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ASSISTANCE TO THE ESSENTIAL OIL INDUSTRY - ZANZIBAR

DP/URT/86/026/11-01

TANZANIA

Terminal report*

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

Based on the work of B. Gulati, Chief Technical Adviser

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United Nations Industrial Development Organization
Vienna

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* This document has not been edited.

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ABBREVIATIONS

T.Sh. or Sh.	Tanzanian Shillings
US $	United States Dollar
GOZ	Government of Zanzibar
ZSTC	Zanzibar State Trading Corporation
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
Distillery	The Clove Stem Oil Distillery, Chake Chake, Pemba
Forex	Foreign Exchange
T.P.R.	Tripartite Review Meeting of the Project

Conversion Rate: One US Dollar = T.Sh. 230 (November, 1991)

ABSTRACT

The Project URT/86/026, Assistance to the Essential Oils Industry - Zanzibar "Maximising the Capacity Utilisation of the Clove Stem Oil Distillery, Chake Chake" started from 25 June, 1989. The Project had three immediate objectives i.e. a) Upgrading performance of the Distillery, b) Selection and trial propagation of a few essential oil-bearing plants and c) Developing marketing strategy for increased trade in stem oil. Since its start, the Project has achieved significant improvement. Exports touched US$ 420,150 during 1990-91 (Project period) as against pre-Project export worth US$ 112,530 during 1988-89. There has been improvement in processing of clove stems producing 46.27 tons of its oil during 1990-91 as against 22.00 tons of its oil during 1988-89. Simultaneously, clove bud oil production picked up i.e. 13.73 tons (value US$ 137,300) was produced during 1990-91 as against 0.96 tons (value US$ 9,600) during 1988-89.

Work done on the local aromatic plants has indicated promising results on lemongrass, which is now grown over an area of 90 acres. Vetiver, Ocimum basilicum, Cinnamon and Ylang Ylang have now been selected for future programme of development and processing.

In respect of marketing and export, there is noteworthy improvement. Total exports during 1990-91 were valued at US$ 420,150 as against export worth US$ 112,530 during 1988-1989. While sales during 1984-89 (5 years) was only for US$ 334,402, the same for 1989-91 (2 years) was for US$ 640,786.

Among the International Experts, only Chemical Technologist (C.T.A.) and Marketing Expert have completed their mission. The Quality Control Chemist and Agronomist have completed only preliminary mission. They will complete their mission as soon as their counterparts are appointed. The Engineer has completed a part of his mission in the preparation of a Techno-Economic Feasibility Study for setting up a Processing Facility in Unguja.

He is expected to complete his mission during March, 1992 for work connected with the Distillery in Chake Chake. An Expert Perfumer is likely to be selected and fielded in March-April, 1992.

In the Training programme of National Personnels, the Plant Manager, Production Manager, Distillation Supervisor and Maintenance Foreman have completed their training programme. Chemist, Agronomist and the Marketing/Export Manager have not yet been nominated by the Government of Zanzibar.

In order to consolidate further the gains achieved during the Project, the T.P.R. of the Project has recommended extension of the Project with an allocation of US$ 159,000 and to prepare a Techno-Economic Feasibility Study for establishing a Processing Facility in Unguja. This Report has been prepared and submitted to the U.N.I.D.O.

During the extension period of the Project work on value-added products from clove stem oil is proposed to be undertaken which is likely to improve further the product mix and export earnings for the country.

I. INTRODUCTION

The current mission of the Chemical Technologist, Essential Oils, Distillation Plant Expert (C.T.A.) is the 4th splitmission and also the final and terminal mission out of 12 man/months allotted for the Project URT/86/026 "Maximising the Capacity Utilisation of the Clove Stem Oil Distillery, Chake Chake - Pemba". The current mission started from 26 August 1991 through 22 November, 1991. Job description is attached at Annex I. Main object of the current mission is to (a) Optimise the capacity utilisation of the Distillery using the spare parts ordered by formulation and implementing a comprehensive plan of work, (b) to co-ordinate activities of other expert colleagues and (c) train the local personnels through all the relevant means. The current report embodies the factors and activities, leading the the fulfillment of the Objectives as also the important recommendations of the Experts fielded so far for the Project work.

To recapitulate, the Project activities started from 25 June, 1989 with the fielding of the Chemical Technologist (C.T.A.). Quality Control Chemist and the Agronomist joined later on towards the end of C.T.A.'s first mission. All the preliminary work pertaining to the evaluation of existing facilities and inputs required in respect of spare parts for equipment and vehicles, Laboratory design and modification as also inputs for establishing a quality control Laboratory were completed (Ref: Report Baldev Gulati, M.L. Maheshwari and K. Duerbeck of 10 Aug. 1989, 16 Aug. 1989 and 16 Sept. 1989 respectively). The inputs identified were procured through normal channels and UNIDO procedures and put to use as and when received and required.

Fielding of all the experts so far is given at Annex II.

The Project duration was originally stipulated for 2 years with an approved budget of US $ 398,200 (as per Project Document). Due to unavoidable circumstances, the duration was increased beyond 2 years and with a current budget of US $ 495,308 as per details given in Annex V.

The Immediate Objectives of the Project were designed to fit into the overall objective of the Government of Zanzibar in rehabilitating the existing industrial plants and increasing their capacity utilisation. The Immediate Objectives i.e.

i) Upgrading the performance of the Distillery
ii) Selection and trial propagation of essential oil - bearing species based on International Market and
iii) Development of marketing strategy for the increased trade of clove stem oil have not been changed.

Progress achieved on the fulfillment of Objectives, outputs and activities is summarised at Annex III. Even through capacity utilisation of the Distillery has improved significantly, there are occasional set - backs to its smooth working due to electricity and water stoppage and for want of some important inputs such as lorry. The Zanzibar State Trading Corporation (Z.S.T.C.) is doing its best to overcome these lacunas on its own. Contribution of Z.S.T.C. for the Project work is summarised at Annex IV.

Due to certain unforeseen circumstances, the Project Experts (other than the Marketing Expert) could not complete their assignments. Training of national personnels abroad is also not complete due to reasons already mentioned (Report Baldev Gulati, 8 July, 1991, Pages 7 - 8).

The Project has now been extended for a further period of 2 years as per recommendations of the Tripartite Review Committee meeting held in Zanzibar on 20 June 1991 with technical assistance component of 8 m/months and with an overall budget of US $ 159,000 comprising of the following:

Components	Allocation
- Int. Experts 8 m/m (C.T.A. 6 m/m Short Term Consultants 2 m/m).	US $ 80,000
- Training	20,000
- Equipment	30,000

- Adm. Support	16,000
- Travel	3,000
- Sundries	10,000
Total:	159,000

The U N D P Project has contributed significantly to the overall improvement in rehabilitating the Pemba Distillery by increased production of all the essential oils i.e. clove stem, bud and lemongrass. Export of the oils is also on the increase as there is now ready demand of these oils primarily due to their quality and competitive price. Details of production and sales are given in this report.

During the current mission, a Techno-Economic Feasibility Report for setting up a Pilot Processing Facility in Unguja was also prepared together with the Project Engineer as per recommendation of the T.P.R. This Feasibility Report has been submitted separately.

II. MAXIMISING CAPACITY UTILISATION AND PRODUCTION OF ESSENTIAL OILS:

The Clove Stem Oil Distillery having 10 stills of 3000 litres capacity each equivalent to 700 kg. stems per still can distil 7 tons of stem per shift per day. Based on this calculation, about 1400 tons of stems can be distilled giving on an average 65 tons of oil with export value of US Dollars 325,000 per year. Distillation capacity can be increased in case the Distillery is operated 3 shifts per day and if the required quantity of clove stems could be available every year on sustained basis. (Availability of 1000 tons stems per year correspond to production of 4 - 5000 tons of clove buds which may not be the case every year as per past production data of clove buds). Based on these assumptions it is for consideration if Distillery capacity can be utilised to process about 2000 tons of stems alone every year.

The above also presumes that all the 10 stills would be operational and that the clove growing farmers will collect all the stems; the farmers do not give much attention to gather all the stems at the present due to its price of shilling 4/kg; (now increased to Shillings 6/kg for grade I quality from September 1991) as compared to prices of clove buds.

In case, clove buds are to be distilled as well, either using full capacity or part of the capacity will need changing the entire working schedule and pattern. Clove buds need much longer period upto 48 hours as against 5 - 6 hours needed for clove stems. Clove buds should also be distilled preferably without interruption.

It may also be mentioned that working 2 shifts per day has not been found practicable due to the reason of organising workers coming to the Distillery and dropping them back at odd hours due to non-availability of both public and Distillery transport. Also, electric supply is shut off between 6 pm to 10 pm. In that case only viable and workable alternative is to work the Distillery continuously for a number of days. Under these circumstances Distillery has to provide food to the entire work force. This arrangement has been observed to be workable and is followed now.

While the Distillery has capacity to process 1400 tons of stems per year, if operated on one shift basis (possible only for clove stems and now lemongrass: one charge of stems and 1 or 2 charges of lemongrass can be distilled in one shift), the Distillery has never processed more than 900 tons of stems, that too in the first year of working (1983 - 1984) when the Distillery was new with very few incidence of equipment breakdown and was operated under the supervision of French technicians.

Clove stems, buds and lemongrass, (latter two during the UNDP Project) processed since inception to date are given for reference.

(Data given in earlier Report by the C.T.A. was based on year: January to December. However, as the Government of Zanzibar financial year is from July - June, data is now given according to this. For the preparation of this data all the production records maintained by the Distillery and the C.T.A. were cross - checked - as some minor discrepancies were noted in the data presented earlier).

For the purpose of comparison, annual processing and production data from inception to date is given covering period January to December as also July to June.

PROCESSING OF CLOVE STEMS, BUDS AND LEMONGRASS
FROM 1983 - 1991 (AUG.)

Year	Raw Material Processed & Oil Produced					
	Stems	Oil	Buds	Oil	L.Grass	Oil
1983	475.34	23.61	NP	NP	NP	NP
1984	424.96	22.63	"	"	"	"
1985	349.00	16.82	"	"	"	"
1986	262.50	13.62	"	"	"	"
1987	558.72	25.16	"	"	"	"
1988	422.80	20.31		"	"	"
1989	659.40	26.80	14.30	1.99	8.61	27.56
1990	1159.90	49.44	53.80	7.51	121.87	287.64
1991 (Jan-Sept)	529.52	22.90	142.06	19.55	177.94	473.02

N.B. - Quantities in tons except for lemongrass oil given in litres.
- NP denotes: Not processed/produced
- No production of Clove stem oil after July 1991 due to no - raw material.
- Year: January to December.

Processing of Clove Stems, Buds and lemongrass: 1983 - to-date

Year	Raw Material Processed & Oil Produced					
	Stems	Oil	Buds	Oil	Grass	Oil
1983-84	900.30	46.25	NP	NP	NP	NP
1984-85	281.10	14.14	"	"	"	"
1985-86	168.70	7.74	"	"	"	"
1986-87	420.52	20.71	"	"	"	"
1987-88	424.50	18.95	"	"	"	"
1988-89	492.80	22.38	7.19	0.96		
1989-90	1039.50	42.65	43.92	6.14	41.91	119.36
1990-91	1069.95	46.27	99.16	13.73	169.18	424.54
1991-92 (July-Sept)	44.77	2.22	59.90	8.23	97.33	244.22

N.B. - Quantities in tons except for lemongrass Oil which is in litres.
- NP denotes: Not processed/produced
- No production of clove stem oil after July 1991 due to no - raw material.
- Year: July - June as followed by the Govt. of Zanzibar.

It will be observed that since the start of the Project, the annual processing and production of essential has more than doubled. Following figures also clearly bring out this fact.

Number of Charges Loaded & Days Distillery operated:

Year	Days worked	Charges Loaded For			
		Clove Stems	Clove Buds	L.Grass	Total
1983-84	145	1286	-	-	1286
1984-85	51	402	-	-	402
1985-86	30	245	-	-	245
1986-87	75	598	-	-	598
1987-88	83	595	-	-	595

Year	Days worked	Charges Loaded For			
		Clove Stems	Clove Buds	L.Grass	Total
1988-89	94	704	8	-	712
1989-90	106	1430	48	54	1532
1990-91	121	1487	127	241	1855
1991-92	30	70	69	113	252

Summary:

Pre Project Period (1983 - 89)	478	3830	8	-	3838
Project Period 1989 - 1992 (only 3 months during 1991-92)	271	2987	297	435	3719

During the Project period, the entire accumulated and purchased stock of clove stems was processed, rather there was no stock of clove stems after July 1991. Thereafter, the Distillery processed only clove buds (purchased during the current clove season of 1991) and lemongrass, the later to the extent that could be transported in the absence of availability of transport (Distillery lorry was engaged exclusively for transporting fuel wood for the Distillery).

Raw Material Processed & Essential Oil Produced During Pre Project & Project Period:

Pre Project Period	Raw Material Processed & Oils Produced					
	Clove				Lemongrass	
	Stems	Oil	Buds	Oil	Grass	Oil
1983 - 1989 (5 years & 10 months)	2687.92	130.17	7.19	0.96	-	119.36
Average Annual	460.78	22.31	-	-	-	-
Project Period						
1989 - 1991	2109.45	88.92	143.08	7.10	-	668.76
1991 - 1992 (2 months)	44.77	2.22	59.90	8.23		
Total	2154.22	91.14	202.98	15.33	266.51	668.76
Average Annual (2 years & 2 months)	994.25	42.06	93.68	7.07	123.00	308.66

It was envisaged in the Project Document that processing of raw material would be increased by working the Distillery on 2 shift basis. This was a logical consideration. However, at the start of the Project, considering various factors specific to conditions prevailing in Pemba, 2 - shift regular operation was considered inadvisable. On the other hand, it was considered desireable to operate the Distillery on a continuous basis so long as the supply of electric and thereby of water was available. The labour and other work force was looked after well by providing regular meals and overtime. This mode of operation proved beneficial in improving production. The above data brings out this fact clearly.

III. QUALITY ASSESSMENT AND STORAGE OF ESSENTIAL OILS:

Following three essential oils are now produced on large scale in the Distillery.

i) Clove Stem Oil
ii) Clove Bud Oil
iii) Lemongrass Oil - (West Indian type)

All the above essential oils are adequately covered by standards not only by various countries (National standards) but also by the International Standards Organisation (I.S.O.). It is, therefore, very important to produce these essential oils to meet these Standards Specification. Besides physico - chemical Characteristics, odour of these oils also plays dominant role. As mentioned elsewhere in this Report, proper methodology for producing these oils have been worked out to produce oils which meet both physico-chemical characteristics and odour character.

Storage of essential oils, after distillation plays a major role in retaining and maintaining their standard quality. Work was done during the Project on this aspect, work on other essential oils, as and when produced on large scale, will also be undertaken.

IV. EXTENSION OF THE PROJECT:

Tripartite Review Meeting (T.P.R.) of the Project was held in Zanzibar on 20 June, 1991. It was noted with satisfaction by all concerned that the Project contributed a great deal towards its success. Practically, all the Objectives, Outputs and Activities were achieved or were in the process of achievement. It was the considered view of the T.P.R. that the Project should be extended for further period of 2 years with some technical and other inputs. Additional inputs recommended are given as under:

B.L.	Component	Allotment	
10		M/M	Dollars
11-01	Chief Tech. Adv.	6	60,000
11-50	Short Term Consultants	2	20,000
13-99	Adm. Support		16,000
15-99	Project Travel		3,000
39-99	Training		20,000
41-99	Expendable Equipment		20,000
42-99	Non-Expendable Equipment		10,000
51-99	Sundries		10,000
99-99	Project total		159,000
Government	Cost-sharing		60,000

During the Project Extension period, not only work for the complete achievements of the Project Objectives will be carried out but it will be the endeavour of the experts to consolidate the gains for sustained production of essential oils to earn for the Government of Zanzibar annual export earnings of not less than half a million dollars.

V. MARKETING:

According to ITC/UNCTAD/GATT Market Study on "Essential Oils and Oleoresins" 1986, world demand for clove oils is about 1,700 to 2,000 tons per annum, of which 90 to 95 percent consists of clove leaf oil. Also, world production of clove and bud oil is estimated at 40 - 50 tons while estimate demand for clove stem oil is not indicated. However, at one time Zanzibar exported upto 200 tons of this oil. No other country was reported to have replaced Zanzibar for clove stem oil. It is quite likely that some of users of this oil switched over to cheaper clove leaf oil.

Nevertheless, it has been observed that demand for stem oil still exists and Zanzibar (and Pemba) could capture this market once again. As a matter of fact, perhaps only about 100 tons or less of this oil could be produced (which will require 2000 tons of clove stems every year) considering the average annual availability of this raw material. On the other hand, there seems to be scope for producing clove bud oil to as much as 50 tons or more per year. Our estimates are based on the market response to the increased and increasing production of these two essential oils. Further, due to reported dislocation of production of clove oils in the Malagassy Republic, demand for Pemba Clove stem and specially clove bud oil is expected to improve further.

It is pertinent to mention that quality of Pemba Clove oils is the best in the world especially with respect to its colour, appearance and contents of active principles.

All that is needed now is to sustain production on a regular basis. According to our view, it is an opportune time to establish a second Distillery in Unguja. There will not be any problem of trained technical man - power in Zanzibar to run these units.

VI. MARKETING - EXPORT OF CLOVE STEM, BUD AND LEMONGRASS OILS:

Clove tree, Syzygium aromaticum syn Eugenia caryophyllus is the source of 4 products i.e. clove buds, clove bud, stem and leaf oils. The bud oil is of the highest quality and value followed by stem oil and then by the leaf oil. Leaf oil is the largest volume clove oil; at about 2000 tons per year. Market for both clove bud and stem oils are estimated at about 10 percent of all the clove oils.

Export of clove stem and bud oils from Zanzibar during 1984 to 1990-91 has been as under:

Export of Clove Stem and Bud Oils

Year	Oils of (in tons)			Value
	Clove Stem	Clove Bud	Lemongrass	(US $)
1984-85	24.00	-	-	146,400
1985-86	-	-	-	-
1986-87	3.74	-	-	23,332
1987-88	7.06	-	-	52,140
1988-89	22.00	1.98	-	112,530
1989-90	39.82	1.54	-	220,636
1990-91	60.94	10.86	0.50	420,150

Source: Statistical Division, ZSTC., Zanzibar.

It will be observed that while production of clove stem and bud oils has increased during the Project period, sales have also picked up. Sales during 5 years, 1984 - 1989 (pre-Project period) was US $ 334,402. The same during two years 1989 - 1991 was US $ 640,786.

Improved sales/exports of clove oils is a cumulative effect of concerted efforts put in by the Z.S.T.C. as also support by the Project.

In the beginning of the Project, both the Export Manager Z.S.T.C. and the Plant Manager, Distillery, were deputed to attend

the International Congress of Essential Oils, Flavours and Fragrances held in New Delhi in November, 1989.

They got a unique opportunity to meet consumers of and dealers in essential oils from all over the world. Samples of clove oils were distributed freely in the Congress. Later on the Plant Manager, while on Training abroad, had also an opportunity to meet dealers in essential oils in France, U.K. and India.

Marketing Expert provided under the Project completed his mission during May - June 1990 for 2.2 months. After studying in details the work of the Marketing/Sales Division of the Z.S.T.C., he submitted a comprehensive report with a number of recommendations which merit attention. His report is expected to improve further the working of Marketing/Sales Division of the Z.S.T.C.

The Marketing/Export Manager of the Z.S.T.C. is to be trained further in abroad through a Project Fellowship. It is hoped that experience/training through this Fellowship will go a long way in improving further the sales of Clove oils in particular and other essential oil in general.

VII. FUTURE PROSPECTS:

1. So far, especially in the beginning of the Project, all the efforts were concentrated on processing clove stems to the maximum; about 1040 tons of clove stem while only 44 tons of clove buds and lemongrass (to yield 120 litres of the lemongrass oil) were processed during 1989-90. The product mix was improved subsequently during 1990-91; while 1070 tons of clove stems were processed, clove buds processing increased to about 100 tons with corresponding improvement in the production of lemongrass oil to 425 litres. Corresponding figures for 1991-92 are expected to be still better particularly in respect of clove buds and lemongrass, as seen from the trend of processing during July - August. (The production value for these 2 months is about US $ 100,000).

(It is heartening to note that the Government of Zanzibar has realised the extent of improvement during the Project period and has promised their full support through Z.S.T.C. both financially and otherwise for sustained production. Z.S.T.C. has committed to ease transport problem of the Distillery by providing a lorry after the clove harvesting season is over by end October. During tne year 1991 - 92 equal stress will be given to processing of clove buds thereby improving further the value of product mix for export. For example it is now felt certain that the Distillery will be able to process at least 1000 tons of clove stems, 200 tons of clove buds plus about 1 ton of lemongrass oil which taken together will be worth more than US $ 500,00.

There are now two main important consideration for the Distillery operations i.e.

i) To sustain annual production level of not less than US $ 500,000.

ii) To further improve upon with proper product mix and to add on other essential oils for which steps have already been taken during the Project.

It is possible to achieve the above goals taking into consideration the fact the officers and the workers of the Distillery have adjusted themselves to the "intensive working" as against regular one shift basis.

2. Value Added Products:

Scope and desireability of producing a few value added products from clove stem oil from Grade II of stems, 'black oil' and sub-standard lots of stem oil, if it happens though not very probable, was discussed in details in an earlier report of the C.T.A. (Report, Baldev Gulati, 8 July, 1991). However, relevant facts are summarised again.

With the improved and increasing production of clove oils, fairly good quantities of low quality stem oil (from Grade II of stems), 'black oil and may be small lots of sub-standard oils are likely to be available in future. These could be gainfully utilised for value - added products. To begin with only the following derivatives (value added products) may be started:

i) Eugenol
ii) Iso-eugenol
iii) Eugenol and iso-eugenol derivatives depending on standardisation of technology by the current team of International Experts.

Some preliminary work on the isolation of eugenol ex. clove stem oil has already been done by the C.T.A. Yield of eugenol is encouraging. Isolation of eugenol by chemical means only was undertaken. This work is proposed to be undertaken further to produce larger quantities of samples for quality and market evaluation.

It may be mentioned that while sale price of good quality clove stem oil is US $ 5.0 only, eugenol and iso-eugenol sale price is about US$ 7.0 and US$ 9.0-10.0 per kg. It is quite likely that eugenol and iso-eugenol ex. clove stem oil would be better in quality and yield as compared to those from clove leaf oil.

VIII. TRAINING FELLOWSHIP AND STUDY TOURS OF NATIONAL PERSONNEL:

1. Training at Site

So far, only 4 Experts have been fielded for the Project work. Except for the C.T.A. and the Marketing Experts who have been fielded for the entire duration of their mission, the Agronomist and the Quality control Chemist have completed part of their assigned period for preliminary work only. Both of them did not have suitable qualified counterpart i.e. agronomist and chemist and hence could not train at site any person. Both the C.T.A. and the Marketing Expert associated their counterparts in the Project work. Training at site was an ongoing activity through instructions, lectures and practical work covering practically every aspect of production, quality control, standardisation of distillation parameters, marketing etc. In the absence of Agronomist, the C.T.A. also looked after cultivation of aromatic plants, under diversification programme, to the extent required. The Plant Manager, (the National Project Director) was involved in this work.

2. Training through Fellowship

Six fellowship/training programmes were proposed in the Project. Progress under this activity is given hereunder:

Training/Fellowship	Progress/Status
i) Plant Manager (Mr. Nasib S. Omar)	a) Participated in the International Congress of Essential Oils, Flavours & Fragrances, New Delhi 12-16 November, 1989. b) Completed training for 10 weeks in Poland, U.K., France and India; 29 July 1990 to 14 October 1990. c) Participated in the Second UNIDO Workshop on Essential Oils Industry, Manila. 4-8 February 1991.

ii) Production Manager (Mr. Ramadhan K. Feruzi)	Completed training in India and Sri Lanka 12 September - 22 November, 1990.
iii) Distillation Foreman (Mr. Ali Shaali)	Completed training together with the Production Manager in India and Sri Lanka, 12 September - 22 November, 1990.
iv) Maintenance Foreman (Mr. Badru Ali Zubeir)	Completed training in Pakistan, 6 May - 5 July 1990.
v) Marketing/Export Manager, Z.S.T.C. (Mr. Suleiman J. Jongo)	Participated in the International Congress of Essential oils, Flavours and Fragrances, New Delhi, 12-16 November, 1989. Mr. Jongo is on 2 years study leave, further training programme was, therefore, kept in abeyance.
vi) Analytical Chemist	Training programme will be planned as soon as a suitable incumbent is available.

3. Future Training Programme

Training programme/study tours of the national personnels for the future are proposed as under:

National Personnel	Proposed Training/Country
i) Agronomist	i) Central Institute of Aromatic & Medicinal Plants Regional Centre at a) Pantnagar (India) b) Rangalore (India) ii) Sri Lanka
ii) Analytical Chemist	i) National Bureau of Plant Genetic Resources, Chemistry Section, I.A.R.I. Pusa Campus, New Delhi (India).

		ii) Regional Research Laboratory, Trivandrum (India).
iii)	Marketing/Export Manager	i) I.T.C. UNCTAD/GATT, Geneva
		ii) France, U.K. and Switzerland to selected companies dealing in Essential Oils.
		iii) Chemexil, Bombay, (India)
iv)	Production Manager	O.N.D.R.I. London for one month.
v)	a) Marketing/Export Manager, Z.S.T.C.	To participate in the International Congress of Essential Oils. Flavours, & Fragrances to be held in Vienna (Austria) in October, 1992.
	b) Plant Manager Clove Stem Oil Distillery	
	c) General Manager, Z.S.T.C.	
	d) Principal Secretary/ Director - Ministry of Trade & Industry Zanzibar.	

IX. DIVERSIFICATION OF AROMATIC CROPS:

Details of work done on the diversification of aromatic crops are given in the earlier report of the C.T.A. (Report August 90, pp 19 - 20, 8 July, 1991, pp 8 - 10). The current position is summarised for ready reference.

Following essential oil - bearing plant species are under cultivation:

i)	Lemongrass (West Indian type) Cymbopogon citratus	90 acres
ii)	Cinnamon (Cinnamomum verum): true cinnamon	2 acres
iii)	Vertiver (Vetiveria zizanioides)	2.5 acres
iv)	Cardamom (Eletteria cardamomum - Malabar type)	Small area
v)	Ocimum basilicum (Methyl chavicol type)	Small area (0.20 acres)

i) Lemongrass:

Planted from mid - 1989 to early 1991 in Magome in a cleared forest area. The area is mildly undulating and is rainfed. In the beginning, cultivation practices were standardised by the C.T.A. during his first mission (July - August, 1989). Optimum spacing of 75 cm x 60 cm (spacing between rows and plants respectively) has resulted in good cover of the area and has reduced incidence of weeds to a great extent. Application of boiler ash has proved beneficial.

Oil content and quality, with respect to citral content are satisfactory. Due to problems of transport, harvesting of the crop has been irregular affecting production. However, distillation parameters have been standardised yielding oil of standard quality. Oil has been accepted in the European market. About 700 kg. oil has already been sold so far.

Economics of lemongrass could not be studied primarily due to irregular harvesting. However, the crop seems to be an economic proposition for Pemba as a rainfed crop.

On an average about 3.0 - 3.5 kg is obtained per acre per harvest. Potential of production is about 15 - 17 kg. of oil per acre per year as a rainfed crop.

The lemongrass crop is free from any incidence of pest and disease.

ii) Cinnamon:

Cinnamon planted earlier as inter-crop of lemongrass due to non-availability of clear area at that time in 1989 has been discontinued. It is now raised as a pure crop where the plants have come up well. In all 2932 cinnamon plants were planted in the fields, only 511 plants have survived.

Even though the overall growth of the plants is satisfactory, plants are affected by pests and disease. Experts from the Plant Protection Department, Pemba and Unguja were consulted. So far satisfactory measures have not been suggested except to burn the affected plants.

iii) Vetiver:

An area of 2.5 acres has been brought under vetiver from the locally available material. Planting was done on ridges in sandy loam soil. Crop growth as seen from the averground part seems to be satisfactory.

Oil content from the plants dug on trial basis was observed to be about 0.7 percent in the Laboratory distillation.

iv) Cardamom:

As mentioned in the last report cardamom cultivation did not succeed. No further work has been done since last report.

v) Ocimum basilicum (Methyl Chavicol tyoe)

A small area of about 0.2 acres was brought under culvitation in the factory premises. Nursery was raised in May 1991 and transplanting in July 1991. First harvest was taken in early September.

The plants after harvesting are coming up well again with the prospect of second harvest in about 6 - 8 weeks. Oil produced from the first harvest will be evaluated further.

X. WORK DONE ON LOCAL AROMATIC PLANTS:

It was observed earlier (Report Dr. B. Gulati June 1984) that a fairly large number of aromatic and medicinal plants occur in both Unguja and Pemba; including plants growing in state of nature, as garden plants and cultivated. Some of these have potential and at a later stage could be brought under regular cultivation if required for their essential oils.

During the course of various missions under the Project, some work was done on screening of the available aromatic plants for their essential oils, their evaluation for eventual utilisation. Work done so far is summarised for ready reference.

1. Ocimum species: Following Ocimum species growing spontaneously in Pemba were studied:

a) Ocimum canum: Two distinct chemical types were observed; one having camphor the other containing Methyl cinnamate. While camphor was isolated, methyl cinnamate could not be isolated due to small percentage in the oil.

The plant is susceptible to viral disease. Oil content was observed to be as given hereunder:

Material distilled	Percent oil content (v/w) on	
	Fresh weight	Dry weight
i) Green healthy leaves with inflorescens	1.05	5.00
ii) Wilted leaves with mature inflorescens	1.47	4.40
iii) Leaves from seeding plants	0.30	0.68
iv) Leaves from viral infected plants	0.31	1.41

On an average, oil content from leaves plus inflorescense ranged between 1.0 to 1.5 percent (v/w) on fresh weight basis and 4 to 5 percent on dry weight basis.

b) Ocimum sauve: The plant grows spontaneously in bushy form throughout the island and is known as Mtule. As it produces seeds profusely, regeneration is abundant from scattered seeds.

Oil content was 0.4-1.25 percent and 0.8-5.0 percent (v/w) on fresh weight and moisture free basis respectively. The oil has eugenol. Detailed study is called for. This would be undertaken by the Quality Control Chemist after GLC equipment is installed in the Distillery.

c) Ocimum basilicum (Methly Chavicol type) Locally called Mrehani has been observed to occur in 2 distinct morphological forms; one with serrated leaves, the other with plain elliptical leaves. Oil from both the distinct forms is rich in methyl chavicol of about 90 percent. However, oil from the plant with serrated leaves is of better odour value. This form also is predominant among the plant population when raised from seeds. The plants can also be raised through stem cuttings which is adopted by the local people when raising this Ocimum as garden plant for its pleasant odour.

Oil content of the leaves plus inflorescens was observed to be:

	Percent Oil content (v/w)	
	Fresh wt. basis	Dry wt. basis
Material from plants with elliptical leaves	0.40	2.50
Material from plants with serrated leaves	0.47	2.35

The Quality control chemist has observed 90 percent methyl chavicol and 3 percent linalool.

Plants from this species of ocimum were raised on pilot scale in the premises of the Distillery from the seedlings raised in a nursery in the month of May 1991. Transplanting was done in June and harvested in early September. The whole overground part of the plant was distilled in the Distillery unit.

188 kg. of the material gave 300 ml. of an oil which is now being studied and evaluated prior to raising this crop over an area of 1-2 acres for study of economics.

Harvested plants are coming up well again with profuse growth of leaves. Second harvest should be available in about 6-8 weeks.

2. Artemisea camphorata: Locally known as Mpachori, this species of Artemisea, which does not flower, is a popular garden plant raised for its pleasant odour. The plant is raised through stem cuttings. Dry leaves are reported to be exported to Kenya besides local use.

(The plant was identified at Kew Gardens, London).

The leaves on distillation give a blue coloured oil, due to azulenes. Oil content was observed to be as under:

Material distilled	Percent Oil content (v/w)	
	On Fresh weight	On Dry weight
i. Leaves (fresh)	0.77	2.34
ii. Leaves (dry)	1.00	-
iii. Leaves dried for one day	0.80	1.60
iv. Tender Stems	0.17	0.34
v. a. Resinoid extracted with ethanol	19.8 percent	
b. Absolute	12.0 percent	
c. Resinoid extracted with benzene		
- from fresh leaves	8.49 percent	
- from dry leaves	14.86 percent	

Ratio of leaves: stalks in the freshly harvested plants was 1.4:1.0.

3. Pogostemon plectaranthoides:

Pogostemon plectaranthoides grows profusely on the road sides and in uncultivated lands. It flowers profusely. Flowers and leaves contain resinous material besides an essential oil. The inflorescens have better oil content. The oil needs further study and evaluation. Preliminary data on oil content was observed to be:

Material distilled	Percent Oil Content (v/w) on	
	Fresh weight	Dry weight
i) Leaves plus inflorescens	0.11	0.48
ii) Leaves only	0.06	0.20

4. Petitgrain Oil (Bitter orange leaf oil)

Bitter orange tree is valued for its leaf oil (petitgrain), fruit and flower oil (neroli). The last one is highly priced (about $ 600 - $ 700/kg.) and prized. Even water from distillation is a saleable commodity.

Leaves from a tree growing in the premises of the Distillery were distilled in the Laboratory with the following results:

Material distilled	Percent oil content (v/w) on	
	Fresh weight	Dry weight
i) Fresh leaves	0.36	1.00
	0.70	1.70
ii) Dry leaves (one day wilted)	0.55	1.04

Essential oil produced from leaves, fruits and flowers would be a useful addition to the existing product range if collection from these materials from the trees growing could be organised.

5. Citrus grandis leaf oil: Petitgrain oil from leaves of Citrus grandis was produced on Laboratory scale. It has not been evaluated for its utility which will be done no sooner the Perfumer arrives for the Project work.

- Oil content on fresh weight of leaves (v/w) 0.35 percent
- Oil content on dry weight of leaves (v/w) 0.95 percent

6. Vetiver: Vetiver a common plant in Pemba raised as a hedge/border of the houses was observed to give as much as 1.0 percent of oil (calculated on fresh weight, and 2.35 percent calculated on dry weight basis) in the Laboratory. Preliminary evaluation of the oil indicated its good quality. Vetiver has been put under 2.5 acres for study of its economics.

Trial harvesting from 3 plants in September raised above gave following data:

Yield of roots 80 gms/plant (average)

Oil content 0.75 percent v/w.

7. Cinnamon leaf: Leaves from locally growing cinnamon gave an oil in yield of 0.4 percent (calculated on fresh weight) and 0.8 percent when calculated on dry weight basis (both v/w). However, yield of 0.8 percent was also reported by the Quality Control Chemist.

Leaves from the cultivated Cinnamon in Magome gave 0.72 percent oil on fresh weight basis.

Cinnamon leaf oil will be yet another useful addition to the range of essential oils produced in Pemba Distillery.

8. Cardamom (Small): Cardamom (Elettaria cardamomum var. miniscule) of the Malabar type is raised both in Unguja and Pemba. The crop comes up well. The post - harvest technology needs a

great deal of improvement in order to produce a product of good quality.

Locally available cardamom from the Agriculture Department was procured for Laboratory distillation work. (Cardamom capsules were one year old: these were observed to be of not good quality, perhaps adequate care was not taken in both drying and storage).

Percentage content of cardamom seeds was 71 in the capsule. (Oil is confined only in the seeds). Moisture content of the cardamom capsule was 20 percent. Oil content data were observed in the Laboratory to be as given hereunder:

	Material distilled	Oil content (v/w)
i)	Seeds only (whole)	7.00 percent
ii)	Seeds (powdered)	5.10 percent
iii)	Whole capsule	4.00 percent
iv)	Whole capsule (crushed)	4.50 percent
v)	Outer husk only	Traces
vi)	Whole capsule only	3.78 percent (w/w)
vii)	Seeds only	5.40 percent (w/w)

9. Ylang Ylang Flowers:

Oil of Ylang Ylang an indispsnsible item in the fragrance industry has potential of production both in the Unguja and Pemba island. Trees flower profusely and regularly. However, as the present growth of trees is straight and high harvesting of flowers is a difficult proposition. From the laboratory work it has been observed that quality of oil is good.

However, harvesting season concides with the season of clove picking which could pose problem in Pemba but not that much in Unguja (Flowering season of Ylang Ylang is July and September). Nevertheless, there is good potential of development ylang ylang for oil in Unguja and Pemba.

Ylang Ylang flowers were distilled in the laboratory. Yield data of oil is as given below:

Material distilled	Percent oil content (v/w) on	
	Fresh weight	Dry weight
a. Fresh ripe flowers (July crop)		
i. First Fraction	1.40	6.26
ii. Second Fraction	1.03	4.66
Total	2.43	10.92
b. Immature un-opened flowers (green)	1.10	-
c. Dry flowers (brown)	1.70	3.40
d. September crop		
First Fraction	1.17 percent v/w	
Second Fraction	0.65 percent (v/w)	
Total	1.82 percent (v/w)	

A large number of distillations consistently gave good yield of oil with fine quality, especially of the first fraction which is sold as "Extra Quality" in the trade.

XI. IMPROVEMENT IN THE EXTRACTION METHODOLOGY OF THE ESSENTIAL OILS:

Clove stem oil distillery set up through French loan and by a French Company, Tecotex, had trial runs on 11 Aug. 1982 to 14 Aug. 1982. Regular production started from 5 September, 1983. Method of clove stem distillation as recommended by the Tournair Frere, Grasse, (Supplier of the main distillation equipment) was followed subsequently. Yield and quality of oil was satisfactory and the oil was accepted in the European market. The equipment is of an excellent quality as also the lay out. Charging of the stems for distillation and discharging of the exhausted stems is convenient. Subsequent drying of the exhausted stems is done continuously for use as fuel for the boiler. There is, however, no arrangement for co-hobation: the distillate reservoir is of short capacity resulting in loss of good part of the oil through distillate. This is a serious drawback in the whole set up which otherwise is very good.

The Distillery comprises of 10 stills of 3000 litres capacity each capable of taking a charge of 700 kg. clove stem or about 850 kg. of clove buds or 750 kg. of lemongrass each. The distillation units have built in arrangement for distilling the material at 100°c to 120°c. (Still temperature corresponding to a still pressure of 1 bar to 2 bars). It is, therefore, possible to distil the material within this range as the need be. The boiler has adequate capacity, 2.8 tons steam per hour to distil material in all the 10 units at one time. However, except, in the earlier years for a short period only, all the 10 stills are never loaded at any time primarily due to the fact that one or more units always need some repair due to their continuous use.

In order to improve upon and standardise distillation parameters of essential oil bearing crops of different nature, some work was done during the Project, in order to get product of quality with respect to both physico-chemical characteristics and good odour value. This work is described in details.

1. Clove Stems:

As the name indicates, the Distillery was designed to distil primarily clove stems only (but without cohobation resulting in

less than optimum recovery of the oil). As the clove stem oil comprises mostly of eugenol, distillation of stems under pressure does not pose any problem in respect of quality. However, higher still pressure and, therefore, higher temperature can introduce a 'burnt note' in the final product. Replicated trial distillation of clove stems, in the regular distillation unit at the following temperatures in the still was undertaken.

	Still Temperature	Pressure
i)	100°c	1.00 bar
ii)	105°c	1.22 bar
iii)	110°c	1.50 bar
iv)	115°c	1.80 bar

Oil fractions were collected at interval of 30 minutes initially and later on after every hour. Eugenol content was determined for each fraction. Odour was also evaluated. It was observed that distillation of clove stems at still temperature of 105°c gave optimum yield of oil in about 5 hours time and having good odour.

(It was also proposed to continue this work further after G.L.C. equipment was installed whereby a fairly accurate idea about that composition of the oil fractions could be obtained. However, G.L.C. equipment has not been installed yet).

Since the start of the Project in 1989 about 100 tonnes of clove stem oil have been produced so far and exported. Not even a single lot exported has been rejected or any complaint about its quality received.

2. Clove Bud Oil:

Clove bud oil, even though, evaluated for its eugenol content as per various standards has also other constituents such as beta - caryophyllene, alpha - humulene and eugenyl acetate. The last is considered very important. Content of eugenol acetate of the oil depends on conditions of distillation i.e. still temperature and rate of steam inlet. This work needs to be

repeated on large scale distillation units as available in the Distillery. However, this type of work can only be done using G.L.C. to determine percentage content of these four constituents.

Good quality clove bud oil has low contents of beta - caryophyllene (upto 3 percent), alpha - humulene (upto 0.5 percent) eugenol (65-75 percent) and eugenyl acetate could be as high as 28 percent but about 15-20 percent.

In general, these 4 constituents comprise of about 97 percent of the bud oil. A good quality bud oil will have eugenol and its acetate in a ratio of 3:1. Normally, caryophyllene and humulene are maximum in the early stage of distillation, so is eugenol while eugenyl acetate content increases with the progress of distillation (As mentioned earlier these facts need to be confirmed for large scale distillation).

Under the condition of distillation of clove stem oil, it is not possible to get quality bud oil. It was, therefore, considered necessary to work out parameters to get a good quality clove bud oil. Still temperature during distillation was kept as low as possible i.e. less than 100°c. It has been observed that under present set up a still temperature of 95°c-98°c not only keeps the distillation going on at steady rate but also gives an oil of acceptable quality with respect to contents of important constituents and odour. However, distillation under these conditions necessitates distillation over a long period extending upto 48 hours to recover optimum oil quantity.

Clove bud oil produced has been readily accepted in the European market.

3. Lemongrass Oil:

The Distillery is equipped to handle essential oils heavier than water. Lemongrass oil is lighter than water and cannot be produced in the existing available oil - water separators. Also, citral the main component, on which oil quality is determined, is

heat sensitive. These 2 considerations had to be kept in view for distilling lemongrass.

Florentine receiver to separate oils lighter than water was procured by the Distillery and installed with one still. Loading of the still with lemongrass is also different as compared to clove stems and buds. The partitions in the still have been removed and grass is charged directly. When large quantities of the grass is received, the still after loading is closed, stem let in for about 10-15 minutes and then re-opened which permits additional charging of the grass. By this way, about 800 kg. of lemongrass can be charged.

Distillation is done at a still temperature of less than 100°c whereby citral is unaffected. Distillation takes about 2 hours. Oil thus produced is of standard quality with respect to citral content and having good odour.

XII. CO-ORDINATING ACTIVITIES OF EXPERTS:

Following experts have been selected for the Project work.

	Expert	Duration	M/M used
i)	Dr. Baldev Gulati Chemical Technologist Essential Oils; C.T.A.	12 m/months	All including current mission
ii)	Dr. Mohan L. Maheshwari Quality Control Chemist	2.5 m/months	0.5
iii)	Mr. Klaus A. Duerbeck Agronomist	3.0 m/months	1.1
iv)	Mr. A.M.A. Abeysinghe Marketing Expert	2.0 m/months	2.2
v)	Mr. Shahid Ahmad Engineer	1.5 m/months	1.0
vi)	Perfumer Not yet selected	0.5 m/months	Nil

It may be seen that only C.T.A. and the Marketing Expert have completed their mission. Engineer Expert joined the Project on 5 October 1991 for a period of 6 weeks but left after one months after completing Techno-Economic Feasibility Study.

Both the Quality Control Chemist and the Agronomist have completed preliminary mission and were to complete their mission pending:

- For Quality Control Chemist:
  a) Appointment of Chemist (Counter part) in the Distillery.
  b) Receipt of Laboratory inputs.
  c) Installation of G.L.C. equipment.
- For Agronomist
  a) Appointment of an Agronomist (counterpart).

In the case of Quality Control Chemist, while Laboratory inputs have since been received, Chemist is yet to be appointed.

G.L.C. equipment has also not been installed. However, it is now recommended that no sooner G.L.C. is installed, he may be fielded. He can train the Plant Manager & Production Manager or any other suitably qualified person in the Distillery in operating G.L.C.

The Q.C. Chemist may be asked if he is still available and if he could complete his mission. In the event, a chemist is appointed he may be trained; otherwise he may be sent for training abroad for which requisite budget allocation exists.

In case of Agronomist, Mr. Duerbeck may also be asked to inform his availability. He may be fielded immediately to complete his mission. In case he is not available, a suitable Expert may be recruited with adequate experience in aromatic crops especially Cymbopogon Species, Vetiver, Cinnamon and aromatic crops in general suitable for tropical climate.

XIII. FACTORS AFFECTING ACHIEVEMENT OF OBJECTIVES:

Immediate Objective 1 of the Project i.e. "upgrading performance of the Chake Chake Clove Stem Oil Distillery" in a broader sense covers not only the enhanced production by improving its capacity utilisation but also all the connected factors such as improving extraction methodology, appropriate quality control, storage of oil and marketing in order to realise the benefit of improved production. During the course of the Project work while an overall improvement in most of the aspects governing a commercial venture has been achieved resulting in significantly enhanced export of the essential oils bringing into the country increased foreign exchange, there are still a number of factors which limit continued sustained improvement. Some of the most important factors are detailed below:

1. Repair and maintenance of Equipment:

The Distillery which started commercial production in September 1983 is entering into 9th year of production. It has processed till June 1991 about 5400 tons of raw material (2905.4 tons till June end 1989 i.e. about 7 years and 2416.9 tons thereafter till Aug. 1991 i.e. 2 years and 2 months covering Project period with corresponding export earnings of US $ 362,726 and US $ 640,786 respectively.

Over a period of about 9 years even though the Distillery did not work to the full capacity, time has taken toll of the equipment which now needs frequent repair, maintenance and replacement of various components. This was all the more relevant during Project period when much more raw material was processed as compared to the past.

Increased production during the Project period was possible due to substantial inputs of spares both for equipment as also for workshop. Nevertheless, hardly any month passes without some breakdown resulting in closure of the Distillery. Repairs and replacements of parts is not only time consuming for want of requisite facilities at Chake Chake and even Pemba Island but also

expensive as parts of equipments for repair have to be sent to Dar-es-Salaam. It is not practical to keep in stock all the spares e.g. cooler fans needing replacement were ordered from the suppliers in May 1991. These have not yet been received (Oct. 1991). Some more instances have already been given in C.T.A.'s report of 8 July 1991, p. 13.

It may also be relevant to mention that other aspects specially those of post production have been adequately taken care of by the Project C.T.A. regarding standardisation of production parameters, quality control, packing and storage. Z.S.T.C. on its part has done commendable work on the marketing/export of clove stem, bud and lemongrass oils.

2. Fuel for Boiler:

Production of clove bud oil, started during the Project while bringing in more foreign exchange has also brought in 2 major problems i.e.

a) Organising Distillery Schedule of operation
b) Fuel for the Distillery.

While the problem at (a) above is an organisational one which has been taken care of, problem at (b) has posed constraints on the Distillery operations.

The Distillery designed for clove stem distillation operates on the use of exhausted stems as boiler fuel. The whole operation of distillation, drying of exhausted clove stems, their feeding into boiler is streamlined. On an average the boiler needs about 1 ton of stems per hour to produce sufficient steam. At any time if 8 units are used for clove stem distillation, need for other fuel does not arise as stems take only 5 - 6 hours for distillation. It is only when only a few stills are used for clove stem, necessity for fuel such as dry coco-nut shells or firewood arises. Clove buds which take 24 - 40 hours for complete distillation cannot provide adequate fuel for boiler.

In order to operate the Distillery for 2-3 shifts (2 shifts are not workable) fuel requirement comes to 150 tons per week (6 working days). For improved capacity utilisation there is no alternative but to arrange for fuel wood now as clove bud distillation is a regular feature. This has put pressure on the Distillery resources in respect of transport. Moreover, wet fuel does not produce steam to the required pressure and quantity which has prolonged the distillation hours; clove stems and bud take 7-8 hours and 40 hours respectively.

3. Vehicles:

Distillery has only one lorry which is busy throughout the day in transporting fuel wood with the result that lemongrass harvested cannot be transported regularly. This has affected severly production of lemongrass oil. During the period the lorry is under repair, fuel wood cannot be transported resulting in stoppage of Distillery operations.

In case full capacity utilisation is to be achieved, at least one but preferrably 2 additional lorries are needed. (This year, 1991, there is a bumper crop of clove buds and it is absolutely essential to transport about 2000 tons of clove stems and 4th grade (distillation grade) of clove buds becomes all the more very important. In the absence of transport vehicles this is likely to suffer).

The lorry available now is about 8 years old and needs regular maintenance and frequent repair resulting in its immobility.

Next to repair and maintenance of the Distillery lack of transport vehicle is the most serious problem facing the Distillery.

4. Electricity & Water Supply:

The Island of Pemba receives its electricity supply from a diesel-power plant of one - megawatt capacity. It has already

operated for more than 22,000 hours and is not in very healthy state. Also, supply of diesel for its operation is not regular. It is often closed for want of diesel supply. During such periods water supply for the town of Chake Chake is also stopped completely. The Distillery operates only during the period of electric and water supply, which disrupts its operation affecting production.

There are 3 standby generators in the Distillery with capacity of 165 KVA (Rolls Royce), 90 KVA (DAF) and 33 KVA (Ford) respectively. The last one is used only for small odd jobs and is insufficient for Distillery operations which needs at least 60 kw power for operation. The DAF generator is out of order for want of some spares which are awaited from the suppliers. Operating Rolls Royce generator is expensive and cannot be used for regular and continuous operation.

During the first mission of the C.T.A. during July - August 1991, considering the need of the Distillery for regular water supply, it was recommended to have its own water supply. This was agreed and a tubewell was bored. Additionally, water storage reservoir of 5 cu. meter capacity was also installed. This has provided great relief but cannot meet the full demand on its own to run the Distillery for long periods. (During the period of electric and thereby water supply stoppage from the town, all the inhabitants near the Distillery meet their requirement of water from the Distillery reservoir thus putting additional burden on the Distillery resources of water).

It is now given to understand that the Government of Zanzibar is planning to arrange for electric supply from the Mainland of Tanzania through marine cable. It might take about 3 years. Till then the Distillery operations cannot be organised as regularly as desired for improved capacity utilisation.

RECOMMENDATIONS

Following recommendations need attention:

1. In order to operate the Distillery without interruption when working on three shift basis, two more lorries are needed. At least one more lorry on full time basis should be provided immediately.

   It is suggested that one lorry each from Project funds and from Z.S.T.C. should be purchased.

2. Lemongrass harvesting has not been regular so far primarily for want of a lorry. This has resulted in not getting data on its economics and yield potential. This aspect needs priority attention.

3. Steps for future training programme of the National personnels may be taken both by the UNIDO and the Government of Zanzibar as per details given in the report.

4. An area of about 5 ha each should be provided both in Pemba and Unguja for trial cultivation of selected aromatic plant species for future development.

5. A Chemist and an Agronomist to be appointed for the Distillery as soon as possible.

ANNEX I

UNIDO

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT IN THE GOVERNMENT OF TANZANIA

DP/URT 86/026/11-01

JOB DESCRIPTION

Post title	Chemical Technologist - Essential Oil Distillation Plant Expert (CTA)
Duration	2 months 2.0 w/m
Date required	15 August 1991
Duty station	Chake Chake (Pemba)
Purpose of project	Maximising the capacity utilization of the Clove Distillery in Chake Chake (Pemba)
Duties	The Chemical Technologist will be responsible for activities connected with the modernization of the Chake Chake Distillery, Optimisation of its present capability and introduction of an appropriate production programme. Specifically the expert in collaboration with local personnel will be expected to carry out the following:

a) Utilizing spare parts ordered by UNIDO following recommendation of the Essential Oil distillation consultancy (11-51) the expert will formulate and implement a comprehensive plan for better utilization of existing installation thus bringing the plant into two shift operation and recommend additional hardware and other requirement.

b) The expert will co-ordinate the activities of the experts and will be specifically involved in the "In plant training" programme be means of lectures or seminars or any other period of instruction that may be required.

The expert will embody his observations and recommendations in a report which he will be expected to finalise and present to UNIDO upon completion of each of his mission.

ANNEX II

Fielding of Experts:

1. Dr. Baldev Gulati (C.T.A.)	25 June 1989 - 11 Aug., 1989 01 December 1989 - 03 - 1990 29 June 1990 - 30 August 1990 08 April 1991 - 29 June 1991 26 August 1991 - 21 Nov., 1991
2. Mr. Klaus A. Duerbeck (Agronomist)	1 Aug. 1989 - 2 Sept., 1989
3. Mr. Arya Abheysinghe (Marketing Expert)	30 April 1990 - 29 June 1990
4. Dr. Mohan L. Maheshwari	3 Aug. 1989 - 16 Aug. 1989
5. Mr. Shahid Ahmad (Engineer)	6 October 1991 - 7 Nov. 1991

ANNEX III

Achievement of Objectives

Progress on the achievement of Development and Immediate Objectives as per Project Document is summarised hereunder:

Development Objective: Rehabilitating the existing industrial plants and increasing capacity utilisation to help Economic Recovery Programme of the Country is one of the priorities of the Country Programme specifying industries with export potential.

Progress: Since the start of the Project, capacity utilisation of the clove stem oil distillery (CSOD) has increased by about 300 per cent with corresponding increase in foreign exchange earning as compared to pre-project years i.e. 1983 - 1989.

Regular and sustained production in the CSOD is expected to generate export exceeding US$ 500,000 per annum in the near future. Further improvement is expected with the extension of the Project and some additional inputs by the UNDP.

Production and export figures are given in this Report for reference.

Immediate Objectives

Immediate Objective - 1: Upgrading of the performance of the Chake Chake Clove Stem Oil Distillery.

1.1 Outputs: As a fully operational plant able to process upto 1700 tons per annum of raw material (clove buds and/or clove stems).

Activities	Progress/Status
1.1.1 To review existing buildings, equipment, process technology and manpower resources.	Completed.

1.1.2	To order spare parts for the plant and lorries.	Completed to the extent of availability of funds.
1.1.3	To train key personnels both on the job and through fellowships, Plant Manager, Foreman Maintenance Section, Distillation Section.	Training of personnels is an on-going activity. Training programme abroad completed for: i) Plant Manager ii) Production Manager iii) Distillation Supervisor iv) Foreman Maintenance
1.1.4	To order lorry for assisting collection of clove stems from 56 buying stations in Pemba.	Could not be ordered for lack of project funds.
1.1.5	To instal spare parts on the Plant equipment.	Completed (Repair of equipment components, as and when required, is done by the Distillery from its own funds).
	To start operation of the Plant in two shifts.	Achieved successfully with great improvement in the production programme. (Details given in the Report).
	To design and implement an equipment sub-system with schedules of inspection and check.	Partially completed by the Plant and Production Managers who are engineers. The activity will be completed by the Project Engineer in the near future.

1.2 Output - 2: Upgraded quality control system for grading and certifying the products to international standards.

Activities		Progress/Status
1.2.1	Draw up requirements for building specification for installation of quality control equipment.	Completed.
1.2.2	Z.S.T.C. to modify building according to requirements specified under 1.2.1.	Completed.
1.2.3	Order and instal quality control equipment.	Completed, except installation of G.L.C. equipment which is to be done by the supplier.

1.2.4	Develop procedures and practices for quality control certifying the quality of the product according to international standards.	Existing standards and procedures are being followed.
1.2.5	Training counterpart personnel both on the job and through a fellowship for the Analytical Chemist to carry out tasks described under 1.2.4.	Lab. Attendant working in the Distillery has been trained. However, a qualified Chemist is being recruited who will be trained at site as also through a fellowship.

2. Immediate Objective - 2: Selection and trial propagation of essential oil - bearing plant species based on International Market prospects.

2.1 Output - 1: A short list of plants yielding essential oils which are suitable for the world market selected.

Activities		Progress/Status
2.1.1	Experimental Propagation of plant species selected under 2.1.	Lemongrass, Vetiver, Cinnamon (ceylon type) and Cardamom are under trial cultivation. A local species of ocimum having potential is now being tried. Details are given in the Report.
2.2.2	Z.S.T.C. to cultivate crop-wise 2 - 3 essential oil bearing plants.	Accomplished.

2.3 Output - 3: Essential oils from distillation of 2 or 3 species under 2.2.2.

Activities		Progress/Status
2.3.1	Modify distillation equipment to enable it to distil essential oils from species selected under 2.1.	Completed for distilling lemongrass and for oils lighter than water.
2.3.2	Experimentally distil essential oils from species selected under 2.1.	Under progress as an on-going activity. However, Distillation unit (pilot scale) is required which will be purchased.

3. Immediate Objective - 3: Development of marketing strategy for the increased trade of clove stem oil.

Output - 1

3.1 Report on marketing strategy for clove stem oil:

Activities	Progress/Status
To develop marketing strategy for clove stem oil due increased output of Pemba Plant and possible need to attract present consumers of clove leaf oil.	Due to steps already taken, sale of stem oil has increased. Export of stem oil during 1990-1991 was about 61 tons valued about US$ 300,000. Reeport of Marketing Expert has been received.

3.2 Output - 2

Sales promotion trip to major present and potential consumers of clove stem oil leading to increased exports.

Activities	Progress
To plan and implement sales promotion study tour to major present and potential consumers of clove stem oil.	The Marketing Manager ZSTC and the Plant Manager (Distillery) participated in the International Congress of Essential Oils held in November at New Delhi. Contacts made have proved useful in improving sales of oils. Training programme/sales promotion study tour for Marketing Manager will be arranged in the near future.

ANNEX IV

Contribution of Zanzibar State Trading Corporation for the Project Work:

The Government of Zanzibar through Z.S.T.C. has contributed the following inputs towards the Project work:

	Description	T.Sh. (Millions)
i)	Land for diversification programme of aromatic plants; clearing and other cultivation expenses.	8.70
ii)	Tube well; boring, pumps and pipeline	3.15
iii)	Water reservoirs	1.00
iv)	Modification of Laboratory and GLC room	1.50
v)	Full time personnel	0.45
vi)	Running and maintenance expenses for Project vehicles	0.50
vii)	Spare parts and special lacquered drums. Through "import support".	38.00
viii)	Repair of boiler furnace	2.00
	Total	55.30
	Committed for future	
i)	Lorry	
ii)	Contribution for Project Extension	860,000

ANNEX V

BUDGET (REV. E) FOR THE PROJECT

B.L.	Description	Allotment	
		M/M	Dollars (US)
11 - 01	C.T.A.	12	111,620
11 - 50	Q.C. Chemist		
	Agronomist		
	Marketing Expert		
	Engineer		
	Perfumer	8.5	89,633
11 - 99	Int. Experts	20.5	201,253
13 - 99	Adm. Support	-	14,792
15 - 99	Travel	-	5,000
16 - 99	Other	-	6,000
18 - 99	-		4,160 (-)
19 - 99	Personnel	20.5	222,865
31 - 99	Fellowships		26,333
32 - 99	Study Tour		33,667
39 - 99	Training		60,000
41 - 99	Equipment Expendable		20,000
42 - 99	Equipment, non-expend.		179,451
48 - 99	-		2,894 (-)
49 - 99	Equipment		198,557
51 - 99	Sundries		16,567
58 - 99	-		701 (-)
59 - 99	Misc. Cost		15,866
99 - 99	Project Total		495,308

ANNEX VI

LIST OF PERSONS MET

I. Government of Zanzibar

Ministry of Trade & Industry

Mr. Issa S. Machano	Principal Secretary
Mr. Kamis K. Songoro	Director, Industry
Ms. Samira Said Salim	Industrial Officer

Ministry of Agriculture

Mr. Jabir Uki Dahoma	Executive Secretary (Zanzibar Cash Crops and Fruits Authority)
Mr. Makame S. Haji	Field Officer
Mr. Badru K. Mwavura	Field Officer
Ms. Nassim S. Mohammed	Field Officer
Mr. Frank Turley	Pathologist
Mr. Salehe Sambani	Incharge, Kizimbani Research Station
Mr. Kombo Ali Rashid	Assistant Farm Manager

Zanzibar State Trading Corporation

Mr. Abdul-Rahman Rashid	General Manager
Mr. Sahib Ali Mossi	Economic Advisor
Mrs. Fatima A. Mwinye	Chief Accountant
Mr. Henry Klaeza	Export Manager
Mr. Ussi M. Juma	Trade Officer

Counterpart Staff:

Mr. Omar S. Nasib	Plant Manager, Clove Stem Oil Distillery
Mr. Feruz Ramadhan	Production Manager

Backstopping Officer's Technical Comments
based on the report of Dr. B. Gulati, CTA
DP/URT/86/026/11-01

This comprehensive report describes in detail the activities connected with the project from the very beginning. The extent to which the objectives of the project has been achieved is evident from the activities described and the outputs attained. Most of the activities have been completed. Some experts have to be fielded and training has not been completed due to the non-availability of the counterpart staff. As a result the project has been extended by two years for the completion of these activities.

The Backstopping Officer is in complete agreement with the recommendation of the consultant (page 41). It is unfortunate that harvesting and processing have been affected due to non-availability of transport. This aspect has to be solved on a priority basis. The other urgent need is to have the counterpart staff in place so that the consultants could be fielded.

Within the time and facilities available, the consultant has done a very good job in executing the activities detailed in the job description.