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ASSISTANCE TO THE ESSENTIAL OIL INDUSTRY - ZANZIBAR

DP/URT/86/026

UNITED REPUBLIC OF TANZANIA

Technical report: Maximising the capacity of the clove distillery of Chake Chake*

Prepared for the Government of the United Republic of Tanzania
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of Mr. Baldev Gulati, Chemical Technologist
Essential Oils (C.T.A.)

Backstopping Officer: Mr. R.O.B. Wijesekera, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

* Mention of company names and commercial products does not imply the endorsement of UNIDO. This document has not been edited.

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SUMMARY

The Project DP/URT/86/026/A/01/37 "Assistance to Essential Oils Industry, Zanzibar", started functioning from July 1, 1989. During the first phase of the mission of Chief Technical Adviser, the main areas of work needing immediate attention were attended to. These are:

a) Improvement of extraction methodology of Clove Stem Oil. Work was started but could not be continued due to water problem.

b) Factors contributing to quality products were identified.

c) List of spares for the existing machinery and vehicles was prepared besides identifying need for additional equipment.

d) Laboratory design and modifications along with items of laboratory furniture, equipment, apparatus and chemicals have been suggested. Laboratory modification work will be done by Z.S.T.C. while other inputs will be provided by UNDP.

e) Even though marketing strategy will be planned by Marketing Expert, a start in this direction has been suggested with the participation of the Marketing Manager and the Plant Manager in the International Seminar on Essential Oils to be held in New Delhi in November 1989.

f) Study of naturally occuring aromatic plants of Pemba has been initiated. The work will be continued. Plants considered suitable for Pemba to augment essential oils production have been suggested.

g) Deployment of Experts in the Project and Training Programme for counterpart personnels of the Project has been planned tentatively.

h) The Distillery has problems,such as irregular water supply, lack of vehicles i.e. jeep and motorbikes which are impediments to its successful and efficient working, especially now that cultivation of aromatic plants has been started.

RECOMMENDATIONS

In order to make best use of the Project and overall efficient working of the Clove Stem Oil Distillery, following recommendations are made:

1. Laboratory modifications and equipping it with requisite benches, shelves and cupboards etc. should be started immediately by the Distillery so that work can start no sooner equipment, apparatus and chemicals are received.

2. A qualified Chemist and an Agronomist should be appointed so that they can be trained by Project Experts during the Project.

3. As a first step to develop increased market for stem oil, the Marketing Manager of ZSTC and Plant Manager of the Distillery should be sent to the International Congress on Essential Oils to be held in New Delhi in November 1989. About 1600 delegates from the world (including India) are expected to attend the Congress.

4. The Distillery does not have a regular and dependable source of water supply. An independent source for water e.g. from a tube-well is considered very essential. UNDP may consider provision of motor and pump if the boring of tube-well is done by the Distillery.

5. Out of Project funds, one Suzuki Jeep and two motor-bikes are strongly recommended.

6. Steps should be taken now to acquire about 25 acre of land and keep it ready for planting under various crops during the Project. The Distillery should make available adequate finances to undertake this work.

7. A Perfumer Consultant may be fielded for two to four weeks to train local personnel in the odour evaluation of essential oils and those produced in the Distillery. His expert opinion on the quality evaluation of stem oil produced under different parameters will go a long way in production of quality stem oil.

8. The Distillery should take steps to procure 200 litres of rectified spirit per annum for analysis of essential oils and quality control work in the laboratory.

9. In order to do maximum possible work in the diversification of aromatic plants cultivation to introduce more oils in the production range, the Project of one year duration may be spread over longer period by staggering deployment of Experts during different periods.

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INTRODUCTION

The project "Assistance to Essential Oil Industry, Zanzibar"; Maximising the capacity of the Clove Distillery of Chake Chake, DP/URT/86/026/A/01/37 started from July 1, 1989 with the arrival of Dr. Baldev Gulati, Chief Technical Adviser in Chake Chake. Briefing was done by a substantive officer of UNIDO in Colombo, Sri Lanka on 26th and 27th of June 1989. Due to lack of information, the Chief Technical Adviser proceeded direct to the Project site at Chake Chake instead of making a brief halt at Zanzibar to meet the concerned officers of Zanzibar State Trading Corporation (Z.S.T.C.) and the Ministry of Trade and Industry. However, contact was made by telephone. The Deputy General Manager of Z.S.T.C. posted at Wete came to meet the Chief Technical Adviser for discussion about the Project.

Detailed discussions were held with the Plant Manager and Production Manager of the Clove Stem Oil Distillery. Modus Operandi of the Project as per Project Document, the job description of the Chief Technical Adviser as also the major needs for succesful working of the distillery was worked out. Details are given in this Report.

The Clove Stem Oil Distillery is located in a spacious premises and is well planned. The Distillery is under the Z.S.T.C. Zanzibar and is manned by a qualified Plant Manager and Production Manager. Organizational chart is enclosed at Annexure I. A brief description of the work done during First Phase of the Mission of the Chief Technical Adviser is given hereunder:

1. Improvement of extraction methodology

Distillation of Clove Stems was standardised by the supplier of the equipment i.e. Tournair Frere, Grasse (France). This is being followed for the production of the oil.

The distillery comprises of 10 distillation units of 3000 litre capacity capable of taking a charge of 700 kgs. of clove stems. The units have built in arrangement for distilling stems at 100°C to 120°C still temperature, corresponding to still pressure of 1 bar to 2 bars. In actual practice, distillation is done at pressure of 1.5 - 1.8 bars in the still. Out of 10 stills, one is reserved for distilling lemon grass while another needs minor repair. The factory which runs on one shift basis processes 5600 kgs. of stems in 8 stills yielding 220 to 250 kgs. of oil per day. The factory normally runs for 5 days a week; Friday is kept for general cleaning and maintenance of equipment and boiler. Under the present working schedule 1300 tonnes of stems can be distilled on one shift basis yielding 50 to 60 tonnes of the oil per annum.

Distillation of stems is done for 5 hours which is supposed to give oil of good quality in optimum yield. Oil obtained is of light yellow colour free from moisture and suspended particles.

Operation of the units is not difficult but needs effective supervision. Oil from separators is removed at regular intervals, weighed, put into containers having fine mesh for removing any dust or suspended matter. The filtered oil is pumped into a vaccum distillation unit wherefrom water/moisture is removed under vaccum. Clean and transparent oil is packed in drums for export.

The entire procedure of distillation was studied carefully. Plan of work was chalked out to determine parameters for distillation so as to get maximum yield of good acceptable quality conforming to International Standards. Work was started; results obtained so far are given elsewhere in this Report. However, this work is expected to take longer time than available during the first phase of the Mission.

One of the main impediments in operating the Distillery on sustained basis is lack of regular supply of water. During this mission, the factory remained closed for 10 days due to non-supply

of water from the town. It will be necessary to have a dependable source of water. The best course would be to have its own independent supply. Digging of a well may be done by the Distillery (Z.S.T.C.) while motor and pump be purchased from UNDP Project funds.

Arrangement of water supply needs immediate attention.

2. **Improved methods of quality assessment and storage of essential oils and related products**

In order to produce quality essential oil of clove stems, care is exercised at the time of clove stems purchase. Stems are classified into 2 grades: grade I which are carefully dried in the sun are free from mould and fungus contamination while grade II are those which are not dried so carefully. Grade I stems are purchased at T.Shillings 4.00 per kilo while Grade II are purchased at T. Shilling 3.00 per kilo. The farmers are encouraged to produce only Grade I stems.

It is planned to study effect of drying and storage of stems on yield and quality of the oil.

Clove stem oil produced, as mentioned earlier, is clean, transparent and free from moisture and suspended particles. It is analysed carefully and packed in clean drums. Further, the oil produced in Chake Chake is light yellow, not common for clove oils, especially leaf oil, which is of deep colour and not free from moisture or suspended materials.

The oil has to be packed in drums which are clean and without any exposed inner surface to mild iron responsible for imparting dark colour to the oil. The oil, however, if stored for long periods, has the natural tendency to acquire colour.

While eugenol content is the prime requirement for good quality clove oils, in the case of stem oil, odour value is likely to influence the quality and thereby its sale. This factor will be given due attention in our work of production of good quality oil

while working for improved methodology of oil production.

3. **Marketing Strategy**

Clove stem oil of Zanzibar origin which has been out of market for quite some time, has been replaced by clove leaf oil which even though is inferior to stem oil can serve the overall purpose of flavour and fragrance industry. Its re-appearance in the market is not well known. Also, clove leaf oil is cheaper (US$ 2.5 to 3.0 per kg.) as against US$ 5.0 per kg. of clove stem oil. Sale of the oil is however, picking up though not commensurate with its production potential. Sales figures of clove stem oil during the last few years are as under:

Oil Produced	1983	1984	1985	1986	1987	1988
(Tonnes)	24.4	22.7	17.7	10.0	27.0	20.62

Trend of sales during 1989 is good. So far during June-July 13.7 tonnes of oils has been sold.

Average annual production of clove stems per year is of the order of 2000 tonnes corresponding to about 80 tonnes to 100 tonnes of oil (after methodology of production is improved). Also 2500 tonnes of clove stems are in stock with additional expected crop of about 1000 tonnes during 1989.

Marketing Expert of the Project is expected to arrive soon who will chalk out strategy for improved sales. Also, Marketing Manager of ZSTC is to go on an extensive tour to explore market for this oil. In the meantime, wide publicity on the availability of this oil on regular basis is called for.

It is also considered adviseable that Plant Manager of Clove Stem Oil Distillery is associated with the tour of Marketing Manager of ZSTC.

An International Seminar on Essential Oils is to be held in New Delhi on 14 - 17 November 1989 where about 800 foreign delegates

from the Industry are likely to participate. Bot the Marketing Manager and the Plant Manager should attend the International Seminar with samples and brochure on clove stem oil. This gathering will be a unique chance and offers a good business opportunity.

4. **Sub-contracting of repairs to the manufacturers**

With the help of Plant and Production Managers, who are both qualified engineers, a comprehensive list of spares needed for efficient running of the Plant has been prepared. Work of repairs will be done locally without the help of suppliers of equipment. Only difficult and specialised job is lining of boiler furnace with refractory bricks. Possibility of getting this job done by a competent party in Dar-Es-Salaam is being explored. Exact position will be known in near future.

It is also envisaged that Expert Engineer of the Project will assist in repair of the equipment after spare parts are received from abroad.

List of spares is enclosed at Annexure II.

5. **Diversification and Selection of essential oil bearing plants for Pemba**

Considerable investment has been made by the Government of Zanzibar in setting up of modern steam distillation plant at Chake Chake. This unit is meant solely for distillation of clove stems, the oil produced is for export only. Production capacity of the unit, if worked on 2 shifts basis, is 110 - 120 tonnes of oil from 2800 tonnes of clove stems. Regular availability of stems is about 2000 tonnes per year. After processing available stems the unit will have capacity to distil other materials.

To make full use of the unit and free it from the risk of one product production it is adviseable to produce other aromatic crops for export.

Pemba by virtue of its good soil and climate will be suitable for a number of essential oil bearing crops. A few important species considered suitable for cultivation are given hereunder. Due consideration to export market and world demand has been given while suggesting these species:

1. Lemongrass
2. Cintronella (Java type)
3. Palmarosa
4. Vetiver
5. Patchouli
6. Cinnamomum cassia & C.zeylanicum
7. Basil, French and Reunion
8. Nutmeg
9. Pimento (Allspice)
10. Yland Ylang & Cananga
11. Eucalyptus

Out of the above, Cinnamomum, Nutmeg, Pimento and Ylang Ylang are long range proposition. However, a start can be made now. Other crops suggested are short-term proposition and can given return within a year and earlier of their cultivation.

It may be noted that introduction and large scale cultivation of other aromatic crops will take long time, may be 3 - 5 years. This Project of one year duration should be spread over 2 years or so to enable to get some results.

(A preliminary survey made during the first phase of Chief Technical Adviser's mission has revealed the presence in natural state of Ocimum Spp. (O canum - & O. sauve) Cinnamomum Spp. Vetiver, Ylang Ylang and Eucalyptus species.)

While lemongrass cultivation of Cymbopogon citratus has been taken up from the planting material available locally, the same for other crops will need to be imported. Following 3 species may be taken up immediately:

Species	Source of Planting Material
Cintronella (Java Type)	C.I.M.A.P., Lucknow, U.P.,India.
Palmarosa	CIMAP, Lucknow and Forest Department, Maharashtra,India.
Vetiver	Indonesia, Reunion, Haiti Islands.

It is also suggested that improved lemongrass material may be imported from India.

Department of Agriculture at Pemba is actively assisting in the cultivation of lemongrass. However, C.T.A. got involved in this activity with regular visits to the planting area. Suggestions regarding land preparation, spacing, maintenance of the crop, control of diseases, harvesting have been given for the crop. This activity of the Clove Stem Oil Distillery will be given due attention by the Project.

While active help of the Department of Agriculture is available, it is considered adviseable that a full time worker may be employed by the Distillery. As and when a qualified worker is employed, he should be sent for training abroad.

Even though one still has been reserved for lemongrass distillation it will be necessary to instal a separate unit outside the distillation hall housing existing stills. The entire atmosphere within this hall is permeated with clove oil odour and other essential oils produced there are likely to get contaminated. This was observed to be the case with the lemongrass oil distilled in trial lots.

Distillation units (two) of capacity 3000 - 4000 litres each are adequate to begin with. These units are to be installed near the boiler in a separate shed.

6. Deployment of Consultants/Experts in the Project

As per the Project Document following experts will be working for the Project:

1.	Essential Oil Distillation Plant Expert (C.T.A.)	12 m/m
2.	Chemical Engineer	1 m/m
3.	Agronomist	3 m/m
4.	Marketing Expert	2 m/m
5.	Quality Control Chemist	2.5 m/m

For effective coordination of the experts it is imperative that they are fielded at different periods and that too when the C.T.A. is present at the Project site.

Marketing Expert and the Engineer should complete their work in single mission while the other i.e. C.T.A., Agronomist and Quality Control Chemist should be fielded in split missions.

After discussion with the counterparts in the Distillery and overall consideration of work programme, fielding of experts has been chalked out as per Annexure III.

C.T.A.'s fielding has been divided into 3 split missions, primarily due to the fact that work of diversification of production of essential oils from cultivated crops as also from the locally available material is likely to take time. (Survey of the existing essential oil bearing species is also proposed to be done: Work on this aspect has already been taken up, locating natural plant species of ocimum, cinnamomum and vetiver.) The Project should, therefore, continue till end 1990.

Quality Control Chemist will complete second leg of his mission after GLC, chemicals and items of apparatus have been received.

Agronomist should visit the Project site in 2 split missions. He should visit for 2 weeks in first mission and for 2.5 months in second mission wherein he will be expected to undertake planting of various species for which planting material will need to be imported.

Fielding of Experts is summarised as under:

	Expert	Mission		
		1st	2nd	3rd
1.	Essential Oil Distillation Plant Expert (C.T.A.)	0.5 months (June-August 1989)	5 months (November 1989-March 1990)	5.5 months (May 1990-Oct.1990)
2.	Agronomist	0.5 months (Nov.-Dec.1989)	2.5 months (May 1990-July 1990)	---
3.	Quality Control Chemist	0.5 months (July 1989)	2 months (May-June 1990)	---
4.	Marketing Expert	2 months (November-December 1989)	---	---
5.	Chemical Engineer	1 month (May-June 1990)	---	---

It is also recommended that a Consultant Perfurmer be fielded for 2-4 weeks to train the concerned factory staff in odour evaluation of essential oils and specially those which are likely to be produced here in due course. Steps may be taken to locate an Expert in this field.

7. Training Programme for counterpart Personnel

All the Experts (International Staff) will be actively involved in Training of Counterpart Personnel at site. The national staff will be trained further by sending abroad. Tentative programme for this activity as per Project Document is given as under:

In all six Fellowships/Training/Study Tour have been identified in this Project.

1. Plant Manager

The Plant Manager is expected to have an overall view of the industry such as production, quality control and marketing. His study tour has been designed based on this conception.

It is recommended that he be associated with the Marketing

Manager for tour; he should attend the International Seminar on Essential Oils to be held in New Delhi in November 1989. Thereafter, he should undertake a separate study tour of selected places such as visiting some premier Institutions and production centres for essential oils in the developing countries. It will be desireable if he also visits countries such as Turkey, Nepal and Vietnam where UNIDO Project of similar nature are in progress. His study tour is proposed as:

i) October 1989 - November 1989: 6 weeks (with Marketing Manager of Z.S.T.C. Zanzibar) Visit I.T.C. Geneva and Firminsch, Furst Day Lasson (Zurich), Grasse-Nice (France), Cavallier Freres, P. Robertit, etc. Naarden (Holland), companies is London (U.K.) like R.C. Treat; International Seminar at New Delhi to be visited at the end of the study tour. If possible C.T.A. of the Project will associate at New Delhi and then join Project at tne second leg of his mission in Pemba. Period of study tour to be decided in due course.

ii) R.R.L. Jammu, R.R.L. Trivandrum, CIMAP, Lucknow, R.R.L. Jorhat, Assam (all in India), H.P.P.C.L., Nepal and Turkey on return journey.

The above study tour is expected to benefit the Project in a big way.

2. Marketing Manager

Marketing Manager of Z.S.T.C. Zanzibar will have a joint study tour with the Plant Manager as given above at No. 1.

3. Production Manager/Chief Engineer

i) Production Manager to be sent to the suppliers of G.C. equipment to learn about the instrument and its maintenance. Period of visit (about 2 weeks)to be decided in consultation with the suppliers of equipment.

ii) Visit to the production centres of essential oils of Vetiver, Patchonli, Ylang Ylang, Clove leaf, etc. in Indonesia.

4. Distillation Foreman

Distillation Foreman will accompany the Production Manager to Indonesia as suggested above.

5. Maintenance Foreman

Maintenance Foreman is proposed to be sent to Karachi for training including, the machine operation and related jobs of maintenance.

6. Analytical Chemist

Analytical Chemist is proposed for training in CIMAP, Lucknow for 3 months on the analysis of essential oils by routine chemical methods and by instrumentation technique. Period of training to be decided in due course in consultation with CIMAP, Lucknow.

8. Laboratory Design - Modification and List of Equipment, Apparatus and Chemicals

The Quality Control Chemist who was to arrive at the Project site to suggest modification in Laboratory and prepare list of equipment, apparatus and chemicals was asked by UNDP/UNIDO to cancel his split mission. This work has, therefore, been done by the C.T.A. In the meantime, the Expert was sent to Pemba. He was briefed by the C.T.A. in Dar-Es-Salaam on 4 August 1989 and was given the list of laboratory equipment, apparatus and chemicals and lab. design.

Two rooms have been set apart for laboratory; one will be equipped for chemical analysis while the second will be used for GLC and other sophisticated equipment. Design sketch of the two rooms is enclosed.

The Distillery (ZSTC) will undertake laboratory modification job while other inputs will be provided by the Project.

List of equipment (except GLC and its accessories being

ordered by UNIDO, Vienna), apparatus and chemicals is enclosed at Annexure IV. These are to be processed for placing order by UNIDO.

9. **Machinery,Vehicles and List of Spares for efficient working of the Distillery**

The Distillery is well equipped with the following equipment and machinery.

1. Distillation Units (10 of 3000 litres capacity each capable of a charge of 700 kgs. of clove stems each) complete with condensors, separator, storage tanks and vacuum distillation unit for removal of moisture.
2. Boiler with dryer (for exhausted clove stems to be used as fuel) conveyers.
3. Water Treatment Plant
4. Maintenance Workshop
5. Generators: i. 165 KVA (Rolls Royce)
   ii. 90 KVA (DAF)
   iii. 33 KVA (Ford)

   At the present, only 165 KVA generator is in working order. 33 KVA generator will be repaired locally.
6. Vehicles: i. Tata truck, 7 tonnes - (Purchased about a year back)
   ii. Renault Lorries - small - 5 year old (Two)
   iii. Peugeot Pick-up Van - 7 year old in very bad condition.
   iv. Forklift

   Tata Truck, needing a minor repair will soon become road worthy. Other vehicles, except Forklift are in bad shape. As the position stands the Distillery is without any transport and urgent steps need to be taken to overcome this deficiency.

With the enhanced activity of the distillery in the procurement and transport of material for distillation, regular and effective supervision and related works in cultivation, following vehicles are considered absolutely minimum essential requirement.

1. Truck - 7 tonnes (Either Tata or Isuzu) - ONE
2. Suzuki Jeep - ONE
3. Motor Bike - TWO

Motor bikes will be useful in economising expenses on visits to cultivation areas as also will be mobile where jeep cannot go for want of motorable roads.

Evan though there is no provision for a jeep and motorbikes in the Project their purchase is strongly recommended. Annexure II.A.

Requirement of spares for the existing equipment and vehicles has been evaluated and is given at Annexure II.B.

10. **Work done on local Aromatic Plants & improvement in methodology for Stem Oil**

A preliminary survey of some places indicated presence of essential oil bearing plants. Some of these were collected and distilled in the Laboratory to get an idea about the oil content and quality. Data is as under:

1. Ocimum canum. The varietal identification needs to be done. The leaves and inflorescens (the plant is in the stage of seed setting) on distillation indicated:
   Oil content on fresh herb 0.8 to 1.2 percunt V/W
   Oil content on moisture free basis 3.2 to 4.0 percunt V/W

2. Ocimum sauve. The plant seems to be O.sauve but botanical identity should be confirmed. Eugenol seems to be the main constituent of the oil. oil content data is:
   Oil content 0.87% on fresh herb
   2.17% on moisture free basis

3. Cinnamomum species. Identification of the plant species needs to be done. Distillation gave an oil heavier than water and seems to contain eugenol. Oil content was as under:
   Oil content 0.4% on fresh herb
   0.8% on moisture free basis

4. Vetiver. Vetiver thrives well in Pemba. Under natural conditions of growth, yield of roots is less which would improve under proper cultivation. Oil content was:

Oil content	0.8% on fresh weight
	3.2% on moisture free basis

Quality of oil from oil from odour point of view seems good. Further work on larger charge could not be undertaken as boiler did not operate for want of water.

5. Work on the distillation of clove stems (on large scale) was started by isolating a still exclusively for this work. Distillation was done under following conditions:

	Still Temperature	Pressure
i.	100°C	1.0 bar
ii.	105°C	1.22 bar
iii.	110°C	1.50 bar
iv.	115°C	1.80 bar

Oil fractions were collected after every 30 minutes and late on every one hour. Engenol content was determined for each fraction as also for the complete oil.

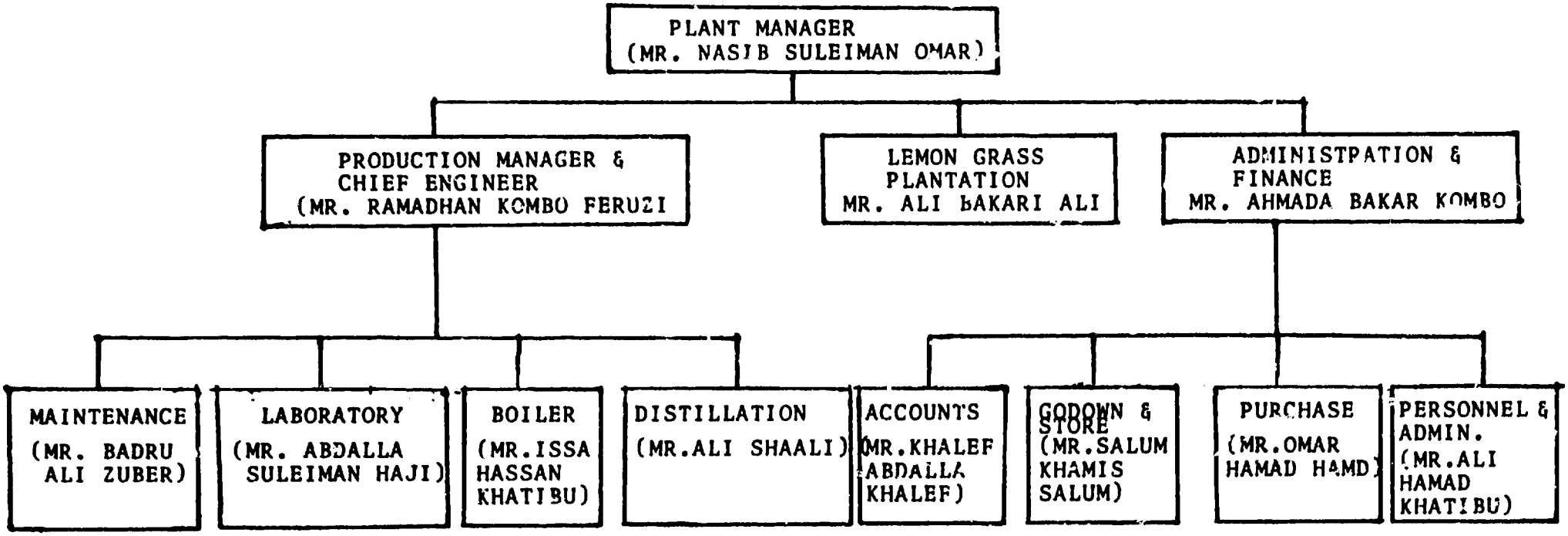
The work could not be continued as boiler was out of operation for want of water. This work is proposed to be carried out during next mission when the Laboratory is expected to be equipped enabling complete analysis of fractions including GLC profile of the fractions.

6. Analytical. Samples of clove stem oil from experimental work were routinely analysed.

A sample of lemongrass oil produced on large scale distillation was analysed for its citral content by sulphite method. It was found to be 77 percent indicating suitability of the cultivated material. A good number of samples of lemongrass oil will be analysed after receipt of chemicals to study quality from different harvests.

ANNEXURE - I

ORGANIZATIONAL STRUCTURE OF CLOVE STEM OIL DISTILLERY (PEMBA)



TOTAL STAFF STRENGTH (PERMANENT) 75

CASUAL WORKERS (FOR LEMONGRASS PLANTING,ETC.) 20

ANNEXURE II.A

LIST OF EQUIPMENT & VEHICLES TO BE PURCHASED

1. Truck (7 tonnes capacity) either Isuzu or Tata. Tata truk is expected to be cheaper and good.

2. Jeep Suzuki

3. Motor Bikes

4. Distillation unit - twin set, 3000 - 4000 litre capacity

5. Pilot distillation unit, capacity 50 litres (effective) to work with steam and/or electricity

6. Photocopy machine

7. Typewriter

SAPRES FOR THE PRPOSED NEW CAR (SUZUKI)

No.	Name	Quantity
1.	Brake master cylinder repair kit	4 pcs
2.	Brake wheel cylinders complete (rear and front)	1 set
3.	Clutch plates	4 pcs
4.	Brake liners	3 sets
5.	tyres and tubes	8 pcs
6.	Ball joints for steering system	2 sets
7.	Crank shaft bearings (S.T.D.)	1 set
8.	Oil filters	10 pcs
9.	Cylinder head gaskets	4 pcs
10.	Spark plugs	8 pcs
11.	Suspension dampers	2 sets
12.	Engine overhaul gasket	
13.	Cross joints for transmission	3 pcs
14.	Brake wheel cylinders (rear and front)	3 sets

SPARES FOR THE PROPOSED NEW TRUCK (TATA)

No.	Name	Quantity
1.	Brake master cylinder repair kit	4 pcs
2.	Brake wheel cylinders complete (rear and front)	1 set
3.	Clutch plate	4 pcs
4.	Brake liners	3 sets
5.	Tyres and Tubes	6 pcs
6.	Ball joints for Steering System	2 sets
7.	Crank hsaft leanings S.T.D.	1 set
8.	Oil filters	10 pcs
9.	Cylinder head gaskets	4 pcs
10.	Injectors	12 pcs
11.	Suspension dampers	8 pcs
12.	Engine overhaul gaskets	2 sets
13.	Gross joints for propeller shaft	3 pcs
14.	Brake wheel cylinders (rear and front) repair kit	3 sets

ANNEXURE II.B

LIST OF SPARE PARTS FOR EXISTING MACHINERY AND VEHICLES

No.	Name	Part No./Specification	Quantity
	BOILER		
1.	Paint	High temp	20 Lts.
2.	Steam purge valve	PN25/40.25C.7207980	4 pcs
3.	Water pump complete with pressure booster and pressure senser	EMA 4 3 phase 5 OHZ No. F 10503431 2 40 Volts 275 amps	1 pc
4.	Speed reduction unit for screw conveyer	Leroy semer NV 25 V 0 1 586667/1	1 pc
5.	Electrovalve	240 V	4 pcs
6.	Speed reduction unit for screw conveyer	Leroy semer No. 510454 Type PS 1220 R1/20	2 pcs
7.	Steam pressure gauge	(0 - 20 bar)	2 pcs
	DISTILLATION		
8.	Drain valves	VT 201.A.114	7 pcs
9.	Steam pressure gauge	(0 - 4 bars)	10 pcs
10.	Tree way valves with sets of joints	B.1411 Tournaire	10 pcs
11.	Mild steel sheet	3000 x 1500 x 5	20 pcs
12.	Clocks		10 pcs
13.	Balances	upto 500 kgs.	1 pc
14.	Silicon Rubber sealent		10 tubes
	PURIFICATION		
15.	Vacuum pump complete with controls	LONE 253090 BN 131 01 0 NO. 2678877	1 pc
16.	Sensing unit for vacuum pump	Max pressure 8 bars Tmax 100°C Type 3 VC OM 12 M	1 pc
	WORKSHOP		
17.	Car battery charger	(6V - 24V)	1 pc
18.	Gas welding and cutting unit including gauges and nozzles		1 set
19.	Wood saw machine belt drive	1 HP	1 pc
20.	Multimeter for industrial use	EVC	1 pc
21.	Megger		1 pc
22.	Portable arc welding machine	Single phase 240 V	1 pc

23.	Welding rods	Cast iron	10 kgs
24.	Welding rods	Mild Steel (4mm)	15 kgs
25.	Welding rods	Mild Steel (5mm)	15 kgs
26.	Welding rods	Mild Steel (3mm)	20 kgs
27.	Welding rods	(Arc)Stainless Steel	5 kgs
28.	Bolts and Nuts of various size	M10, M13, M17, M19,M24	30 kgs Each
29.	Welding rods	Aluminium	15 kgs
30.	Gasket sheet	For steam pipes	1 roll
31.	Drill bits	H.S.S. (3mm-24mm)	2 sets
32.	Araldite	Tubes (large)	5 pairs
33.	Taps, Dies and Holders	H.S.S.(M24 - M3) (In triplicate)	1 set
34.	Lathe machine	Bored to pass ~ 30mm Admission between points ~ 600mm, overbed ~ 200mm	1 pc
35.	Cutting discs (Super flex)	230 x 3 x 22.2 Max R.P.M. 6600 - 80 m/s	100 pcs
36.	Caster wheels	Ø 20 cm	16 pcs
	WATER TREATMENT		
37.	Centrifugal pump for cooling tower	NOWA 5016 155 BN 041 02 2(B.3431) NO 9 000 139	2 pcs
38.	Water Pump	AKHE 3603 BN 081 01 0(B-3432) NO. 2 802 127	2 pcs
	GENERATORS		
39.	Alkaline batteries for standby generatorys (feedom battery)	12V - 102AH	6 pcs
40.	Injection Pump for Rolls Royce Engine Engine No. C 132030 - 5 Designation C 6132G Build No. 68566	OX3127	1 pc
41.	Starter Motor for Rolls Royce Engine Engine No. C132030 - 5 Designation C6132G Build No. 68566	O D 16740	1 pc
42.	Alternator CAV AG5R for Rolls Royce Engine Engine No. C132030 - 5 Designation C6132G Build No. 68566	O D 19128	1 pc

43.	Water Pump for DAF Engine Engine Type D T 615A Engine No. E 50173 Spec.No. 443266		1 pc
	ELECTRICAL		
44.	Circuit Breakers MERLINGERIN	C 32 H - 10A 2 wires	4 pcs
45.	- do -	C 32 H - 15A 2 wires	4 pcs
46.	- do -	C 32 H - 20A 2 wires	4 pcs
47.	- do -	C 100 - 40A 4 wires	4 pcs
48.	- do -	C 32 N - 2A 2 wires	4 pcs
49.	- do -	C 32 H - 15A 3 wires	4 pcs
50.	- do -	C 32 H - 32A 4 wires	4 pcs
51.	- do -	C 160 N - 160A 4 wires	4 pcs
52.	- do -	C 250N - 250A 4 wires	4 pcs
53.	Contactors BBC	10B 105/30 - 22	1 pc
54.	Contactors UNELEC	RDV 48 Volts	2 pcs
55.	- do -	RAV 12 48 Volts 50HZ	3 pcs
56.	- do -	RAV 8 48 Volts 50HZ	1 pc
57.	Contactors BBC	10B 45/30+CP 85	2 pcs
58.	Bloc UNELEC	AC 11	2 pcs
59.	Block UNELEC	AC 22	3 pcs
60.	Blocs TELEMECANIQUE FRANCE	LA 1/D22	2 pcs
61.	- do -	LA 1/D11	5 pcs
62.	- do -	LA 2/D20	2 pcs
63.	- do -	LA 1/F311	2 pcs
64.	- do -	LA 2/D22	2 pcs
65.	- do -	LA 1/D40	1 pc
66.	Overhead Relay TELEMECANIQUE FRANCE	LR1/D09314	3 pcs
67.	- do -	LR1/D09312	1 pc
68.	- do -	LR1/D12316	1 pc
69.	- do -	LR1/D09310	3 pcs
70.	- do -	LR1/D09307	2 pcs
71.	- do -	LR1/D25322	1 pc
	TRANSPORT		
72.	Brake Front Wheel Cylinders (complete) for Renault truck FRANCE	0870 507 500	6 pcs
73.	Repair kit for item 72		6 pcs

74.	Brake Rear Weel Cylinders (complete) for Renault truck FRANCE	0870 507 400	6 pcs
75.	Repair kit for item 74		6 pcs
76.	Brake Master cylinder (complete) for Renault truck FRANCE	0855 755 700	3 pcs
77.	Repair kit for item 76		3 pcs
	BOILER		
78.	Valve DN32	B. 2444	3 pcs
79.	Floats 4½"	B. 2426	2 pcs
80.	Roller Step bearing	B. 2457	2 pcs
81.	Bearing SN 212	B.2450	3 pcs
	HOIST		
82.	Rope guide	SNO. of electric hoist-19109 038, capacity - 2000 kgs No. of hoist motor - 31 d/3 Brake type - FAH.	6 pcs
83.	Rope	- do -	6 pcs
84.	Limit switch rod	- do -	6 pcs
85.	Limit switch	- do -	6 pcs
	FURNACE		
86.	Bricks		500 pcs
87.	Cement and Glue		Sufficient for lining 500 bricks

****

PLEASE CONTACT THE FOLLOWING FOR SPARES

1. Tournaire S.A. 50 Route de la Pacute-B.P.4-LE PLANDE GRASSE 06638 GRASSE CEDEX/FRANCE Tel:93 70 49 91 Telex: TURNR 470804F	Boiler, distillation unit, purification unit and water treatment plan parts (SNO 1 -38,78-81)
2. CENTRAL DIESEL Unit 33, Salisbury Square Salisbury Street, Radford NOTTINGHAM NG7 2AB Tel: 0602 785981 Telex: 37557 Fax:0602 420856	Generator parts (SNO. 39-42)
3. DAF DIESEL Geldropsewey 303 5645 TK EINDHOVEM - Holland Tel: 040- 149111 Telex:51085 Cables: DAF TRUCKS	Generator parts (SNO. 43)
4. BIRMINGHAM TRUCKS LTD. 292 Wharfdales Road TYSELEM BIRMINGHAM B11 2EA Tel: 021 707 9700	Transport (Renault truck (SNO. 72 - 77)
5. TECOTEX 243, Boulevad Pereire 75017 PARIS Telex:642 567F Tel: 574 03 06/574 00 27	Electrical parts (SNO. 44 - 71)
6. ALSTHOM -UNELEC Route de Neuvy 18100 Vierzon-France Tel: (36) 75 35 45 Telex: 76 04 91	Hoist parts (SNO. 82 - 85)
7. M. DEUPEUX 5-7, Villa Nieuport - 75013 PARIS B.P. 337 75624 Paris CEDEX 13 Tel: 583 51 89 Telex: 270105 F - Ref. 142	Furnace parts (SNO. 86 - 87)

ANNEXURE III

DEPLOYMENT OF CONSULTANTS/EXPERTS FOR THE PROJECT

	1989						1990									
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.
1. Essential Oil Distillation Expert (CTA)	(1.5 months)			(5 months)							(5.5 months)					
2. Agronomist				(0.5 month)							(2.5 months)					
3. Quality Control Chemist	(0.5 month)										(2 months)					
4. Marketing Expert				(2 months)												
5. Engineer											(1 month)					

Note: Mission of Quality Control Chemist (besides his first mission in July 1989) Engineer and Agronomist will take place after inputs are received at site.

LABORATORY EQUIPMENT & APPARATUS

	Item	Qty.
1.	Boiling water Bath - Stainless Steel 6 holes, concentric rings Electrically heated	Two
2.	Water Bath Aluminium with concentric rings Adjustable constant level device & automatic Cut out Electricall heated Dimensions - 145x 260 mm	one
	200x240 mm	one
3.	Laboratory Oven with 2 removable shelves Range 40°c - 200°c Approximate Dimensions: (mm) Height Width Depth Internal 240 360 330 External 420 440 430	
4.	Abbe's Refractometer for Essential Oils (Liquids) with spare - i) Thermometers - 2 ii) Illuminator - 1	one
5.	Polarimeter (for optically active liquids) with spare Sodium lamp - one Tubes 10cm. length - two 5cm " - two 2.5cm " - two	
6.	Heating Mantles: Capacity:- i) 500 ml R.B. flask 2 ii) 1000 " " " 2 iii) 2000 " " " 2 Complete with regulators 220 - 250 volts	

7.	Analytical Balance Digital Range 200 gm Accuracy 0.1 mg	one
8.	Balance - Digital Range 5 Kg Accuracy 1 gm	one
9.	Refrigerator - with Freezer compartment capacity - 360 litres	one
10.	Drying cabinet - Aluminium with 2 racks, sliding door Dimensions about (mm) Height 525 Width 760 Depth 335	one
11.	Hot Plates - round 6" diam	two
12.	Melting Point Apparatus Range 20° to 360°c Capillary Tubes (100 per box)	one two boxes
13.	Mortar & Pestle - Porcelain External diam about 230 mm	one

GLASS APPARATUS

1. Round Bottom Flasks (Pyrex)

Standard joint	34/35		
Capacity	500 ml	-	5
	1000 "	-	5
	2000 "	-	5
Adapter - reducer	34/28	-	5
	34/24	-	5

2. Flat Bottom Flasks - (Pyrex)

Capacity	500 ml	-	5
	1000 "	-	5
	2000 "	-	5

Standard joint 34/35

3. Volumetric Flask

Capacity	100 ml	-	2
	250 "	-	2
	500 "	-	5
	1000 "	-	5

4. Conical Flasks (Pyrex)

Capacity	100 ml	-	10
	250 "	-	50
	500 "	-	20
	1000 "	-	10

Conical Flasks 250 ml with ground glass joint		-	28/30
500 " " " " "		-	34/35
1000 " " " " "		-	34/35

5. Cassis Flask - 150 ml capacity - 20
calibration 10 ml x 0.1 ml

6. Funnels (Soda glass)

Size top diam	2"	20
	4"	20
	6"	20

Funnels Plain Polythene
(Acid, alkali, oil resitant)
Top Diam:

65 mm	5
90 "	5
115 "	5
140 "	5

7. Buchner Funnel Porcelain

Overall Diam:	105 mm	2
	125 mm	2

8.	Beakers: Pyrex		
	Capacity	100 ml	10
		250 "	10
		500 "	10
		1000 "	5
	Beakers Polypropylene		
	Capacity	500 ml	10
		1000 "	10
9.	Reagent Bottles Narrow mouth white glass (with polypropylene stopper)		
	Capacity	250 ml	20
		500 "	50
		1000 "	20
10.	Reagent Bottles wide mouth with glass stopper		
	Capacity	250 ml	50
		500 "	50
11.	Dropping Bottle with grooved glass grip		
	Capacity	100 ml	10
12.	Wash Bottle 150cc capacity Polythene squeeze bottle		10
13.	Weighing Bottle 50x 25mm		5
14.	Winchester Bottles		10
	carrier for above (No. 14)		2
15.	Brushes for cleaning		
	Test tubes		20
	Pipe cleaner		20
16.	Burettes Glass		
	50 ml	x 0.1 ml	5
	100 "	x 0.1 "	5
	Burette stands with clamp		5
17.	Crucible - Porcelain		
		2" diam	2
		3" "	2
		4" "	2

18. Measuring Cylinders - glass

10 ml	5
50 "	5
100 "	5
250 "	5
500 "	5
1000 "	5

19. Solubility cylinder

10 ml x 0.1 ml with glass stopper — 10

20. Desiccator with lid
Plate diam 200 mm, overall height about 250 mm — 2

21. Vacuum Desiccator — 1
Internal diam 200 mm
Effective depth 85 mm

22. Filter Papers:- Whatman No. 1

Diam	42.5 mm	10 boxes
	55 mm	10 "
	570x460 mm	5 "

23. Filter Pumps to be used with water tap with non - return valve — 2
nozzel for 6 - 9 mm tube

24. Self Adhesive labels
Pack pf 500 labels

Size 50x20 mm	2 Packs
75 x 25 mm	2 "

25. Self Adhesive Clear Tape

Width 12mm	2 rolls
25"	2 rolls

26. Reduction Adapters

Socket	Cone	
14/23	19/26	two
14/23	24/29	two
14/23	29/32	two
19/26	24/29	five
19/26	34/35	five

27.	Leibeg Condenser 350 mm long, socket 19/26 Cone 19/26	five
28.	Air condenser 1m long, cone 14/23	10
29.	R.B. Flask 100 ml. Capacity Cone 14/23	5
30.	Pipettes	
	1 ml	2
	2 ml	2
	5 ml	5
	10 ml	5
	25 ml	5
	50 ml	2
	100 ml	2
31.	Pipette stand to hold 10 pipettes	2
32.	Spatula - one end flat & other end formed into scoop - 140 mm long	2
33.	Clamps with boss head	20
34.	Iron stand with heavy stable base	
	Length 30 cm	5
	100 "	5
35.	Retort Rings	
	Diam 55 mm	5
	75 mm	5
	100 "	5
36.	Stoppers cork - asserted Top diam 8 - 38 mm	2 Gross
37.	Stopper Rubber Asserted Sizes 8, 9, 10, 11, 13.	200
38.	Cork Borer Range 5 - 19 set of 12	one set
39.	Litmus paper - in Reel of 5m x 6 mm	
	Red litmus	2 reels
	Blue "	2 reels
	Universal 150 paper book 1.0 - 11.0 P H	one box

40. Test Tubes:- Neutral Borosilicate glass with rim

Length	Diam	
125	16 mm	100
150 "	16 mm	100
250 mm	24 mm	50
200 mm	24 "	50

41. Test tube holder 2

42. Test Tube stand 2

43. Thermometers Mercury

1°c caliberation

10°c to 110°c	2
0°c to 250°c	4
0°c to 360°c	2

44. Tongs Iron:-

Length 200 mm Straight	2
Length 200mm with Bow	2
Tongs for Flasks	2

45. Tripod stands Triangular

Legs bent out wards

130 mm one side length	10
200 " high	

46. Triangles - Pipe clay 10

47. Glass tubing - Borosilicate glass

Outer Diam	Bore	
6mm	4 mm	5x1.5 m
8 "	6 "	5x1.5 m
10 "	8 "	5x1.5 "

48. Rubber Tubing

Bore	Wall	
5 mm	1.5 mm	20 m
6.5 "	1.5 "	20 "
8 "	2 "	20 "

49. Tubing connector Polypropylene

Staright

outer Diam	7mm	10

50. Petri Dishes Glass

Diam	Depth	
80 mm	15 mm	20
100 "	15 "	10
150 "	20 "	10

51. Glass Rod
Diam 4mm 1x10m
6mm 1x5 m

52. Separating Funnels
Conicals:- with stoppers
Spherical

Capacity		
	100ml	5 each
	250ml	5 each
	500ml	5 each
	1000ml	5 each
	2000ml	5 each

53. Condensers -Leibeg

400mm long	Socket	19/26	5
	cone	19/26	
400mm long	Socket	24/29	5
	cone	24/29	

54. Specific Gravity Bottle capacity 10 ml 5

Sykmometer capacity 1 - 2 5

55. Soxhlet Extraction Apparatus

Extractor capacity	Flask capacity	Flask socket	Condenser cone	
200 ml	500 ml	29/32	50/42	2
500 "	1000 "	34/35	50/42	2

56. Triangular File with handle for cutting glass tubes/rods
150mm 2

57. Adapters

Socket	Cone		
19/26	34/35	(Reduction adapter)	2
24/29	34/35	(Reduction adapter)	2
19/26	28/30	" "	2
19/26 (with bent tube)	-		2
19/26 (Bends with vent)	34/35		2
19/26 (Receiver adapter Plain bend, short)	34/35		2

58. Bottles -W/C Cartney
Capacity 7 ml 2 Cross
Thread R3 20

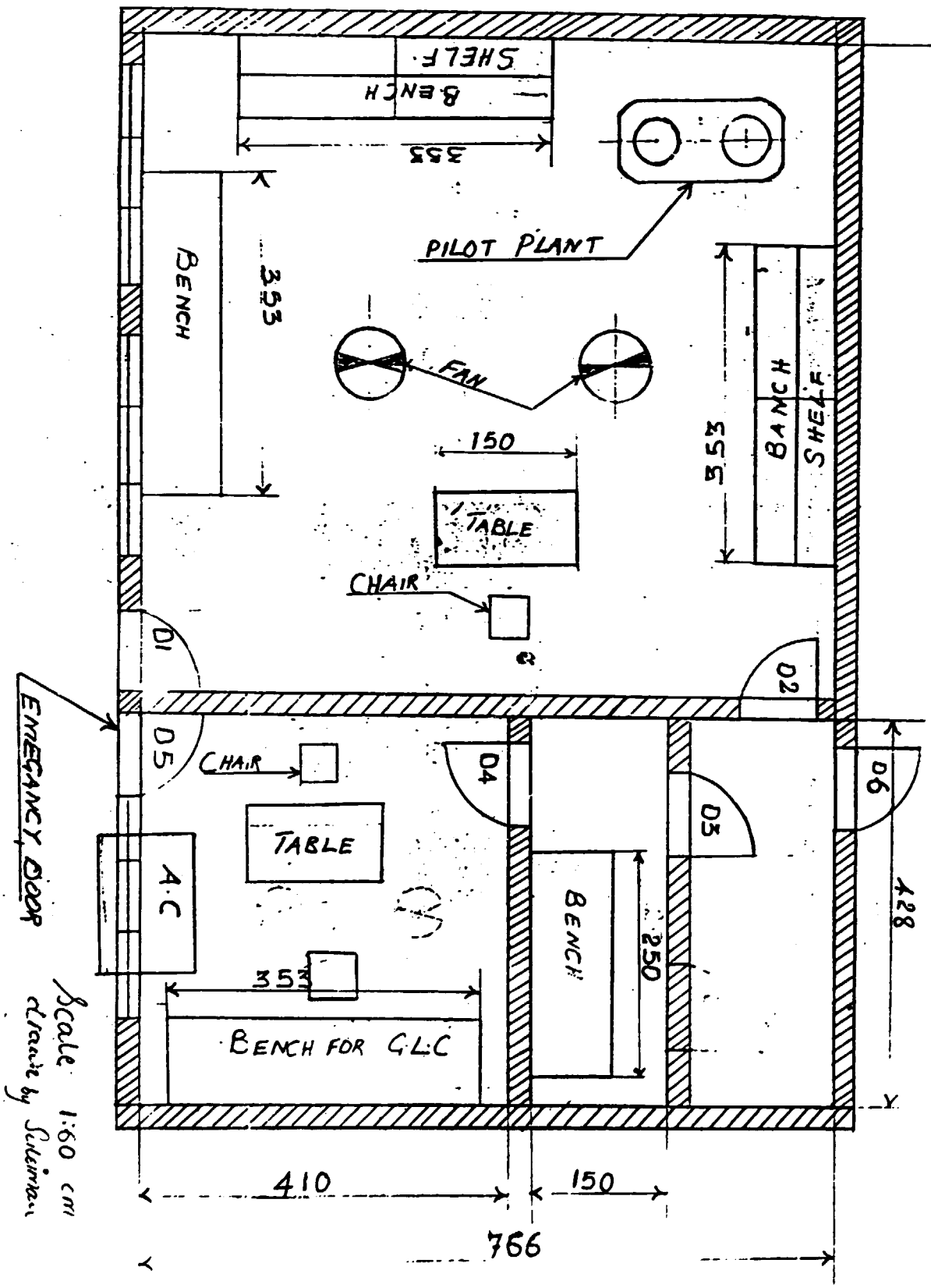
CHEMICALS

	Chemical	Quantity
1.	Acetic Acid Glacial	2.5 litres
2.	Acetic Anhydride (Min 95%)	10x500 gm
3.	Acetyl chloride	5x100 ml
4.	Benzene	20x1 litre
5.	Bromophenol Blue	2x5 gm
6.	Calcium chloride suitable as drying agent	4x500 gm
7.	Chloroform	5x500 ml
8.	Cotton wool	10x500 gm
9.	Normal hexane	10x500 ml
10.	Diethyl ether	20x500 ml
11.	Ethylene glycol	2x500 ml
12.	Ethylene di-chloride	5x500 ml
13.	Hydrochloric acid 36 %	2x2.5 litres
14.	Hydrochloric acid 0.5 N.	2x2.5 litres
15.	Hydroxylammonium chloride	10x100 gm
16.	Methanol	2x2.5 litres
17.	Methyl orange	1x5 gm
18.	Methyl red	1x5 gm
19.	Phenolphthalein	4x5 gm
20.	Phthalic anyhdride	1x250 gm
21.	Potassium hydroxide Pellets	20x1 Kg
22.	Acetone	2x2.5 litres
23.	Sodium Acetate	4x500 gm
24.	Sodium Hydroxide Pellets	2x1000 gm
25.	Sodium Bisulphite	10x500 gm
26.	Sodium Sulphite	5x500 gm
27.	Sulphuric Acid Conc.	2x2.5 litres
28.	Toluene	1x2.5 litres
29.	Sodium Sulphate Anhyd.	5x1 Kg
30.	Ortho Cresole	5x100 gm
31.	1: 8 Cineole	1x500 gm
32.	Phenol Red	1x5 gm
33.	Sodium Carbonate	5x1 Kg
34.	Xylene	2x1 litre

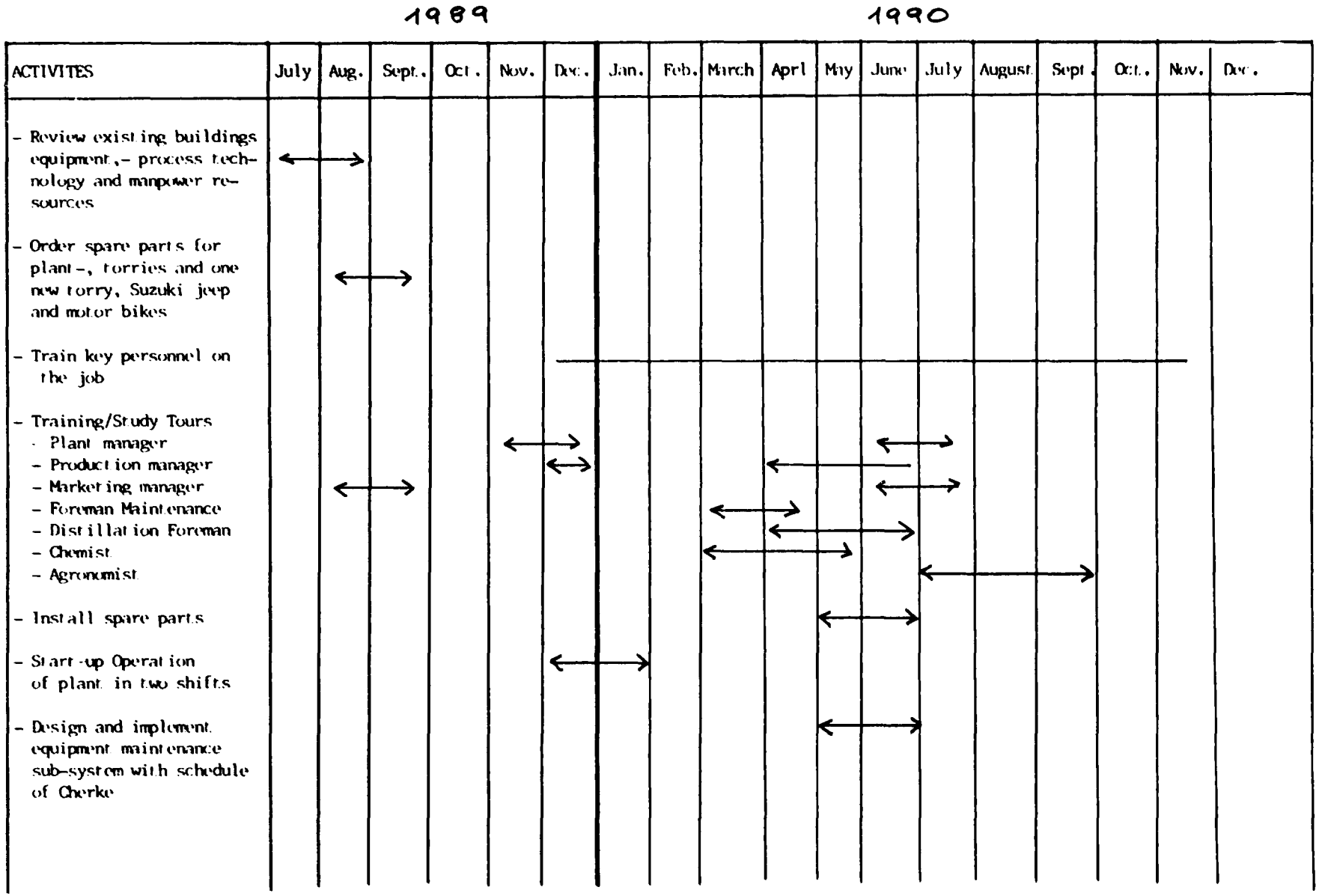
LIST OF ITEMS REQUIRED FOR THE LABORATORY

NO.	ITEM	QTY	SPECIFICATION	TOTAL (T.Shilling)
1.	LARGE WOODEN BENCHES	3	115m (12" x 1")	67,000.00
2.	LARGE WOODEN OUTBOARDS	8	100m (12" x 1")	50,000.00
3.	WOODEN SHELVES	8	100m (12" x 1")	50,000.00
4.	CEILING FAN	2	60w	20,000.00
5.	REFRIGERATOR	1	165w	180,000.00
6.	AIR CONDITIONER	1	½ H.P	150,000.00
7.	PLY-WOOD	15	¼" (4 x 8 ft)	22,500.00
8.	CYPRESSWOOD	300m	(4" x 2"C	40,500.00
9.	MAIN DOOR	2	6" x 2½"	4,000.00
10.	LOCK	2		4,000.00
11.	PLY WOOD	20	¼" (4 x 8ft)	30,000.00
12.	HINGE	6	4"	420.00
13.	TABLE	1	20m (12" x 1")	
14.	CHAIR	2	10m (12" x 1")	16,000.00
15.	STOOLS	2	10m (12" x 1")	
16.	NAILS	5kg	3"	1,100.00
17.	NAILS	5kg	2½"	1,100.00
18.	NAILS	3kg	1"	660.00
19.	DRAW LOCK	8		2,400.00
20.	SCREW	2pcts	1"	600.00
21.	HINGE	2dozen	3"	1,680.00
			TOTAL	641,460.00

Annexure V A.



Scale 1:60 cm
drawn by Sulaiman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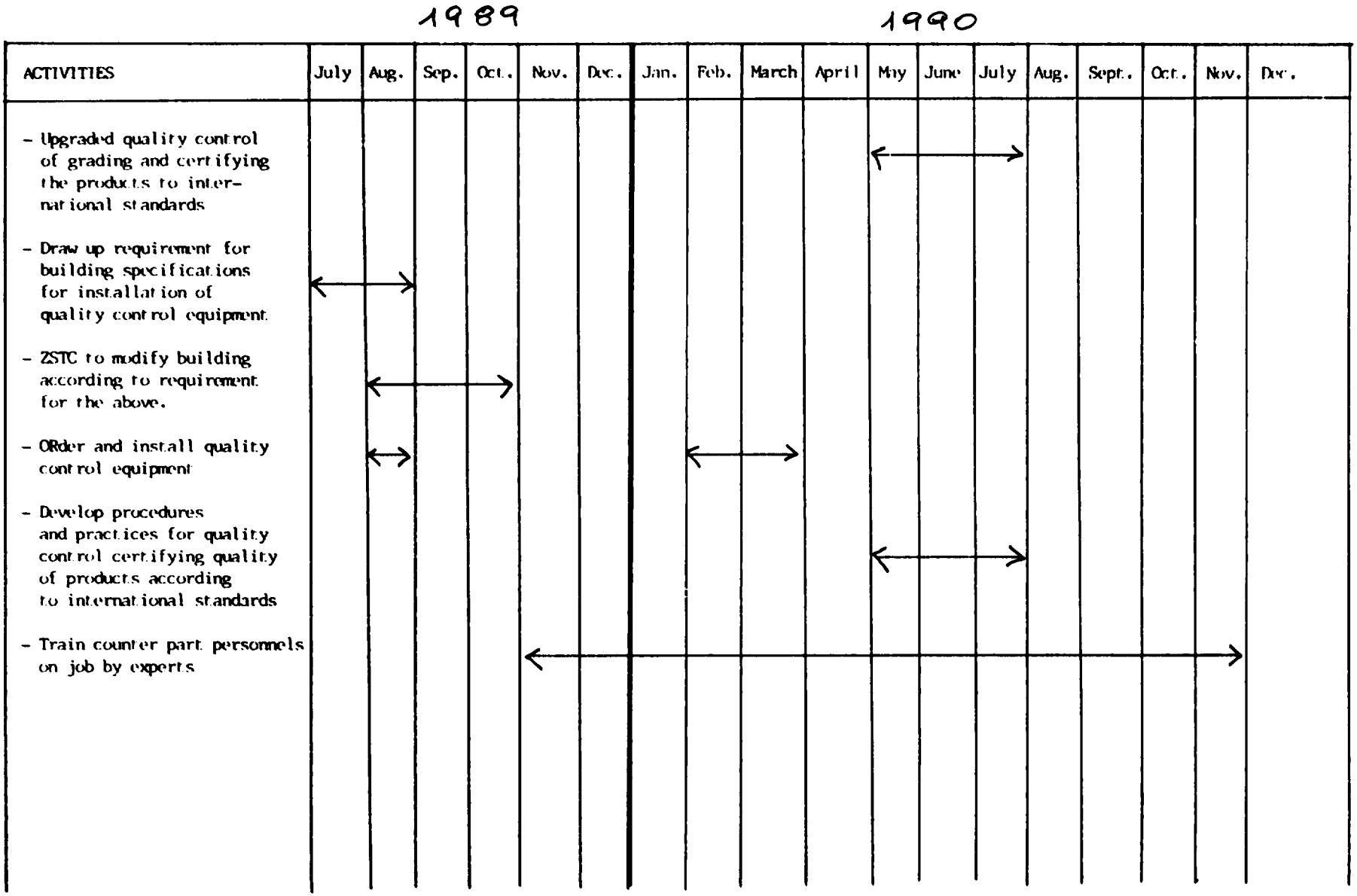
- Review existing buildings equipment,- process technology and manpower resources
- Order spare parts for plant-, torries and one new torry, Suzuki jeep and motor bikes
- Train key personnel on the job
- Training/Study Tours
- Plant manager
- Production manager
- Marketing manager
- Foreman Maintenance
- Distillation Foreman
- Chemist
- Agronomist
- Install spare parts
- Start-up Operation of plant in two shifts
- Design and implement equipment maintenance sub-system with schedule of Cherko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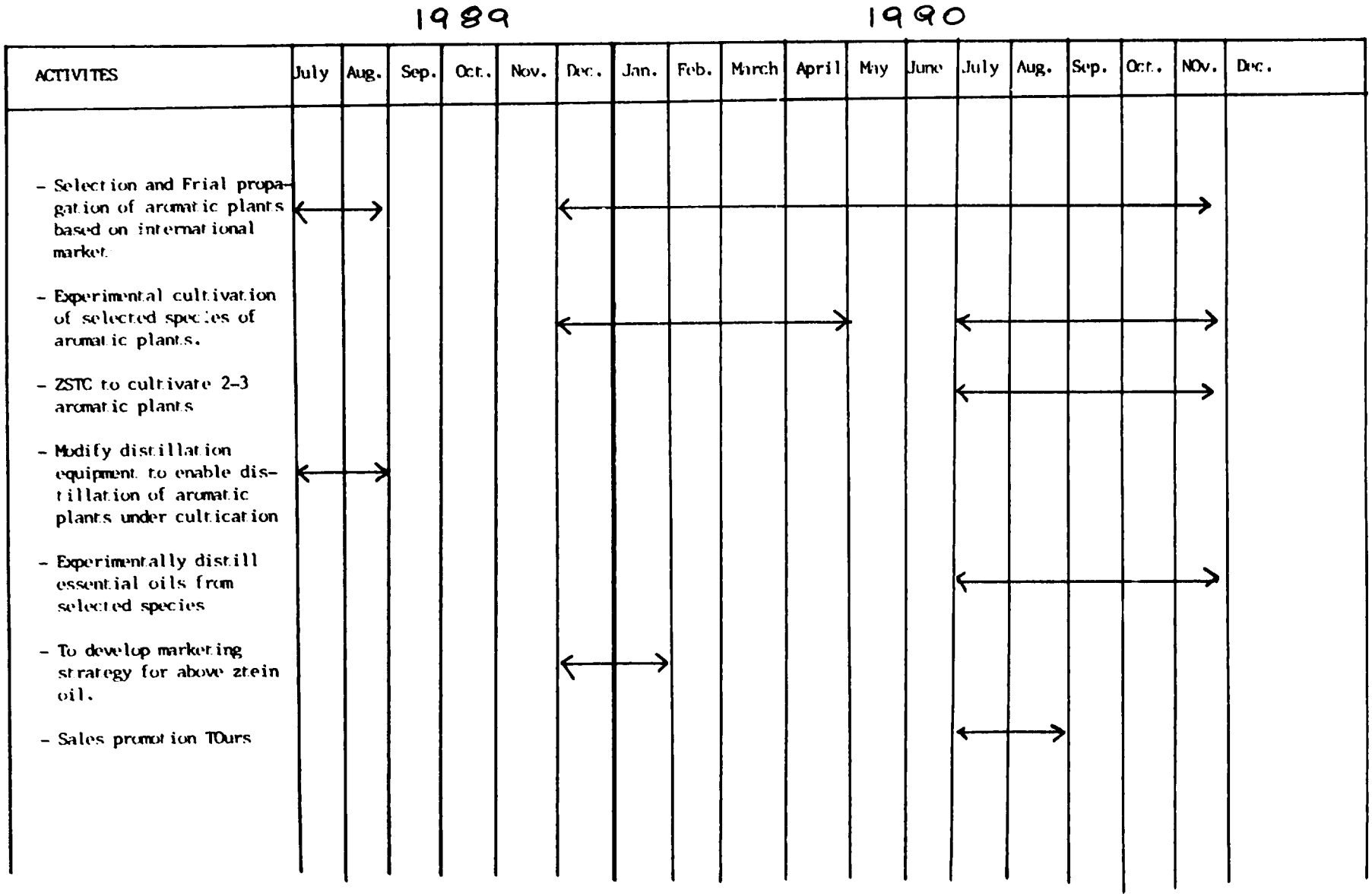
- Upgraded quality control of grading and certifying the products to international standards
- Draw up requirement for building specifications for installation of quality control equipment
- ZSTC to modify building according to requirement for the above.
- ORder and install quality control equipment
- Develop procedures and practices for quality control certifying quality of products according to international standards
- Train counter part personnels on job by experts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- Selection and Frial propagation of aromatic plants based on international market
- Experimental cultivation of selected species of aromatic plants.
- ZSTC to cultivate 2-3 aromatic plants
- Modify distillation equipment to enable distillation of aromatic plants under cultication
- Experimentally distill essential oils from selected species
- To develop marketing strategy for above ztein oil.
- Sales promotion TOurs