5)	1	17	10380
Technical Manager (2)	1	16	9300
Commercial/Admin. (3)			
Purchasing Manager	1	16	9300
Foreman (Beamhouse)	3	6	8136
(Tan & Finish) (4)			
Senior Accounts Clerk	1	9	4044
Clerk	1	4/5/6	2352
Store Clerk	1	4/5/6	2352
Stenographer	1	3	3540
Maintenance Engineer	1	10	4620
Driver	1	4	2028
Watchman	2	2/3	1644
<b>Total</b>			<b>359340 P.A.</b>
			<hr/>
Plus 15% uplift to cover pension payments and other social benefits			568241
			<hr/>

Notes: (1) To avoid the necessity to adjust salaries for annual increments, etc. in each year of the cash flow account, it is felt expedient to cost posts constantly on Step 3 or middle grade of multigrade posts.

(2) As noted elsewhere it is assumed that this post must initially be held by an expatriate. For operational efficiency, it is essential that the expert is in an executive position (Not Advisory). The small scale of the project precludes the possibility of the tannery paying the expert's full salary and allowances. Thus it seems essential that external assistance must be sought to "top up" to acceptable levels.

- (3) It is assumed that this post will be filled by the Senior Livestock Officer (Hides and Skins) - Ministry of Agriculture and Natural Resources, Abuko.
- (4) Ideal candidates for these posts would be found among the livestock assistants (Hides and Skins) at Abuko.
- (5) In the event that a suitable G/M is not available, it would be acceptable if the expatriate technical manager initially also hold this post until a suitable candidate was trained. It would, in such case, be necessary for the expert to have extensive commercial experience.

TABLE V

Job Allocation

Labour

	<u>Total</u>	<u>Skilled</u>	<u>Semiskilled</u>	<u>Unskilled</u>
Stores	1	1		
Soak/Beamhouse	2	1	1	
Tan/Sammy	2	1	1	
Split/Shave/Buff	3	1		2
Dry	2		2	
Finish	2	1	1	
Effluent	1		1	
Fitters	2	1		1
				2
	<u>17</u>	<u>6</u>	<u>6</u>	<u>5</u>

Cost - Annual cost at 300 days p.a. to cover skin processing.

				<u>Annual Cost</u>
Skilled	6	@ 4.75 D/day	=	3550
Semiskilled	6	@ 3.75 D/day	=	6750
Unskilled	5	@ 3.50 D/day	=	5250
Total				<u>20550</u>
Plus 3.33% uplift to cover Obligation for gratuities			=	<u>221235</u>

If the tannery project is implemented, no drying of hides and skins from Abuko abattoir will be necessary. Thus a large number of LMB/Gamhide staff would be redundant. (currently employ 3 office personnel, 6 in Stores, plus 13 labourers).

The new project could consider employing some of these personnel but must ensure that only those who accept realistic industrial discipline would be suitable for tannery employment.

TABLE VI

Utility Consumption

Electricity (1)	Cost P.A.	= D27,130
<u>Diesel Oil</u> (Bailer) (2) at 50L/day = 12,500 L p.a.	" "	= D12,500
<u>Water</u> 16,487 M <sup>3</sup> p.a. (3) = 3627 at F.60 x 10 <sup>3</sup> gals	" "	= D13,057
Total Utilities		<u><u>D52,737</u></u>

(1) Could expect circa 250 Kwh/day (average 30 Kva) i.e. 62,5000 units pre-monthly bill may be

5,208 units at 23 bututs	= D1,198
40 KVA max. demand at D26.67	= <u>D1,067</u>
Monthly Bill	= <u><u>D2,265</u></u>

(2) Allowing for inflation could assume 1 litre = 1D

(3) 250 x 63 M <sup>3</sup>	= 15750
25 x 23 M <sup>3</sup>	= 575
25 x 6.5 M <sup>3</sup>	= 162
	<u>16487 M<sup>3</sup> p.a.</u>

TABLE VII

Freight on Raw Hides & Skins

Assuming 50% of supplies are delivered free from Abuko by LMB one may have to transport

11,000 Hides	at 5.9 kg	64.9 MT
11,000 Skins	at 0.5 kg	<u>5.5 MT</u>
		<u><u>70.4 MT</u></u>

Commercial quotes for 5 Ton loads Basse - Banjul and Georgetown - Banjul of D600 & D500. were obtained. If one assumes average cost of D550 and assumes only 3 Tons loaded per 5 Ton lorry. annual cost would be 12,907D



TABLE VIII

<u>Working Capital Requirement</u>	
I	D
Hides & Skins - 1 month	28,750
Work in Progress (Finished stock):-	
Export Sales 3 months	165,352
Local Sales 1 month	40,402
Chemicals - 6 months	70,438
Other	106,430
	<u>411,972</u>

TABLE IX

J	<u>"Start Up Cost" *</u>	D
Training	17,720	
Site Survey	300	
Total "Start Up"	<u>18,520</u>	

\* This study is sufficiently detailed to avoid need for further studies in this sector. The expatriate Tech. Manager in cooperation with consulting engineers should be able to detail all technical requirement.

TABLE X

K	<u>Total Capital Required</u>	D
Fixed Capital	969,508	
Working Capital	411,972	
"Start up" costs	18,520	
Total Capital Required	<u>1,400,000</u>	

L      Source of Funds

It is suggested that the Total Capital Requirement of 1.4 million Dalasis be raised:-

- 1.2 million D - Long Term Loan (L.T.L)
- 0.2    "      D - Bank overdraft facility

In this study it is assumed that the LTL will be on the following terms 7 years at 11% Interest. 2 years grace being allowed and then the loan being amortized with 5 annual equal payments.

Production Cost      Profitability

A Production Cost

The production costs may be seen at Table XI overleaf. The data is drawn from earlier chapters as well as Tables XII - XVIII following

Due to major erratic fluctuations in international hide prices (therefore leather prices) it would be unrealistic to include an inflation escalation index. Export values of "wet blue" on world market will automatically be adjusted to balance international increases in hide price, chemical and other costs.

In the sales plan it has been assumed that export sales are on an F.O.B. basis with local sales ex factory.

B Profitability

This may be seen in Table XIII overleaf

It may be noted that it is projected that in the first 2 years accumulated losses of 350,000 Dalasi may be incurred however from year 3 significant profits could be expected.

Projected Profits (Gross)

	<u>Year 3</u>		<u>Year 3</u>
Gross Profit	D 216,207 P.A.	-	D 407,983 P.A.
Gross Profit as % of Capital Investment 1,200,000 D.	18%	-	34%

In all areas this feasibility study has attempted to be on the conservative side. Yield of leather from hides is assumed to be 30ft<sup>2</sup>/Hide whereas others suggest 32ft<sup>2</sup>/Hide.

Input prices suggested to be paid to primary producers are appreciably above current levels. Sales prices of leather are well below levels found elsewhere in Africa. An extra 6 months is allowed for the preparation activities (Fig. VI. Chapter VI).

However it must be stressed that the study assumes efficient management, acceptable technical quality of product and the use of reconditioned machinery in a cheap, low cost, building with no prestige project trimmings. (It is important that capital costs do not exceed those suggested).

TALBE XI

Production Costs in Dalasi  
(Further Details at Cash Flow & Elsewhere)

ITEM	Year 1	2	3	4	5	6	7	8
<u>FIXED COSTS</u>	63,593	77,241	77,241	77,241	77,241	77,241	77,241	77,241
<u>Variable Costs</u>								
Labour	-	10,618	21,235	21,235	21,235	21,235	21,235	21,235
Chemicals	-	39,942	140,975	140,975	140,975	140,975	140,975	140,975
Machine & Veh. Maint.	546	9,980	19,441	21,520	23,834	26,397	29,317	32,532
Others	7,000	48,895	83,737	83,737	83,737	83,737	83,737	83,737
Hides & Skins	-	97,749	344,997	344,997	344,997	344,997	344,997	344,997
Depreciation	8,190	35,409	71,801	63,240	55,927	49,650	44,232	39,535
Interest L.T.L.	132,000	146,520	162,637	136,522	107,535	75,359	39,644	-
Interest Bank C/D	-	-	9,964	8,047	2,498	-	-	-
<b>Total</b>	<b>211,329</b>	<b>466,359</b>	<b>932,028</b>	<b>897,514</b>	<b>857,979</b>	<b>819,591</b>	<b>781,378</b>	<b>740,252</b>

1  
12  
1

TABLE XII

Production/Sales/Stock Plan

ITEM \ YEAR	YEAR 1	2	3	4 and late
Production % of Annual Capacity	NIL	28.33%	100%	
Production Value Dalasi	NIL	325,333	1,148,235	1,148,235
Sales Revenue Dalasi	NIL	Export 55,284 Home 96,965 Total 152,249	Export 630,240 Home 484,825 Total 1,115,065	1,148,235
Finished Products Increase in stock (Total Stock)	NIL	173,084 ( 173,084 )	33,170 ( 206,254 )	- ( 206,254 )
Hides & Skins Purchases Increase in stock (Total Stock)	NIL	126,499 28,750 ( 28,750 )	344,997 NIL ( 28,750 )	344,997 NIL ( 28,750 )
Chemicals Purchases	2350	108,080	140,975	140,975
Utilise	NIL	39,942	140,975	140,975
Increase in Stock	2350	68,138	NIL	NIL
Total Stock	2350	70,488	70,488	70,488

Note Sales

Export- 663,410 P.A. - 55,284 D Month ( 3 Month Stock )  
Home - 484,825 P.A. - 40,402 D " ( 1 " Stock )

TABLE XIII

Profit and Loss Account

ITEM	Year 1	2	3	4	5	6	7	8
Net Sales	NIL	152,249	1,115,065	1,148,235	1,148,235	1,148,235	1,148,235	1,148,235
Increase in finished stock (From Table XII)		173,084	33,170	-	-	-	-	-
Total	-	325,333	1,148,235	1,148,235	1,148,235	1,148,235	1,148,235	1,148,235
Production Costs ( From Table XI )	211,329	466,354	932,028	897,514	857,979	819,591	781,378	740,252
Gross Profit for Year	-		216,207	250,721	290,256	328,644	366,857	407,983
Loss for year	211,329	141,021	-	-	-	-	-	-
Accumulated Loss		352,350	136,143	-	-	-	-	-
Taxable Profit				114,578	290,256	328,644	366,857	407,983
Tax	-	-	-	-	-	-	?	?
Net Profit				114,578	290,256	328,644	?	?
Gross Profit As % of Capital Investment 1.2 Million			18.0%	20.9%	24.2%	27.4%	30.6%	34.0%

### C. Cash Flow

This may be seen at Table XIV overleaf and one may note that although earlier it was suggested that the total capital requirement was 1.4 million Dalasis (1,200,000 long term loan + 200,000 bank overdraft) the data in the table suggests the most critical year to be year 2 when bank overdraft of 91,000 D is projected. (The overdraft level of 200,000 D thus seems a safe level).

It may be further noted that the repayment of the long term loan allows for 2 years grace and then by 5 equal repayments, years 3 - 7 inclusive (see Table XV). This is the rate at which a dynamic commercial management may attempt to amortise such loan. However it does imply a high level of managerial efficiency. To ease the situation, it may be prudent to seek 2 years grace and then 7 equal payments. Thus annual repayments would be reduced from 5 x 400,000 D p.a to 7 x 313,765 D p.a. This will ease the cash flow but of course will reduce the profit due to increased interest payments. (D196,134 extra interest spread over the years).

#### Notes to Cash Flow

- 1) Assume 80% of full years staff cost for year 1.
- 2) Assume due to inexperience of labour in year 2 will require 50% of full labour cost although production only less than 30%.
- 3) Assume utilities at 40% due to inefficiency during commissioning.

TABLE XIV CASH FLOW

D A L A S I

ITEM	YEAR	YEAR 1	YEAR 2	3	4	5	6	7	8
<b>Income</b>									
Brought FWD		-	260,106	-	-	-	30,963	84,572	135,261
Long Term Loan		1,200,000	-	-	-	-	-	-	-
Bank Overdraft		-	90,581	(73,150)	(22,711)	-	-	-	-
Sales Revenue		-	152,249	1,115,065	1,148,235	1,148,235	1,148,235	1,148,235	1,148,235
<b>Total</b>			<b>502,936</b>	<b>1,115,065</b>	<b>1,148,235</b>	<b>1,148,235</b>	<b>1,179,198</b>	<b>1,222,807</b>	<b>1,283,496</b>
<b>Expenditure</b>									
Capital Items (Table XVI)		866,405	121,623	-	-	-	-	-	-
Management/Staff (Table IV)	1)	54,593	68,241	68,241	68,241	68,241	68,241	68,241	68,241
Audit/Bank fees		5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Insurance		2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Directors Expenses		2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Labour (Table V)		-	(2) 10,618	21,235	21,235	21,235	21,235	21,235	21,235
Chemicals (Table III)		2,350	108,020	140,975	140,975	140,975	140,975	140,975	140,975
M/O + Veh Maintenance (Table XVIII)		546	9,980	19,441	21,520	23,834	26,397	29,317	32,532
Utilities (Table VI)		2,000	(3) 21,095	52,737	52,737	52,737	52,737	52,737	52,737
Offices expenses		-	12,000	12,000	12,000	12,000	12,000	12,000	12,000
Local Travel		5,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Packing		-	600	2,000	2,000	2,000	2,000	2,000	2,000
Transport/Export		-	200	2,000	2,000	2,000	2,000	2,000	2,000
Hides & Skins		-	126,499	344,997	344,997	344,997	344,997	344,997	344,997
Interest Bank o/d		-	-	9,964	8,047	2,498	-	-	-
Repay " "		-	-	17,431	50,439	22,711	-	-	-
Repay L.T.L.		-	-	400,044	400,044	400,044	400,044	400,044	-
Company Tax		-	-	-	-	-	-	?	?
<b>Total Expenditure</b>		<b>939,894</b>	<b>502,936</b>	<b>1,115,065</b>	<b>1,148,235</b>	<b>1,117,272</b>	<b>1,094,626</b>	<b>1,097,546</b>	<b>700,717</b>
C/F		260,106	-	-	-	30,963	84,572	135,261	582,779

TABLE XV

Amortization Schedule

Long Term Loan at 11% 2 years Grace. Repay  
over 5 equal payments (years 3 - 7)

Long Term Loan 1.2 million D	Year 1	2	3	4	5	6	7	8
Balance (B/F)	1,200,000	1,332,000	1,478,520	1,241,113	977,591	685,082	360,397	
Interest Annual	131,000	146,520	162,637	136,522	107,535	75,359	39,644	
Balance Outstanding	1,332,000	1,478,520	1,641,157	1,377,635	1,085,126	760,441	400,041	
Repayment	-	-	400,044	400,044	400,044	400,044	400,044	
Repay Interest	-	-	400,044	177,635	107,535	75,359	39,644	
Repay Capital	-	-	-	222,409	292,509	324,685	360,397	



TABLE XVI

Cash Disbursements - Years 1 & 2

"Fixed Assets" & "Start Up"

	Year 1	Year 2
Site Survey	300	
Land/Fencing	19,110	
Building/Landscaping	321,621	35,736 (1)
Effluent Treatment Plant	24,583	24,582
Services/Misc. Engineering	34,254	34,254
Consulting Engineers	36,667	12,221
Vehicles	27,300	-
Furniture	10,500	-
Lab/Fitters	13,650	-
Plant & Machinery Installed	360,200	14,330
Training	17,720	-
	<u>366,405</u>	<u>121,623</u>

988,028

(i.e. Fixed Assets + 5%  
Contingency + Start up)

(1) 10% Retention

TABLE XVII

Depreciation Schedule  
(in Dalasis)

	Amount	Rate	Year 1	2	3	4	5	6	7	8	
Buildings & other Civil Engineering services	447,722	2.5%	Nil	11,193	10,913	10,641	10,374	10,115	9,862	9,616	
Balance			447,721	436,528	425,615	414,974	404,600	394,485	384,623	375,007	
Plant & Machinery Effluent mechanical etc.	464,877	12.5%	Nil	17,433(2)	55,930	48,939	42,822	37,469	32,786	28,687	
Balance			464,877	447,444	391,514	342,575	299,753	262,284	229,498	200,811	
Vehicles	27,300	30%	8,190	5,733	4,013	2,809	1,966	1,377	964	674	
Balance			19,110	13,777	9,364	6,555	4,589	3,212	2,248	1,574	
Furniture	10,500	10%	Nil	1,050	945	851	765	689	620	558	
Balance			10,500	9,450	8,505	7,654	6,889	6,200	5,580	5,022	
Total Depreciation			8,190	35,409	71,801	63,240	55,927	49,650	44,232	39,535	367,984
Balance of Fixed Assets	950,398 <sup>(1)</sup>									582,414	582,414

950,398  
=====

(1) This figure represents the Fixed Assets as seen in Schedule II minus land cost but includes the Contingency Allowance.

(2) Only taken at 30% of full year due to low production (3.75%).

TABLE XVIII

Machinery & Vehicle Maintenance & Repairs Schedule

The costs of machinery and vehicle maintenance and repairs may be expected to increase over the period:-

Machinery (10% increase P.A. after Year 3)

	Year 1		3	4	5	6	7	8
% of new cost Anticipated	Nil	2%	4%	4.4%	4.84%	5.32%	5.86%	6.44%
(D464,877)	-	9,297	18,595	20,455	22,500	24,732	27,242	29,938

Vehicles (25% increase P.A.)

% of new cost Anticipated	2%	2.5%	3.1%	3.9%	4.9%	6.1%	7.6%	9.5%
(27,300)	546	683	846	1,065	1,334	1,665	2,075	2,594

Total Cost of Maintenance and Repairs	546	9,980	19,441	21,520	23,834	26,397	29,317	32,532
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D Breakeven Point

An analysis of operating costs in Year 3, first full year of production of nominal 100% capacity suggests that a thruput of 59.3% would be breakeven point viz:-

	D	D
Production Level	100%	59.3%
Fixed Costs	321,643	321,643
Variable Costs	610,385	365,010
Total Production Costs	932,028	686,653
Sales	1,143,235	686,645

E Discounted Cash Flow - Internal Rate of Return (Economic)

At Table XIX it may be seen that an I.R.R. (Economic) of 32.0% could be yielded.

TABLE XIX

Discounted Cash Flow - I.R.R. (Economic)  
(In Thousand Dalasi)

	CASH OUTFLOWS FIXED ASSETS AND WORKING CAPITAL EX.	CASH INFLOW					AT 32.0%	
		GROSS PROFIT	DEPRECIATION	INTEREST	RECOVERAGE INVESTMENT	TOTAL INFLOW	P.V.	NPV
Year 1	1,200		8	132		140	1061	+1
2	91		35	147		182	1309	
3		216	72	163	17	468	1261	
4		251	63	137	50	501	1163	
5		290	56	108	23	477	1058	1
6		329	50	75		454	943	
7		367	44	40		451	793	
8		408	39	-	582 (1) 18 (2)	1047		

(1) Represents depreciated value of Fixed Asset

(2) " original value of fenced cleared site.

N.B. THE I.R.R. and P.V. found in the above table have been calculated employing a programmed calculator-discounting from year 8 until NPV of Approx Zero is obtained.

Tannery Site

Minutes of meeting held at 10 a.m. on 31/12/79 at M.E.P.I.D.

Present:- Medical Officer of Health  
Factory Inspector (Medical & Health Dept.)  
Ag. Director of Fisheries.  
Physical Planning Officer.  
Senior Livestock Officer (Hides & Skins) Abuko  
Senior Architect, P.M.D.  
Economist, M.E.P.I.D.  
UNIDO Leather Industry Consultant.

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Discussion

The UNIDO Consultant briefly reviewed tanning, technology and effluent production and amplified the aide memoire prepared (see Annex II), and outlined the characteristics of 5 sites evaluated. The outline data for the 5 sites was:-

Site A - Immediately to the North East of Abuko Radio Station (In the palm wine collection area)

"Well removed from residential areas, high cost of necessary road & power supply. Would need own borehole. Problem with effluent disposal due to presence of rice paddies adjacent to mangrove swamp."

Site B Adjacent to the fish drying activity at Old Jesuwang.

"Reasonably removed from residential area, road and power easily available. Mains water available at high cost. Possible problem with effluent discharge due to adjacent oyster collection area".

Site C On the small knoll some few hundred metres north west of the causeway on the Old Cape Road.

"Although currently removed from residential area could be a future residential zone. Services relatively easily available. Some doubt exists regarding the disposal of effluent at this site as the adjacent swamp appears to be almost a lagoon and high dilution may not be obtained"

Site D Some 30 metres north of the cinema boarding on the western approaches to Denton Bridge (where the Boabab trees are visible)

"Services available but doubt exists in 2 areas regarding suitability (i) whether a noxious industry should be installed in this virgin area (ii) whether the effluent discharge would affect nearby oyster collection if the effluent was discharged into the adjacent lagoon"

Site D East of the G.P.M.B. Factory at Denton Bridge (north of the road).

"The presence of the G.P.M.B. unit establishes this as an industrial area, utilities are available and the discharge of effluent to the area would allow more rapid dilution than at the other sites".

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Following an "on site" visit and further elaboration of the proposed effluent treatment it was agreed that site D, Prima Facie, was the most suitable.

The exact site would depend on G.P.M.B. expansion plans and land ownership being clarified.

At the request of the M.O.E. it was agreed that the tannery should have standby pumps to ensure that in the event of power failure the plant could still operate. Additionally M.O.E. requested that the tannery make daily checks of the final effluent with regard to:-

- ( i ) Chrome in Solution
- ( ii ) Level of Sulphide - agreed a colorimetric standard test could be established (lead acetate paper ?).

Aide Memoire

D. Winters U. N. Consultant

Possible Tannery in Gambia - It's environmental impact and  
Mitigating measures

A) Introduction

Unfortunately Tanneries from time immemorial have been universally categorized as noxious industries with relatively high pollution potential. However this view has not allowed for the improvements in Tanning Technology which has accrued in recent decades. Thus, today it is possible to operate a tannery with minimal air pollution and following on-site effluent treatment aqueous discharges are much lessened in toxicity with the environmental impact being greatly improved.

B) Basic Parameters of the proposed tannery

This tannery is being designed to process all of the Gambian Hides & Skins collectable. This is some 80 Hides a day plus a similar volume of skins. Thus there is little fear of rapid expansion in volume of the project. Even with processing 100% of Gambian Hides & Skins the tannery will be a MINI Tannery - about 25% in size compared with a typical fully mechanised unit in countries with less limited raw material supplies. The end product will initially be a semi-processed form known as "Wet Blue" with only the Rejects being fully finished. Daily input may be 400kg dried Hide (1200 kg Lined).

In addition to waterborne pollution tanneries also produce solid wastes and in the tannery under discussion one may expect 15% solid waste. i.e. 130 Kg/day.

Basic Tannery Process

Leather making processes vary greatly according to end - product. However, the major sequences are broadly similar. The major processes are listed together with the chemicals employed (percentages calculated as weight of Raw material).



<u>Major Process</u>	<u>Agents Employed</u>
Soak (Rehydrate)	0.51% Bacteriacide + 0.01% surfactant
Lime	4% Lime + 2 $\frac{1}{2}$ % Sodium sulphide
Deline - Bate	2% Sodium Bisulphite + 0.5% Enzymatic material
Pickle	6% salt + 1.2% sulphuric/Formic acids.
Tan	+ 10% Chrome Tanning salt (25% Cr <sub>2</sub> O <sub>3</sub> ) + 1% Sodium bicarbonate (now known as "wet blue") or 15 <sup>3</sup> - 20% vegetable tannin.
Retan	1% Calcium formate 1% Dyestuff 4% mimosa extract 2% synthetic tannin. 4-8 sulphited or sulphonated oils.
Finishing	Insoluble pigments (hand operation).

D) Expected Characteristics of Effluents & Wastes

Effluents & Wastes are derived from 2 major sources

- 1) Unutilised chemical agents and their derivatives
- 2) Hide and hair fragments and partial protein breakdown products.

A study in 1975 by UNIDO/UNEP suggested a typical composite tannery effluent, with water consumption of 66 litres/kg Hide could be L-

Suspended solids	mg/L 2,500
B. O. D <sub>5</sub>	mg/L 900
Sulphide	mg/L 160
Chrome (Tri valent)	mg/L 70
Chloride	mg/L 2,500

N.B. If less water is employed the pollutants will be proportionally stronger. A more simplistic view of the effluent may be the following 5 categories :-

- 1) Partially dissolved hair and epidermal and other protein tissues (accounts for over 50% of the B.O.D. load).
- 2) Residual sodium sulphide (1.0%)
- 3) Residual chrome Tannin ( - 20% of offer)
- 4) Lime and other miscellaneous chemicals
- 5) Non degradable dyes and pigments.

### E. Mitigating Measures

In the feasibility study being prepared it is assumed that the following measure will be taken.

- 1) Solid wastes will be removed daily and tipped at approved site, covered with soil and allowed to decay naturally. (Hide Trimmings and Flashings). (Municipal tip?)
- 2) The internal drainage will be so designed that high pollutant liquors may be segregated and treated
  - a) Sulphides will be oxidised in the presence of a manganous salt + ( $S^{2-}$  level lowered to 20 mg/L - with subsequent mixture with other liquors may be about 2 mg/L in final effluent).
  - b) Chrome bearing liquors will be treated with alkali to precipitate the chrome -  
  
(The supernatant chrome free liquor may be gently pumped out, (periodically the chrome Hydroxide must be pumped out - dried sealed and buried).
- 3) The 2 treated liquors above will be mixed with the other liquors, equalised for 24 Hrs., given primary sedimentation in a horizontal flow tank and the supernatant discharged to tidal waters.
- 4) Dyestuff and pigment residues will be directed to a land soakway which should effectively eliminate the small volume (only 20% of the leather is expected to be dyed/finished).

### F. Final Discharge

With the above measures in force one will have a virtually toxin free effluent. The major constituents may be:-

Lime (Small amount not sedimented), other soluble chemicals, Hair & Protein degradation products.

As estimate of the strength of the discharged effluent may be :-

suspended solids circa 1500 mg/L (40% reduction on primary sedimentation

B. O. D5	600 mg/L (33% " " " " " )
Chrome (Trivalent)	1 mg/L
Sulphide	2 mg/L
(assuming water consumption =	66 L/kg Hides)

Maximum Daily Water Utilization

From the "Outline Process Technology" it may be seen that maximum daily water consumption when hides are being processed may be :-

Flow O - General	53.2 M <sup>3</sup>
Flow S - Sulphide Bearing	5.4 7.4 M <sup>3</sup>
Flow C - Chrome "	4.0 2.5 "
Flow D - Dye/Pigment	1.0 1.0 "
Total Charge	<u>63.6 76.1 M<sup>3</sup></u>

However to allow for 20 - 25% future expansion it may be expeditious to have capacity to process up to 80 M<sup>3</sup> day.

Requirements and cost for Tannery Effluent Treatment Unit

ALL CONCRETE TO BE ACID RESISTANT (Cement Fondu)

I. Internal Drainage channels For further Technical details see "Environmental Considerations in the Leather Producing Industry." UNIDO/UNEP  
UNIDO/ITD 337/Add 1/Rev.1. Vienna 1979

A/ Approx. 30 linear metres of channel closed with 5 cm thick perforated wooden covers.  
(Local hardwood)

B/ 3 Sets of dams to allow flow to be directed at Y junctions in channel

C/ 6 Sets of coarse & medium screens for channels.  
(25 mm & 6 mm grids)

II Flow Line S.

See schematic diagram.

A/ Holding Pit 8 M<sup>3</sup> in concrete  
ie 1.13m Radius x 2m deep.

To include large bladed slow moving stirrer and pumping facility to oxidation tower.

A/ Catalytic Oxidation Tower.

6 or 8 mm mild steel tower - Resin Coated internally.  
8 M<sup>3</sup> - If 3 m high has r of 0.92m

In presence of Manganous catalyst need air supplied at  
circa 30 cu. ft. min from a (2 or 3 Hr) Rotary vane air  
blower via sintered alumina diffusers.

Ref: BAILEY & HUMPHREYS - JSLTC. 1967 . 51. 154

III Chrome Flow C

A/ Precipitation/Catch tank

Volume 3 M<sup>3</sup>. If 1.5m deep. r = 0.8M.

Requires small pump to remove supernatant chrome free  
liquor. Also sludge pump to occasionally remove cr. ppt.  
Possibly employing "CHROMAGIN" as precipitating agent.  
see JSLTC 1978. 62 . 98

IV Flow O

A/ Equalization Tank

3 m deep r = 3m volume = 24.8 M<sup>3</sup>. Must forward pump at  
3 M<sup>3</sup>/r - PUMP ?

needs 4.5m stirrer at 2 - 3 RPM

B/ Horizontal Flow Tank

For 6 Hr. Retention = 3x6 = 18 M<sup>3</sup>      20 M<sup>3</sup>

∴ each Tank      5M x 1M x 2M average depth = 10M<sup>3</sup>

need 2 tanks for use + 1 spare.

GRAVITY

V Flow D

1M<sup>3</sup> day. If Soakway for 20 Day = 20 M<sup>3</sup> - ? Shape/Size

Effluent Treatment Unit - Costing

	General Engineering & building costs obtained from P.W.D.		D
I	A/ Internal channels - Included in building cost		-
	B/ 3 sets of dams *		500
	C/ 6 sets of REMOVABLE screens (2100 each)*		2400
II	A/ Holding pits (Base = $4M^2$ = Walls = $14.5 M^2$ )		
	8M <sup>3</sup> at 14/D/M <sup>3</sup> = 112		
	18.5 M <sup>2</sup> of 20 cm concrete + form at 76 D/M <sup>2</sup> = 1406		
	Stirrer (£200)*	800	
	Pump (£200)*	800	
	hand pump	400	3518
	B/ 8 M <sup>3</sup> Catalytic oxidation Tower		10,000
	(Based on Kenyan Quote = 50%)		
III	A/ Cr. Catchpit (Base = $2 M^2$ , Walls = $7.5 M^2$ )		
	Excavate 3 M <sup>3</sup> @ 14/D/M <sup>3</sup>	42	
	9.5 M <sup>2</sup> of 20 cm concrete formed @ 76 = 722		
	Pump (1/2 Hr. - £50)*	200	964
IV	A/ Equalization Tank - assume 1/2 sunken		
	(Base = $28 M^2$ . Walls = $56 M^2$ )		
	Excavate 42.5 M <sup>3</sup> at 14D/M <sup>3</sup>	595	
	84 M <sup>2</sup> of 20 cm concrete formed at 76D/M <sup>2</sup> = 6,384		
	Stirrer (£500) *	2,000	
	Pump (£400) *	1,600	10,579
	B/ 3 Horizontal Flow Tanks		
	Base 19 M <sup>2</sup> Walls 55 M <sup>2</sup>		
	Excavate 30 M <sup>3</sup> at 14/DM <sup>3</sup>	= 420	
	74 M <sup>2</sup> of 20 cm concrete formed at 76D = 5624		6,044

Soakaway - 20M<sup>3</sup>

20 M<sup>3</sup> Excavate @ 14 D/M<sup>3</sup> = 280

20 M<sup>3</sup> Hardcore /Store filled @ 27 D/M<sup>3</sup>  
= 540

820

VI Discharge to sea.

Say 100 M at 40 D/M = 4,000

4,000

VII Miscellaneous piping, valves etc. \*

4,000

Mobile Sludge pump (self contained motor)

4,000

Total Effluent Treatment Unit

46,825

(Civil - 27,025)  
(Mechanical - 19,800)

Annex IV

COSTING OF MISC CIVIL ENGINEERING

Reservoir - 1 days supply - Possibly same size as Effluent  
Equalisation Tank ie 35 M<sup>3</sup>.

Semi sunken - 3 m deep = R = 3M  
Excavate and concrete = D 6,979  
Canvas or timber cover \* = D 1,000  
40 mm (1½") Mobile pump including petrol  
engine - approx. 2Hp. = D 3,000  

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D10,979

Soak Pit 2 @ 2.5 X 1.8 X 1.7M.

Set 1 m into ground.

Excavate 12.5 M<sup>3</sup> @ 14 D/M<sup>3</sup> = 175  
Base 12.5 M<sup>2</sup> @ 76 D/M<sup>2</sup> = 950  
Walls 28.2 M<sup>2</sup> @ 76 D/M<sup>2</sup> = 2143  

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D3268

Boiler/Calorifier

With the small input, especially in the finishing activities the hot water requirement is minimal. It should be sufficient to install a TYPICAL EUROPEAN domestic central heating type package boiler - adjusted to run on diesel fuel. Thus a boiler of 100,000 BTUs/hr. could in 8 Hrs. raise 1000 gals (10,000 lbs. - (4.5 M<sup>3</sup>) by 80°F (44 °C). This far exceeds the tannery's initial requirement.

It is suggested that such boiler would require a Header tank to support an indirect PUMPED heating coil which would service a 4 M<sup>3</sup> hot water supply at 60 °C or so. European cost for such installation would be circa £Stg. 1,500 therefore one could budget in Gambia for 9,000D (ie. 50% uplift).



Annex V

Possible Shipping Weight & Installed Power

actual Volumes/Weights will depend on particular machines selected. Herewith quoted typical data.

Machine and Plan Reference	Weight (MT)	Volume M <sup>3</sup>	H. P.
(2) - Lime Drum Ironwork, Drive etc.	2.0	2.0	10
(3) Flesher 1.6 M	2.6	8.7	10
(4) " 2.1 M	3.0	10.2	20
(5) Platform Scale	1.0	2.0	-
(6) Tan Drum Ironwork etc.	2.0	2.5	10
(7) SAMMING M/C.	5.6	8.2	20
(8) SPLITTING M/C	4.9	7.4	10
(9) S. W. Shaver	1.4	3.4	5
(10) Dye drum Ironwrok	1.5	2.0	7
(11) Perspex Drum	0.2	1.0	1
(12) Skin Staker	0.8	1.5	2
(13) CROC Staker	1.1	2.8	4
(14) S. W. Buffer	0.9	2.3	3
(15) DW Buffer	1.3	5.0	5
(20) Plate/ Emboss	4.0	4.8	4
(21) ELECTRONIC MEASURE	1.5	8.0	
(22) PINWHEEL MEASURE	1.1	2.1	0.5
(23) Compressor	--	--	0.5
Boiler		2.0	
	<u>34.9</u>	<u>76.4</u>	<u>11.2</u>
Plus 5% for Spares =	<u>36.7</u>	<u>80.2</u>	<u>= 82 KVA</u>

Comparison of F. O. B. M/C quotes - In Dalasi

	Wilson	Murphy	GLenk
Fleshing M/C 1-3 M		31,200	32,500
Fleshing M/C 1-6 M		27,800	28,500
Iron for Drum 2.4 X 2.4 M		13,000	10,580
Iron for Drum 2.4 X 2.4 M		12,000	9,620
Sammying M/C		47,400	32,600
Photoscan		19,800	32,000
Spares			15,238
Drum 2.1X0.9		9,400	6449
Csplitter		38,600	44,000
Shave 10'		5,980	13,000
Buff 10"		5,500	7,600
" D/W		8,600	15,000
Air Comp.		5,140	
Emboss		26,980	15,000
Pinwheel		14,400	13,500
Rotary Staker			
Croc		14,400	2,680
Spare			10,368

Annex VII  
Draft Tender Document

The Government of the Republic of Gambia is evaluating the possibility to install a small tannery. It seeks offers to supply the following Plant, Machinery and Services:

Offers to supply should be on an individual machine basis as well as on a complete package basis. Offers should be in STG at Dentshmark FOB.

Electricity available = 400volt 3 phase 50 cycles

Group I - These must be A1 Reconditioned with guarantees equivalent to new machinery. All machines quoted to include Drive safety Devices Starters , etc..

Ref.	No. Required	Description of machine
1	1 off	Set of Ironwork, stand and drive suitable for a 2.4x2.4m Lime Drum to run at 2 and 4 R.P.M. The Drum body will be fabricated in Gambia a set of Drum and Foundation Plans will need to accompany the Ironwork. In particular the following must be included Cast Iron Support Stands, 2 Heavy duty Trunions, axles bored 10cm to allow feeding, bearings to match the trunions, steel hoops to hold drum body together, bronze or stainless steel bolts to fix to Ironwork to timber, stainless steel door, suitable motor starter and switch gear, reduction unit and V belts
2	1 off	Set of Ironwork, stand and drive suitable for a 2.4m x 2.4m Tan Drum to run at 8 10 R.P.M. Detailed particulars as Ref 1 above.
3	1 off	Set of Ironwork, stand and drive suitable for a 2.1m x 0.9m Dye/Retan drum to run at 10/12 RPM. Detailed particulars as Ref 1 above.

Ref.	No. Required	Description of machine
4	1 off	Perspex Experimental drum complete with stand and drive. Variable speed. Size 0.6x0.3m or similar.
5	1 off	Fleshing machine suitable for skins. 1.4 or 1.6 m working width. Turner Type 205 or similar mechanical operation.
5A	1 set	Spares for fleshing machine as thought applicable to include also 1 spare bladed Fleshing Cylinder and 1 Rubber roller.
5B	1 off	Fleshing machine suitable for fleshing light hides or heavy sides. 2.1m working width
6A	1 set	Spares for Hide Flesher as Ref 5A
7	1 off	Platform Scales to weigh to 1,000kg.
8	1 off	Sammying Machine - Heavy Duty - 1.2M Working width similar to Turner Type 284
8A	1 off	Spares for sammying machine as felt applicable but to include also 3 spare sets of felts.
9	1 off	Electronic measuring machine suitable for measuring wet blue sides and skins

Group II The machines in this group will work at low capacity utilization and the machines sought may be Reconditioned or at least fully servicable. Machines offered must include all necessary drives, starters and safety devices

Ref	No. Required	Description of machine
10	1 off	Bandknife Splitting machine, working width 1.4m as Turner Type 35

Ref.	No. Required	Description of Machines
10A	1 set	Spares for Bandknife Splitting Machine
11	1 off	Single Width Staving machine, suitable for hides as Turner Type 122B or 322 working width 0.3M.
11A	1 set	Spares for single width shaver to include also ready Bladed cutting cylinder.
12	1 off	Rotary staker suitable for softening skins.
13	1 off	Staking machine similar to Turner Type 117. Fitted with single and double roller heads.
13A	1 set	Spares for staking machine
14	1 off	Buffing machine single width as Turner Type 130 0.25m working width ( Not Endless band)
14A	1 set	Spare for above buffing machine to include also 20 Rolls assorted papers.
15	1 off	Buffing machine, Double width, as Turner Types 158 or 458. Working width 0.6m.
15A	1 set	Spares for double width Buffing machine to include also 20 Rolls assorted papers.
16	1 off	Plating and Embossing machine, mechanical, similar to Turner Type 328. To be heated electrically . To include 1 smooth plate and 4 embossing plates (Hair Cell, Pebble, Lizard and Peccary) working width 2.0m.
16A	1 set	Spares for Plating/Embossing machine, to include also spare bed.

Ref	No. Required	Description of machines
17	1 off	Pinwheel measuring machine as Turner Type 155. Working width 1.6M.
17A	1 set	Spares for Pinwheel measuring machine
18	1 off	Portable Compressor suitable to operate 1 spray gun.
18A	1 set	1 set spares for Compressor. To include also 2 Spray Guns and their necessary spares.

Group III - Services

In addition to the supply of the above machines it is envisaged that the following services will also be required:-

19 - Installation of Machinery

The machinery supply company must supply the services of a competent installation Engineer/Fitter to ensure that the plant is correctly assembled, installed and commissioned.

The Gambian authorities will cover direct expenses viz:- Air fare, local subsistence allowance and supply local transport and ensure that sufficient labour is available to assist the installation engineer.

Training

The machinery supply company must assist in training the prospective Gambian maintenance engineer for a 2 month period. Such training may be in the supplying companies own fabrication/Reconditioning workshops and if possible should be augmented with service visits to European Tanneries. It being understood that the Gambian authorities will be responsible for all the engineers personal expenses.



