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ASSISTANCE TO THE ESSENTIAL OIL INDUSTRY - ZANZIBAR

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TANZANIA

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

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

* This document has not been edited.

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SUMMARY:

The Project which started in July 1989 has achieved successfully a great part of the Objectives, Outputs and Activities. In the case of production of clove stem and bud oils, there is nearly 280 percent increase i.e. from 20.31 tonnes and 0.90 tonnes of stem and bud oils respectively in 1988, the same was 51.83 tonnes and 7.61 tonnes respectively in 1990, (January-December). Corresponding increase of production in 1990 compared to 1989 was about 206 percent. Not only the entire produce was exported but orders for future are also positive. As a matter of fact, entire stock of raw material of clove stems accumulated at the start of the Project is now exhausted. Foreign exchange earnings have crossed US\$ 450,000.

Training programme through Fellowships has been completed for the Plant Manager, Production Manager, Distillation Foreman and Maintenance Foreman. Chemist when appointed and the Export/Marketing Manager will be sent for training as soon as nominated by the Government of Zanzibar.

Inputs for the Distillery, spare parts, laboratory equipment, apparatus, chemicals have been received and being used. Regarding International Staff, only Marketing Expert has completed his mission. The Chemical Technologist (C.T.A.) has completed 3/4th of his mission. Out of 23.5 man/months only 13.3 man/months have been utilised so far. All the remaining man/months are expected to be utilised by end 1991.

Almost 100 acres have been brought under cultivation of aromatic plants, mostly under lemongrass besides vetiver, cinnamon and cardamom. Due to continuous planting of lemongrass, it has not been possible to work out yields per unit area. Further expansion will now be done only after evaluating economics of this crop. If raised properly, lemongrass is expected to be a viable proposition.

Set-back in the working of the Project and achieving still better performance was due to major breakdown of furnace of the boiler, in water pumps which together accounted for loss of production for 5-1/2 months. However, timely support received from UNIDO, Vienna, and the ZSTC helped in restoring the production without much loss of time.

The Project, for sustained production, needs additional inputs from the UNDP both for equipment and experts. Extension of the Project for another 2 years and extending Project activities to Unguja (Zanzibar) is felt necessary. These will not only consolidate gains achieved till now but are likely to take the production and export of the essential oils to as much as US Dollars One million per annum in the future.

RECOMMENDATIONS:

Following recommendations are put-forth for consideration:

i) Fielding of the Chemical Technologist (Essential Oils) C.T.A. should be done simultaneously with the Engineer, Quality Control Chemist and Agronomist for effective coordination.

ii) Production of value added products from inferior grade stem oil and 'black oil' should be undertaken on laboratory scale. Quality Control Chemist may be asked to take this up during his mission along with the C.T.A.

iii) Simultaneously, estimated availability of inferior grade clove stems and hence its oil and the 'black oil' should be undertaken to determine the scale of production of value added products.

Cost benefit analysis on the product-mix of value added products needs to be undertaken.

iv) Further expansion of lemongrass should be stopped till its viability as a commercial crop is evaluated. Cinammon should be raised as a close crop, 5000 - 8000 plants per hectare and coppiced when about 2-3m high for bark and leaf.

Basil to be tried on 1 acre area: nursery to be raised in March - April and transplanting at the onset of Masika rains. Spacing to be used: 60 cm x 75 cm.

v) An area of 5 hectare should be earmarked for introduction and trial of aromatic plant species allocating separate budget under 'Research & Development'.

vi) Engineer should evaluate possibility of using a part of equipment available in Malindi Factory, Zanzibar after repairs/modification in order to supplement the processing capacity, recommended under 'Extension of the Project' and extending Project activities to the Island of Unguja.

I. INTRODUCTION

The Project started in July 1989 with the fielding of Chemical Technologist (Essential Oils) C.T.A. The Agronomist and the Quality Control Chemist also joined during that period. All the preliminary work regarding evaluating the needs of the Distillery in respect of spare parts, workshop tools, laboratory chemicals, apparatus etc. was completed. Orders were placed by UNIDO Headquarters. All the inputs ordered have since been received.

During the first and subsequent mission, work on the upgrading quality of clove stem and bud oils and study of local aromatic plants was undertaken. The Quality Control Chemist analysed these samples in his Laboratory in India. Simultaneously, work on the cultivation of aromatic plants, such as lemongrass, cinnamon, vetiver, cardamom, a local Ocimum species was undertaken which is being continued.

Distillery work was organised with the help of National Personnels which resulted in greatly enhanced production. Sales also picked up substantially due to the efforts of the Zanzibar State Trading Corporation (ZSTC). Regular production of clove bud oil also started as also that of lemongrass oil.

Out of all the International Experts, only Marketing Expert has completed his mission so far. His report is with the Government of Zanzibar. It is expected that other Experts will be able to complete their mission by end of 1991.

Training of National Personnel at site and through Fellowships has gone on well. Only Chemist and Export/Marketing Manager have yet to go on training abroad. This will be done as soon as suitable incumbents are nominated by the ZSTC.

For the first time in the history of the Distillery at Chake Chake foreign exchange earnings have crossed US\$ 450,000 with the hope that it would touch US\$ 500,000 in future on sustained basis.

II. RECEIPT OF INPUTS AND THEIR UTILIZATION

Expendable and non-expendable component of the Project budget at US\$ 20,000 and US\$ 85,500 respectively has been fully utilised. Following items of equipment and laboratory apparatus, chemicals, solvents and equipment were ordered and received. (Details of items give in Reports of Dr B. Gulati, C.T.A. and Dr M.L. Maheshwari, Quality Control Chemist, dated 10th August, 89 and 16th August, 89 respectively.).

<u>Item</u>	<u>Value (US\$)</u>
1. Vehicles:	
i) Nissan Pickup van one	9,926
ii) Motor bike one	1,803
Sub-total	<u>11,729</u>
2. Laboratory inputs:	
i) G.L.C. equipment	32,020
ii) T.L.C. items	4,086
iii) Glass apparatus	14,247
iv) Chemicals	1,469
v) Equipment, (Oven, balances, etc.)	24,709
Sub-total	<u>78,531</u>
3. Spare Parts for:	
i) Hoist	4,331
ii) Electricals	12,030
Sub-total	<u>16,361</u>
 TOTAL (1-3)	 <u>104,711</u> =====

All the items ordered have been received and are being used. However, a large number of spare parts for the distillery were not ordered probably due to lack of funds.

G.L.C. even though despatched by the supplier (Shimadzu-Japan) in time was lying in Dar-Es-Salaam for a long time. The suppliers have now been requested to instal it and make it functional.

Considering the overall essential requirements of the Distillery and in order to achieve the objective of "Maximising the Capacity" for processing 1700 tons of clove stems/buds and other aromatic plant materials, the budget allocation is not sufficient. However, progress achieved so far in the Project is satisfactory, but for sustained and regular production as per the Project Objectives, additional inputs are necessary. A proposal to this effect is appended with this report.

III. CO-ORDINATING ACTIVITIES OF EXPERTS:

Following experts have been selected for the Project:

	<u>Expert</u>	<u>Duration</u>	<u>M/M used</u>
i)	Dr Baldev Gulati Chemical Technologist (Essential Oils) C.T.A.	12 m/months	9.25 (including current mission)
ii)	Dr Mohan L. Maheshwari Quality Control Chemist	2.5 "	0.5
iii)	Mr Klaus a. Duerbeck Agronomist	3.0 "	1.0
iv)	Mr A.M.A. Abeysinghe Marketing Expert	2.0 "	2.5
v)	Engineer - (Yet to arrive at site)	2.0 "	Nil
vi)	Perfumer (Yet to be selected)	1.0 "	Nil
	Total	<u>22.5</u> =====	<u>13.25</u> =====

Out of all the Experts, only Marketing Expert has completed his mission. It is also given to understand that Mr Duerbeck, Agronomist, may not be available to complete his mission. Dr Maheshwari's mission is pending due to delay in (a) installation of G.L.C. equipment by the supplier and (b) recruitment of a qualified Chemist for the Distillery. It is expected that G.L.C. will be installed soon and Chemist will be recruited in the near future. Dr Maheshwari will complete his mission no sooner these are accomplished.

Engineer from UNIDO has not come to the Project site. All the preliminary work connected with the evaluation of need of the Distillery for spare parts was accomplished by the C.T.A., during his first mission in July 1989, with the active help of the Plant and Production Managers, both being qualified engineers. All the inputs ordered have been received except spare parts which were not ordered. These are being utilised to operate the Distillery to maximise the production. However, an Engineer is now needed to look into various aspects of the Distillery operations. It is suggested that his job description may now be revised due to changed and improved working conditions of the Distillery. His job description is given at Annexure - 1.

It is suggested that the last portion of C.T.A.'s mission of about 3 months should be arranged in August 1991 at the latest. Engineer and the Quality Control Chemist should be fielded simultaneously so as to enable proper co-ordination of their activities.

IV. TRAINING OF NATIONAL PERSONNEL:

Training of national personnel at site is an ongoing activity, through instructions, lectures and practical work in the laboratory, factory and the farm.

Six fellowships/training programmes have been planned for national personnels in the Project. The progress under this activity is detailed below:

<u>Personnel:</u>	<u>Progress/Status</u>
i) Plant Manager	a) Participated in the International Congress of Essential Oils, Flavours and Fragrances, New Delhi, 12-16 November 1989. b) Completed training for 10 weeks in Poland, U.K. and India from 29 July 1990 to 14 October 1990. c) Participated in the Second UNIDO workshop on Essential Oils Industry, Manila, 4-8 February 1991.
ii) Marketing/Export Manager, ZSTC. (Mr. Sulleiman J. Jongo)	a) Participated in the International Congress of Essential Oils etc. New Delhi, 12-16 November 1989. Mr Jongo is on study leave for 2 years. Training programme, therefore, could not materialise. Training programme will be planned no sooner some suitable person is nominated by the Government of Zanzibar.

- iii) Production Manager
(Mr. Ramadhan K. Ferouz) Completed training in India and Sri Lanka from 12 September - 22 November 1990.
- iv) Distillation Foreman Completed training in India and Sri Lanka together with the Production Manager as in number (iii) above (12 September - 22 November 1990).
- v) Maintenance Foreman
(Mr Badru Ali Zubeir) Left for training in Pakistan on 6 May 1991.
- vi) Analytical Chemist Training will be planned after a suitable qualified person is appointed.

Besides the above mentioned training programmes, Agronomist, as and when recruited, will also be sent abroad for training after reviewing the budget position.

V. DIVERSIFICATION OF AROMATIC CROPS

With a view to introduce a few more essential oils-bearing plants, besides well established clove stem oil from the clove stem in Distillery, Chake Chake, a programme of work was started with lemongrass (West Indian type: Cymbopogon citratus) occurring naturally in the Island. To begin with, 0.75 acres (0.33 ha) were brought under cultivation in the premises of the Factory. It grew well and provided planting material for further expansion.

For large scale cultivation of lemongrass, forest area in Magome (about 3 km from the Distillery) was selected and clearing and preparation started from early 1989. Planting commenced from mid 1989 over an area of about 20 acres. In the absence of any guidance, planting was undertaken as per published information. However, with the start of the Project in July 1989, the planting was undertaken as per the conditions prevailing in the area. Spacing of planting was reduced so as to get maximum possible crop without having adverse effect on the plant growth. This step proved better as was seen from the growth of the crop in 1991 and control of weeds due to cover of the area by the lemongrass crop.

Considering various factors such as natural occurrence and market potential, 2 more species of aromatic plants were selected for trial cultivation. The crops selected were vetiver (growing as garden plant as also spontaneously in Pemba) and cinnamon. Cinnamon grown in Pemba provides bark for the market, even though

the product marketed is not of good quality. It is expected that regular cultivation of true cinnamon (Cinnamomum zeylanicum) would provide not only good quality bark but also leaves for distillation (clove stem oil Distillery is specifically designed for distilling eugenol rich essential oil-bearing plant material).

Cinnamom planting started from end 1989; 500 seedlings were planted in lemongrass fields and 2932 seedlings as pure crop. Planting in lemongrass fields have now been discontinued. Most of the plants have established (about 1 m. high) with branches. Cinnamom plantation will be increased as a long term crop.

Vetiver seems to be of the type which would yield an oil acceptable to the world market. (Vetiver oil is still holding on its own least affected by synthetic substitutes). Some patches in Magome Farm have sandy soil which is considered suitable for vetiver. At the present, 2.5 acres are under this crop raised on ridges during May-June, 1989. Trial harvesting is proposed after rains, to see the extent of root development and its yield per clumps in order to estimate output per acre of the roots and the oil before considering future expansion.

Cardamom seedlings raised in the nursery in 1989 came up well. However, subsequent performance in the fields was not encouraging. Cardamom needs intensive care and good cultural practices for economic yield. Work on cardamom has not been discontinued.

The present acreage in Magome under various crops is as under:

- Lemongrass:	90 acres
(Planted from 1989 and 1990)	
- Cinnamom:	2 acres
- Vetiver:	2.5 acres
- Cardamom:	small area

Future plans:

- Lemongrass plantation will be consolidated; yield of oil and economics will be studied to evaluate its potential as an extension cash crop.
- Cinnamom will be increased to the extent of availability of seedlings and area available for planting.
- Cardamom will be increased under good cultural practices to see its performance.
- Vetiver expansion will be considered after preliminary evaluation of yield potential.

Before considering expansion of area under different essential oil bearing crops it is suggested that 5 hectares should be earmarked for introduction and trial cultivation of these crops. Separate budget should be given for this Research and Development work.

Locally available Ocimum basilicum, yielding an oil rich in methyl chavicol, and Ocimum kilimandscharicum should also be tried, as these have potential, the former as export item and the latter as an import substitution for camphor.

VI. IMPROVEMENT IN PRODUCTION OF CLOVE STEM, BUD AND LEMONGRASS OILS

Since the start of the Project, production of the oils has increased significantly. Efforts put in by the ZSTC coupled with the contacts made by the Plant Manager of the Distillery and the Marketing Manager ZSTC during their participation in the International Congress of Essential Oils, New Delhi, in November 1989, sales picked up steadily. Due to increased demand for clove oils, production tempo was maintained throughout except during April to July 1990 as a result of breakdown of boiler furnace (Details already given in C.T.A.'s Report - 16 August 1990).

Production of clove bud oil was also started during February - March 1990. It is now a regular feature of production.

Production data till June 15, 1991 on clove oils and lemongrass are reproduced here for ready reference.

Clove Stem Oil: Prior to the start of the Project, maximum production of clove stem oil was only in 1983 (735.5 tonnes of stems gave 24.40 tonnes of oil), thereafter, the processing of stems decreased substantially except during 1987 when 606 tonnes of stems were distilled yielding 27.10 tonnes of the oil. Average of clove stems distilled during 1983-1988 (6 years) was 449.5 tonnes yielding 20.375 tonnes of oil (4.53 percent yield of oil). As compared to this, after the start of the Project, processing of stems during 1989 and 1990 is as under:

<u>Year</u>	<u>Clove stem distilled</u>	<u>Oil obtained</u>
1989	650.5 tonnes	26.77 tonnes
1990	1215.9 tonnes	51.83 tonnes
1991 (Jan-15 June)	472.2 tonnes	20.13 tonnes

The Project started from July 1989. Production during Jan - June and July - December 1989 is as under:

a) Jan - June 1989	194.6 tonnes	8.00 tonnes
b) July - Dec 1989	464.9 tonnes	18.77 tonnes

At the start of the Project, 2375 tonnes of clove stems were in stock. This stock is now exhausted: during February to May 1991, 294 tonnes were purchased. There are only 256 tonnes of stems in stock (as on 23.5.91). The General Manager ZSTC is making all out efforts to procure more stems. Next crop of cloves will start from July - August when clove stems will become available.

With the regular off take of clove stems oil in the world market, mostly European, it will be of utmost importance to procure upto at least 1500 tonnes of stems if not more to maintain the gains made during 1989 and 1990 in respect of sale of clove stem oil. Sales will improve further if market in North America, Eastern Europe, Russia, and Japan is also explored.

Clove Bud Oil: Trial distillation of clove buds was started in February 1988 only distilling 1.852 tonnes yielding 271.6 kg. of oil. Since then, production of clove bud oil has been as under:

<u>Year</u>	<u>Buds distilled</u>	<u>Oil produced</u>
1988	6.40 tonnes	0.90 tonnes
1989	14.29 tonnes	1.99 tonnes
1990	54.61 tonnes	7.61 tonnes
1991 (Jan-15 June)	80.36 tonnes	11.15 tonnes

It will be seen that processing of clove buds is on the increase. SZTC has sufficient orders in hand. Estimated expected annual sale are about 20 tonnes valued at US\$ 200,000. There is likelihood of increased sales/export.

It may be mentioned here that only 4th grade of cloves i.e. khokar cloves are distilled for clove bud oil. Availability of khokar cloves is limited: extent of rains or the lack of it determines the quantum of khokar cloves. According to the standards laid down for various grades of clove, a certain percentage of khokar cloves are permissible such as:

- Special Quality: not more than 2% of stems, mother of cloves, khokar cloves.
- Standard Quality: not more than 4% of khokar cloves.
- Distribution Quality: not more than 20% of khokar cloves.

It can, therefore, be inferred that a part of the khokar

cloves are exported within the limits of their content in different grades. It is not possible to estimate availability of distillation grade clove in order to make a reasonable annual estimate of regular production of clove bud oil. Nevertheless, depending upon the size of clove crop, it seems possible to procure upto 200 tonnes of khokar cloves corresponding to 28 tonnes of oil (valued at US\$ 280,000 at the current sale price).

Lemongrass Oil: Lemongrass from Cymbopogon citratus (West Indian type) from the locally available plant material is the main crop in the programme of diversification of essential oils - bearing crops under the Project.

Lemongrass was first raised in the Distillery premises over an area of 0.75 acres. Planting material for further expansion was taken from here. Large scale planting started in early 1989 in Magome. Area is undulating with patchy forest growth. Soil pH is about 5. Land preparation could not be done properly due to availability of clear area in patches only. Latest planting was done in late 1990 bringing about 90 acres under lemongrass.

Data on yield of grass and oil will be evaluated to assess the economic feasibility of this crop.

Lemongrass plantation will be consolidated now for optimisation of produce of grass and oil.

Production of lemongrass oil has been as under:

<u>Year</u>	<u>Grass distilled</u>	<u>Oil obtained</u>
1988	Nil	Nil
1989	5.60 tonnes	6.13 litres
1990	128.38 tonnes	304.59 litres
1991 (Jan-15 June)	73.99 tonnes	211.15 litres

Cinnamon: Cinnamon plants have established well. It is proposed to raise plants as a bush with height upto 2 meters to permit ease in harvesting for both bark and leaf (for oil), spacing will be reduced for planting in order to accommodate 5000 - 8000 plants per hectare. Quality of Cinnamon bark is expected to be good if plants are raised as bush.

VII. FACTORS AFFECTING PROGRESS

Inspite of the fact that there is considerable improvement in the production of clove stem and bud oils with increased and increasing sales, certain factors beyond control affected the production. Some of the more important factors are detailed hereunder:

1. Repair and maintenance of Equipment

a) As indicated in the earlier report (26 August 1990 by Baldev Gulati) that the boiler furnace bricks started falling down. Repair was undertaken locally but it did not last long. Ultimately, specialist from the Tanzania Industrial Research and Development Organisation, Dar-es-Salaam, were entrusted with the repair job. Special cement and refractory bricks were imported from Kenya. Breakdown in the furnace caused closure of the Distillery for 4 months which affected the tempo of production. But for this, it would have been possible to process about 2000 tonnes of the raw material as against 1399 tonnes of material processed.

b) The pumps feeding water into the boiler broke down in March end 1991. Due to lack of repair facilities in Pemba, these had to be sent to Dar-es-Salaam. This affected production for 6 weeks. The production could start only from 15 May 1991. However, during January - March (3 months) 423.08 tonnes of raw material was processed which is as per the annual target of processing 1700 tonnes of the material.

c) Cooler fans, cooling hot water from condensers to ambient temperature for re-circulation are out of order. This has resulted in circulating warm water in the condensers for condensing stem-oil vapours which does not condense the vapours effectively. Further, as clove stem and bud oils, due to their high eugenol content, are soluble to an extent in water, solubility increases with the rise of temperature, their separation in condensate is not optimum. This is likely to affect the overall yield of these oils recovered.

Cooler fans cannot be repaired locally or in Dar-es-Salaam. The solution lies in getting new cooler fans from abroad which would take time. However, steps have been taken to procure these. Till such time that these are received processing of material is being done as best as possible.

(It is nevertheless an accepted fact that there is always some breakdown in a factory. It is only due to the fact that Pemba does not have repair facilities that the problems get aggravated. Taking equipment components to Dar-es-Salaam is time consuming and expensive process. Under such circumstances there is no alternative. Augmenting workshop facilities can help to an extent but cannot solve these problems).

2. Fuel for Boiler:

Clove Stem Oil Distillery is designed to use primarily exhausted clove stems and coconut shells. Clove stems which are distilled under pressure take a maximum of 6 hours but normally 5 hours for complete recovery of oil. Out of ten distillation units,

at least 8 are operated which yield about 5 tonnes of exhausted stems every 6 hours, sufficient to run the boiler without using any other fuel.

Problem of fuel arises when clove buds are distilled. Clove buds which are distilled at atmospheric pressure (to recover all the eugenyl acetate present in the buds) takes as long as 30 hours and more. Problem of fuel, in terms of exhausted stems/buds, therefore, arises. Extent of problem depends on the number of distillation units used for distillation of buds. This necessitates supplementing fuel requirement. In the year 1990 under emergency conditions use of either undistilled stems (old) or partially distilled i.e. removal of stems before recovery of full oil, was made. This was, however, not considered a healthy practice. Now that clove bud distillation is a regular feature, alternate arrangement of fuel had to be made in terms of fuel wood.

The boiler requirement for fuel as clove stems (exhausted) is about 1000 kgs per hour which comes to 100 - 150 tonnes per week (6 working days) depending on 2 or 3 shifts working. In order to achieve target (Immediate Objective - 1) of processing 1700 tonnes of clove stems/buds, arrangement for fuel wood has been made. This has put great pressure on the resources of the Distillery in terms of man power and transport, thus increasing cost of distillation. Fuel wood, which is mostly wet does not produce steam to the extent of requirement. Lack of steam at the required pressure in the boiler has affected the rate of distillation, for example, clove stems and buds take about 8 hours and 40 hours respectively for completion of distillation as against a maximum of 6 hours and 30 hours respectively. This factor is, thus affecting the overall processing capacity of the distillery. However, all efforts are being made to maintain the quantum of processing and production.

VIII. UTILISATION OF LOW GRADE STEM OIL AND 'BLACK OIL' FOR VALUE ADDED PRODUCTS

The current production of clove stem oil is done from good quality material making selective purchase of stems. Depending on the season, a sizeable quantities of poor quality stems are thus wasted. Due to improved production of the oil and its sale, it now seems imperative to purchase large quantities of stems. Clove growers are now required to be given encouragement for taking care of stems also, as also ensuring off-take of poor quality stems at suitable price. It is not possible to give an estimate of availability of low grade stems at the present but availability of a few hundred tonnes cannot be ruled out.

During the course of distilling clove stems, the condensate is collected in 2 reservoirs where some oil settles down which is collected at regular intervals. The oil even though has plus 90 percent eugenol content is 'black' in colour and, therefore, not mixed with the main production of oil for export.

Oil from the above 2 sources can be and should be utilised for production of value added products. As this work of developing value added products from these oils can be done by the present International Experts (Chemical Technologists (C.T.A.) and the Quality Control Chemist), it is suggested that this additional work should be undertaken in the Project.

Value added products envisaged from Clove stem oil and black oil are given as under:

Eugenol: Eugenol used widely in both flavour and fragrance industries is from the natural sources only: the chief source being clove leaf oil produced on large scale in Indonesia and Malagassy Republic (above 2000 tonnes per year). Zanzibar and Pemba can easily produce this oil but it needs a policy decision (Report Baldev Gulati 17 July 1984, Project SI/URT/82/803). So far, synthetic eugenol is not produced commercially.

Eugenol ex clove leaf oil is about \$ 5.0 kg i.e. nearly double the price of the clove leaf oil. Clove leaf oil contains 80-82 percent of eugenol while clove stem oil from Pemba distillery contains more than 90 percent eugenol as also oil from poor grade stems and the 'black oil'.

These oils from Pemba Distillery will, therefore, yield about 10 percent more eugenol as compared to clove leaf oil from Indonesia and Malagassy Republic.

It is quite possible that eugenol ex clove stems oil will be of better quality than that from clove leaf oil as source of such isolates has great influence on the type of raw material used, for example, linalool and geraniol produced from different sources.

Two different technologies can be employed for producing eugenol:

- a) By rectification
- b) By chemical means

Both these methods will be tried under the Project to study the best possible and economical method for eventual use under the conditions in Pemba. Market and quality evaluation will be undertaken before embarking on commercial scale production.

Iso-Eugenol: Iso-eugenol so widely used in the fragrance formulations is prepared from eugenol. Production of this chemical will be undertaken in the laboratory to study its economics. Conversion of Iso-Eugenol from eugenol is nearly quantitative. The current price of iso-eugenol is about US\$ 9.0 - 10.0 per kg. Once eugenol is produced, production of iso-eugenol will be a worthwhile proposition.

Eugenol and iso-eugenol will be source of additional flavour and fragrance chemicals such as acetates and other esters. Work on some such chemicals can also be undertaken during the Project and during its extension.

Vanillin: Vanillin ex-eugenol is no longer produced. Vanilla beans are cultivated and used even now despite their high cost. However, bulk of the world production of vanillin is a bye-product of wood pulping industry (estimated annual world demand of vanillin is 8,000 tonnes). Vanillin ex eugenol from clove leaf oil could not compete with this vanillin. However, it is also not possible to meet even a part of the world demand of vanillin from this natural source alone.

It is recorded in literature that vanillin ex eugenol is superior to that from wood pulp industry. Considering this, it may be worth while exploring possibilities of producing and marketing this. It is felt that a few tonnes of vanillin from eugenol would find a place in the world market even at higher price than that of US\$ 17 - 18 kg. for wood pulp vanillin.

It is visualised that some oil from inferior grade clove stems would be produced in the Distillery. Some quantities of black oil would also be available. These could be put to better use in making value added products.

Additional plant and machinery will be needed for the value added products. However, a preliminary study is proposed in the first instance on the following lines:

- a) Estimate average availability of inferior grade clove stems and that of black oil.
- b) Undertake cost benefit analysis of product mix of eugenol, iso-eugenol and vanillin as also additional few derivatives of eugenol and iso-eugenol.
- c) Based on the market demand of vanillin ex eugenol and production potential, suggest plant size for producing vanillin.

In case vanillin production is suggested based on the above mentioned studies, it would be advisable to purchase a plant on turn-key basis along with its technology, giving best yields. Developing and selection of technology from the available information in literature will not only involve a great deal of expense but also time. Providing additional facilities at site in the Distillery is another factor to be taken into consideration for standardising technology.

IX. PRE-TRIPARTITE REVIEW MEETINGS OF THE PROJECT

In view of the forthcoming T.P.R. meeting to be held sometime in June 1991, the Chief Technical Adviser was asked by the Government of Zanzibar to prepare a Note indicating:

- i. Progress of work with respect to the Objectives;
- ii. Extension of the Project indicating the needs of additional inputs both for technical assistance and equipment components.
- iii. Proposal to extend Project activities to the Island of Unguja.

A note was prepared in consultation with the National Project Coordinator, Mr Nasib S. Omar, who is also the Plant Manager of the Distillery at Chake Chake.

The C.T.A. and the N.P.C. of the Project were asked to meet the General Manager of the Zanzibar State Trading Corporation and the Principal Secretary, Ministry of Trade and Industries in Zanzibar. Mr Krassiakov, U.C.D. at UNDP, Dar-es-Salaam also wished to discuss with the C.T.A. and the N.P.C. various issues to be discussed at the T.P.R. meeting. Records of the meeting with the above are given hereunder. Meetings with the Officers and the General Manager of Zanzibar State Trading Corporation were held on 5 June 1991 both in the forenoon and afternoon.

In the forenoon the meeting was held with the officers of the Z.S.T.C. while the afternoon meeting was held with the General Manager and his officers.

Note prepared by the C.T.A. of the Project on Progress, need for extension of the Project and additional inputs as also for extending the Project activities to Unguja was the main basis for discussion. Summary of discussion is given hereunder:

Meeting in the Forenoon

The meeting was attended by the following:

- | | |
|----------------------------|---|
| i) Mr Hamadi Khamis Hamadi | Dy. G.M., Z.S.T.C., Pemba |
| ii) Mr Shaibu Ali Mossi | Economic Advisor, Z.S.T.C. |
| iii) Mr Nasib S. Omar | Plant Manager, Distillery,
Chake Chake |
| iv) Dr B. Gulati | C.T.A. UNDP Project |

Progress in and achievement of the Objectives, Outputs and Activities was presented by the C.T.A. The contents of the Note were discussed in details thereafter. Following suggestions were made:

- a) For achieving sustained production of the Distillery, inputs for spare parts and workshop tools to be included.
- b) Provision for separate unit for lemongrass and other crops to be kept in abeyance till such times that area under these crops is extended beyond the existing area of about 100 acres and the farmers are involved under extension programme.
- c) Urgent need for providing a pilot scale distillation units for work on the new crops was stressed.
- d) It was considered important to start work on value added products using clove stem oil from inferior grade stems and black oil. A suitable provision was suggested to be included in the future inputs by the UNDP.
- e) To strengthen Diversification of Essential Oil - bearing Crops, it was suggested to have the services of an Agronomist from UNDP/UNIDO for at least 3 months over and above the existing provision.

Meeting in the Afternoon

The following were present:

- | | |
|-----------------------------|--|
| i) Mr Abdulrahman Rashid | General Manager, Z.S.T.C. |
| ii) Mr Hamadi Khamis Hamadi | Dy. G.M., Z.S.T.C., Pemba |
| iii) Mr Shaibu Ali Mossi | Economic Advisor, Z.S.T.C. |
| iv) Mr Henry Kaleza | Marketing/Export Manager, Z.S.T.C. |
| v) Mr Ali Haji | Admin. Officer, ZSTC |
| vi) Mr Nasib S. Omar | Plant Manager, Distillery, Chake Chake |
| vii) Dr B. Gulati | C.T.A., UNDP Project |

The General Manager was briefed about the Project activities and the progress as also on the discussion in the meeting held in the forenoon.

While agreeing with the suggestions made in the earlier meeting, the General Manager, ZSTC also discussed the following:

- a) In the light of involvement of the ODA of the British Government and the International Fund for Agricultural Development (United Nations) in the development of crops in Zanzibar, including essential oil - bearing crops, it was imperative that a suitable processing facility was established in the Island of Unguja. As the existing facility at Malindi was out-dated and non-functional, a new processing facility was needed. Also, due to the expansion of Zanzibar Port, existing facility will have to be abandoned. If UNDP agrees to help both for technical and equipment, the processing facility would be established in a new place, preferrably in the Industrial

Estate, ZSTC will meet all the expenses for buildings, services, electricity and water facilities, etc. It was, therefore, important that the UNDP should not only extend the Project but also involve Unguja Island during the extension period.

- b) In their endeavour to increase their range of products with export potential such as limes and chillies, the ZSTC has actively involved the Department of Agriculture and has set aside Tsh. 3,000,000 for this work by the Department of Agriculture for the year 1991-92. If need arises, ZSTC can take the help of the Department of Agriculture for other essential oil bearing crops recommended by the Project and bear the R & D expenses.
- c) Equipment for production of lime products and clove at Malindi was evaluated by the local experts who were of the opinion that except for a part of the lime processing equipment, distillation units and the boiler could not be used. It was suggested by the C.T.A. that Project Engineer should also evaluate the entire equipment and suggest as to which of these could be used and the extent of repairs needed for putting at least part of the equipment under operation.

The General Manager suggested a meeting with the Ministry of Trade and Industries Officials to elicit their opinion about the Project extension and involving Unguja with the Project activities.

The meeting was fixed for 6 June 1991 at 10 a.m.

Minutes of Meeting 6 June 1991

The following participated:

Ministry of Trade and Industries

- | | |
|----------------------|-------------------------|
| i) Mr Issa Machano | Principal Secretary |
| ii) Mr Salmin Senga | Dy. Principal Secretary |
| iii) Mr K.K. Songoro | Director, Industries |
| iv) Mr M.M. Takrima | Director, Trade |

Zanzibar State Trading Corporation

- | | |
|------------------------------|---|
| i) Mr Abdulrahman Rashid | General Manager |
| ii) Mr Shaibu Ali Mossi | Economic Adviser |
| iii) Mr Hamadi Khamis Hamadi | Dy. General Manager Pemba |
| iv) Mr Henry Kaleza | Marketing/Export Manager |
| v) Mr Ali Haji | Administrative Officer |
| vi) Mr Nasib S. Omar | Plant Manager, Distillery,
Chake Chake |

United Nations Development Programme

i) Dr B. Gulati

Chief Technical Adviser

Progress of work in the Project and the discussions held earlier on 5 June 1991 were presented by the C.T.A. and the G.M, Z.S.T.C. The Principal Secretary, who has been in touch with the Project activities since its start expressed his satisfaction. He remarked that the Distillery at Chake Chake was the only successful venture in the Islands of Unguja and Pemba. He whole heartedly agreed regarding extension of the Project, need of additional technical assistance and inputs by the UNDP. Involving Unguja Island with the Project activities was, according to him, an essential component of "Assistance to the Essential Oils Industry" the main title of the Project.

The Principal Secretary brought to the notice of the Z.S.T.C. the urgent need to appoint a Chemist for the Distillery so as to get trained by the Project Experts. Recruitment of an Agronomist for crop diversification and farm work was also stressed.

After reviewing all the aspects of the Project, proposals embodied in the Note prepared by the C.T.A. were discussed in details. It was suggested and agreed that the Note should incorporate all the suggestions and views of the Government of Zanzibar and be discussed at the T.P.R. meeting to be held on 19th/20th of June 1991.

Chief Technical Adviser and the National Project Coordinator of the Project, after revising the Note in the light of suggestions made at the meetings in Zanzibar met the UNIDO Country Director and the Deputy Resident Representative, UNDP in Dar-es-Salaam on 11th and 12th of June 1991.

The Backstopping Officer of the Project at UNIDO Headquarters, Vienna, asked the UCD at Dar-es-Salaam, UNDP, for an updated PPER. This was prepared by the C.T.A. and the N.P.C. and handed over to the U.C.D.

The Deputy Resident Representative was briefed by the U.C.D. on the Project activities. The C.T.A. and the N.P.C. while presenting the progress also discussed various issues as enlisted in the Note for the purpose of the T.P.R. meeting.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

PROJECT IN THE UNITED REPUBLIC OF TANZANIA
DP/URT/86/026

JOB DESCRIPTION

Post title: ENGINEER

Date required: ASAP

Duty Station: Chake Chake (Pemba)

Purpose of project: Maximising the capacity utilisation of the Clove Stem Oil Distillery in Chake Chake.

Duties: The Engineer will be responsible for activities connected with the modernisation of the clove stem oil Distillery, optimisation of its capacity and introduction of appropriate steps for trouble free operations. Specifically, the Expert, in consultation with C.T.A. and the Plant and Production Managers of the Distillery will attend to the following:

- a) Design and implement an equipment maintenance sub-system with schedules and checks;
- b) Evaluate and recommend steps for safety aspects in the Factory maintenance and operations;
- c) To evaluate existing processing equipment in Malindi Factory at Zanzibar and advise repairs/modifications to bring at least part of the distillation units under operation. He will also evaluate the Lime processing units (for juice and oil) to recommend steps for its optimum utilisation;
- d) To suggest layout of a Distillery to be set up in Zanzibar at a new site;
- e) The Engineer Expert will train his national counterpart and other national personnels involved in factory equipment maintenance and other aspects of factory operations.

The Expert will embody his observations and recommendations in a report which he will be expected to prepare and present to the UNIDO upon completion of his mission.

Qualifications: An experienced Mechanical Engineer with post-graduate qualifications and considerable experience in this field. Experience in a Project/Factory of this type will be an added advantage.

Language: English.

Background Information:

Cloves (Eugenia caryophyllata) are the major crop in the Zanzibar Islands, which include Unguja and Pemba and are traditionally called the Clove Islands.

There are two major facilities for the distillation of clove buds and clove stems under the control of the Zanzibar State Trading Corporation. One is an almost obsolete plant, at Malindi, Zanzibar. The other is a modern plant at Chake Chake, Pemba Island. This project aims at upgrading the Chake Chake facility enabling two shift production and export of quality essential oils. Here is an established capacity but ensurement of maintenance is important.

The Government expects UNIDO to provide support to enhance the economic, commercial and technological structure to modernise the industry in Zanzibar.



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 2.5m/m (0.5m/m home-based work)

Date required ASAP

Duty station Chake Chake (Pemba)

Purpose of project Maximizing 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 requirements.

 b) The expert will co-ordinate the activities of the experts and will be specifically involved in the "In plant training" programme by 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.

...../...

Qualifications

An experienced Chemical Technologist with post-graduate qualifications and considerable experience in the production of essential oils and the operation of stills for this purpose .

Language

English

Background information

Cloves (Eugenia caryophyllata) are the major crop in the Zanzibar Islands, which include Unguja and Pemba and are traditionally called the Clove Islands.

There are two major facilities for the distillation of clove buds and clove stem under the control of the Zanzibar State Trading Company (ZSTC). One is an almost obsolete plant, situated at Malindi in Unguja Island. The other is a modern plant at Chake Chake in Pemba Island. This project aims at upgrading the Chake Chake facility enabling two shift production and export of quality essential oils. Here is an established capacity but ensurement of maintenance is important.

The government expects UNIDO to provide support to enhance the economic, commercial and technological structure to modernise the industry in Zanzibar.

TRIPARTITE REVIEW MEETING

PROJECT URT/86/026

ASSISTANCE TO THE ESSENTIAL OILS INDUSTRY IN ZANZIBAR.

"MAXIMISING THE CAPACITY UTILISATION OF THE
CLOVE STEM OIL DISTILLERY, CHAKE CHAKE"

A NOTE ON THE PROGRESS OF WORK, FUTURE ACTIVITIES,
ADDITIONAL INPUTS NEEDS AND EXTENSION OF THE PROJECT

Prepared by: Dr. Baldev Gulati
Chemical Technologist (Essential Oils)
Chief Technical Adviser

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I. 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 visualised to generate export upto 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 as per Proposal submitted for consideration now.

Production and export figures are attached for reference. (Annexure 1 and 2).

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 partially. Spare parts can be ordered further only when more funds are provided. Please see annexure 3 for reference.

- | | | |
|-------|--|---|
| 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 is abroad for training. |
| 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 | <u>Output - 2</u> : 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. Modifications if and when required will be undertaken. |
| 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. | <u>Immediate Objective - 2</u> : Selection and trial propagation of essential oil - bearing plant species based on International Market prospects. | |
| 2.1 | <u>Output - 1</u> : 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. Another local species 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.

<u>Activities</u>	<u>Progress/Status</u>
2.3.1 Modify distillation equipment to enable it to distil essential oils from species selected under 2.1.	Completed for distilling lemon-grass and for oils lighter than water. Major modification of the existing units not considered advisable.
2.3.2 Experimentally distil essential oils from species selected under 2.1.	Under progress as an on-going activity. However, Distillation until (pilot scales) is required which will be purchased when funds become available.

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:

<u>Activities</u>	<u>Progress/Status</u>
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. Report of Marketing Expert has been received.

- 3.2 Output - 2

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

<u>Activities</u>	<u>Progress</u>
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.

II. Budget Utilisation and Constraints: Proposal for Additional Funds

Equipment components of the budget i.e. expendable and non-expendable at US\$ 20,000 and US\$ 85,500 respectively, comes to about 25 percent of the total budget. While technical assistance and training components have been suitably taken care of, equipment allocation is considered inadequate. Following expenditure has been incurred so far on equipment:

<u>Item</u>		<u>Value (US\$)</u>
1. <u>Vehicle</u>		
i) Nissan Pickup	one	9,926
ii) Motor bike	one	1,893
2. <u>Spare Parts</u>		
i) Hoist		4,331
ii) Electrical		12,030
3. <u>Laboratory Inputs</u>		
i) G.L.C.		32,020
ii) T.L.C.		4,086
iii) Glass apparatus		14,247
iv) Equipment		24,709
v) Chemicals		1,469
	Total US\$	<u>104,711</u> =====

It will, therefore, be seen that while budget allocation has been fully utilised, some essential items are still needed. These are listed hereunder:

- i) Distillation unit for clove bud oil with cohobation and steam jacket (to standardise distillation parameters);

- ii) Pilot scale distillation unit;
- iii) Boiler (Capacity 1000 kg/hr);
- iv) Processing Unit for limes for juice and oil;
- v) Workshop tools/spare parts;
- vi) Truck;
- vii) Nissan Pickup Van Double Cabin;
- viii) Cohobation Assemblies for existing units (4).

Note: Item Nos. i, iii & iv will be installed in Zanzibar, if approved.

III. Justification

Justification for the purchase of the above listed items are given as below:

- i) Distillation unit for clove buds: The existing distillation units are designed specifically for producing clove stem oil; clove buds on the other hand, are distilled at an atmospheric pressure and preferably without interruption for 24 to 30 hours. More important aspect of distillation of clove bud is cohobation which gives an oil true to nature as also in better yield. (Distillation without cohobation can result in a lower yield by 15 to 20 percent which could come to 5 - 10 kg of oil per ton of the clove buds distilled).

Now that clove bud oil is a regular item of production, it is absolutely essential to procure one unit of about 3000 litres capacity with cohobation arrangement. This will enable us to standardise distillation of clove bud to produce an oil of better quality and in improved yield.

- ii) Pilot scale distillation unit: At the present, plant materials can be distilled in the laboratory in batches of 100 - 200 gms only which does not give sufficient quantity of oil for both physico-chemical and other evaluations. Next to distillation on this batch size are units which take a charge of 700 kgs or above of plant material for distillation. It is, therefore, absolutely essential to have unit which can take a charge of about 50-60 kgs to produce sufficient product under various parametes for complete study. Such a distillation unit affords an opportunity to work on not only established products but also new aromatic raw materials. It is pertinent to mention that both flavour and fragrance industries are looking for new essential oils.
- iii) Workshop tools and spare parts: Clove Stem Oil Distillery has a small workshop which caters to day to day repair and maintenance work. It is, however, not fully equipped with the necessary tools and machines for taking care of most of the

vital aspects of repair and maintenance. The Island of Pemba is not only not connected with Zanzibar and Mainland of Tanzania but does not also have local requisite facilities of repair, maintenance and essential spare parts for equipment.

It is, therefore, of utmost importance that the Distillery should have its own facilities for repair, maintenance and for fabrication of small components. The existing workshop facilities should be augmented to make the Distillery self-sufficient to a large extent.

Some of essential spare parts for the Distillery and vehicles which could not be procured earlier are now included.

List of workshop tools and spare-parts is given at annexure-3.

- iv) Truck and Pickup Van (Double cabin): Within the budget allocation under the Project, as stated earlier, it was not possible to purchase a truck as one of the essential requirements of the Project mentioned in the Project Document.

At the present, there is no suitable transport for the use of the Project Experts to perform their duties effectively especially for the Diversification of Aromatic Crops which is an important aspect of the Project. One pickup van was purchased under the Project. However, this pickup van does not have seating capacity for more than 1 or maximum 2 persons.

It is, therefore, strongly recommended that reasonable transport facility must be provided in the Project without which the time and services of Experts cannot be utilised effectively.

- vii) Planting material: Under the programme of diversification of essential oil-bearing crops, it is advisable to import and introduce planting material of improved quality. It is also recommended that sufficient planting material of recommended species to cover 1 - 2 hectares each should be imported. To begin with, planting material of the following species is envisaged:

- Citronella (Java type)
- Palmarosa
- Lemongrass of improved variety
- Basil, French and Reunion types
- Vetiver

IV. Proposal for work in Unguja Island

The current Project DP/URT/86/026 is concerned entirely with developing the essential oil industry in Pemba through the Clove Stem Oil Distillery at Chake Chake with the following Objectives;

- i) Upgrading of Clove stem oil Distillery to process 1700 tons of cloves stem and/or clove buds per year.
- ii) Development and Cultivation of different species of essential oil-bearing plants for diversification purposes.
- iii) Development of marketing strategy for increased sale of clove stem/bud and other essential oils.

The Project which started form July 1989 has progressed well and is expected to achieve fully the Objectives set in the Project Document.

During the course of work in the Project it was realised that if the activities are extended to cover the Island of Unguja (Zanzibar), the pace of development of essential oil industry in the Islands will be much more than if confined only to Pemba. The current Project with some additional funds can take care of the increased work.

Reason for extending the Project activities to Unguja, is as under:

Prior to the establishment of Pemba Distillery, Zanzibar was the only place where clove stem oil and lime oil were produced. Even though Distillery at Zanzibar is no longer functional, the Island of Unguja still has potential for producing essential oils. It is now more relevant as the UNDP Project has embarked upon diversification of essential oil bearing crops suited to Pemba which also holds good for Unguja.

In view of this, it would be advisable to extend the scope of Project work to Unguja also. As the current team of Experts will be able to do this work to a great extent, additional requirement of funds will be only for equipment.

It is suggested that production of essential oils, mainly, clove bud and lime oils should be taken up in Zanzibar. Production of clove bud oil will enable Pemba Distillery to concentrate on stem oil, lemongrass and other oils. It is also essential to revive processing of limes for juice and oil in Zanzibar due to its excellent quality very well received in the International market. Work is going on to increase production of limes in Unguja. In due course, other items will be added for production in Zanzibar.

Work in Unguja will, take care of interruptions due to breakdown (unforeseen) in Pemba Distillery and help maintaining regular supplies of clove stem and bud oil for export. This will ensure and maintain International market on sustained basis.

V. Programme of work at Zanzibar

Extension of Project activities to the Island of Unguja (Zanzibar) will not only enhance the processing capacity of aromatic plant material but will also have a great impact on the foreign exchange earnings of the Government of Zanzibar. ZSTC has experienced personnels in the distillation of clove stem and bud oils, as also for processing lime for juice and essential oil in Zanzibar. The activities envisaged under this programme are:

- i) Selection of site for installation of processing equipment, in case the same is not to be located at Malindi, the previous site of processing facilities.
- ii) Providing buildings by ZSTC for installation of processing equipment.
- iii) Engineer from the Project to evaluate the existing processing equipment at Malindi to suggest if the same or a part of it could be used after modifications and repairs.
- iv) Select a suitable boiler with specification and distillation unit to be ordered from UNDP funds.
- v) Installation of the above and trial distillation and standardise and stream-line processing of clove stems and buds and limes for optimum utilisation of the capacity.

Quantum of Processing and Benefits

To begin with clove buds and stems (especially clove buds) will be processed with the technical assistance from the Project, processing will be standardised on a minimum of 2 shift basis. Based on 2 shifts for 200 working days, the product mix for clove bud and stem oil would be:

- Clove buds to be processed 52 tonnes/annum
- Clove stems to be processed 126 tonnes/annum

The above will yield 6760 kgs bud oil and 6300 kgs stem oil valued at US\$ 67,600 and US\$ 31,500 respectively (total US\$ 99,100).

In case distillation unit of 4000 litres capacity is used the production of these oils would be:

-	Clove bud oil	8450 kgs.	value	US\$	84,500
-	Clove stem oil	8400 kgs.	value	US\$	42,000
			Total	US\$	126,500

In case one or two units from the existing Malindi Factory can be modified/repared, the production capacity will increase accordingly.

Lime oil and Lime juice: The Government of Zanzibar is reviving cultivation of lime to increase current production from about 50 tonnes to may be, 1000 tonnes per year in the future. Large quantities of limes will be available for processing. Currently, about 25 tonnes of limes are processed. Lime oil produced in Zanzibar is very well received in the world market.

As per available data from the Malindi Factory in Zanzibar yield of lime juice and oil per tonnes of limes is as under:

<u>Lime</u>	<u>Juice</u>	<u>Oil Yield</u>
1000 kgs.	200 - 250 litres	1.5 - 2.0 kgs.

However, yield of oil with modern equipment is about 100 percent more than obtained in Malindi at the present. Value of products from 1000 kgs. of lime is estimated at about US\$ 200. The return from limes will go on increasing year by year with the increase in lime production. Overheads in the Zanzibar distillery will also reduce thereby.

VI. Extension of the Project

The Project has provision for the following experts for the duration listed as under:

<u>Expert</u>	<u>Duration</u>	<u>M/M used</u> (Till todote)
i) Chemical Technologist (Essential Oils) C.T.A.	12 m/m	9.25 (including current mission)
ii) Analytical Chemist	2.5 m/m	0.50
iii) Agronomist	3.0 m/m	1.00
iv) Marketing Expert	2.0 m/m	2.50
v) Engineer	2.0 m/m	Nil
vi) Perfumer	1.0 m/m	Nil
Total	22.5 m/m	13.25

It will be seen from the above that only Marketing Expert has completed his mission. The C.T.A. has completed three quarter of his assignment. The Agronomist, Analytical Chemist, Engineer will complete their assignment as soon as all the inputs relevant to their mission are received at site. The Perfumer will join the

Project when sufficient samples of essential oils are produced from trial distillation of clove stem and bud and locally available aromatic plants. All the man-months are, therefore, expected to be utilised fully by end of 1991.

The production and sales of clove stem and bud oil in the past (as per data in the Project Document) and the export of clove stem and bud oil was as under:

<u>Year</u>	<u>Export of oil of (kg)</u>			<u>Sales (US\$)</u>
	<u>Clove Stem</u>	<u>Clove Bud</u>	<u>Lemongrass</u>	
1984	1,320	---	---	12,125
1985	9,040	---	---	64,300
1986-87	4,926	---	---	31,452
1987-88	14,740	---	---	102,619
1988-89	20,200	1,900	---	152,230
1989-90	30,992	1,540	---	220,460
1990-91	60,940	12,340	0.10	438,000

A few more orders for stem and bud oil are to be completed before June end 1991.

It will be observed from the above data that production and sale of both clove stem and bud oil has increased after the start of the UNDP Project. During the Project period, oil of lemongrass is also being produced on commercial scale. Due to efforts of ZSTC there is perceptible improvement in the sale of these oils with the prospects of further improvement in the future. Sales of clove bud oil is also expected to improve substantially due to its standard quality and competitive prices.

One of the immediate objective of the Project is to process 1700 tonnes of clove stem and/or buds equivalent to about 100 tonnes of the oils. Processing of this quantity is feasible as was seen from actual work in the Project. (Clove stems 1315.9 tonnes giving 51.83 tonnes of oil and 54.61 tonnes of clove buds giving 7.6 tonnes of oil besides 128.36 tonnes of lemongrass giving 305 litres of oil, making a total of about 1400 tonnes of material distilled: the factory worked for only 8 months during 1990. Computing these figures, it may be inferred that achievement of production of about 100 tonnes of stem and bud oil worth US\$ 500,000 per annum is an achievable target. However, to achieve these figures of sales and export on a sustained basis will need concrete efforts of both UNDP and the Government of Zanzibar (through ZSTC).

It can be safely inferred that UNDP Project has contributed substantially to the overall improvement of the rehabilitation of the Pemba Distillery resulting in improved production, sales and foreign exchange earnings. Considering overall view of the situation such as achievement of objectives, outputs and activities and progress of work, future scope and creation of capacity and capability in the Distillery, it would be necessary for additional technical inputs in the Project. Provision of additional 12 man months i.e. 6 m/m for the Chemical Technologist (Essential Oils), C.T.A. 3 m/m for Agronomist and 3 m/m for short term consultants would be in order.

It is also relevant to mention that we visualise production of additional essential oils both from introduced cultivated crops as also from the locally available aromatic plants resources. Work on the essential oils from such sources is an on-going regular activity of the Project with expected positive results.

Need for additional UNDP inputs/equipment, technical support both for extension of the Project and work at Unguja is as under. ZSTC contribution is also given hereunder:

VII. Budget: Extension of the Project: 2 years

International Experts

<u>BL</u>	<u>US Dollars</u>
11-01 Chemical Technologist (Essential Oils) C.T.A. 6 m/m	60,000
-- -- Agronomist 3 m/m	30,000
11-50 Short Term Consultants 3 m/m	30,000
31-00 Fellowships)	
32-00 Study Tours)	20,000
41-00 Equipment Expendable for value Added Products	20,000
42-00 Non-expendable Equipment (Details overleaf)	280,000
51-00 Sundries (Planting material)	10,000
Total	450,000
	=====

List of Expendable Equipment

1. Distillation Units		
a) Clove bud oil with cohobation and steam jacket	1	50,000
b) Pilot scale distillation unit (capacity 300 litres)	1	10,000

2.	Processing unit for limes (for juice and essential oil)	1	40,000
3.	Boiler: capacity 1 ton/hr.	1	50,000
4.	Workshop tools and spare parts		50,000
5.	Truck (7 tonnes)	1	30,000
6.	Nissan Pickup Double Cabin Van Diesel, 4 wheel drive	1	15,000
7.	Cohobation essembles for existing units at Pemba	4	20,000
8.	Generator - 70 KVA	1	15,000
	Total		US\$ 280,000 =====

VIII. Government of Zanzibar Inputs (Local Currency)

Government of Zanzibar through ZSTC has already contributed substantially towards the Project work. It also proposes to contribute further inputs in case Project is extended.

Inputs contributed

<u>Item</u>	<u>T.Sh. (million)</u>
1. Land for cultivation of aromatic plants (diversification programme of the project), clearing and other expenses	8.700
2. Tube well provided for the Distillery to augment water supply	3.150
3. Additional water storage tanks	1.000
4. Modification of laboratory	1.500
5. Appointment of full time personnel for project work (Agronomist, Chemist, Lab. technical assistants, driver)	0.300 (per annum)
6. Personnel already committed for project work	0.150 (per annum)
7. Running and maintenance of project vehicle	0.500
8. Spare parts, special lacquered drums through "import support"	38.000
9. Repair of boiler furnace (Material and Labour)	2.000
Total	55.300 =====

Proposed additional inputs

1.	Buildings for new distillation units (at Zanzibar and Pemba), boiler, shed, stores, offices, etc.	7.000
2.	Storage vessels for lime juice and other products	2.000
3.	Tube well for assured supply of water	3.000
4.	Any other unforeseen requirement	1.000
	Total	13.000 =====

PRODUCTION OF ESSENTIAL OILS: 1983 - MAY 1991 (in tonnes)

<u>Year</u>	<u>Clove Stems</u>		<u>Clove Buds</u>		<u>Lemongrass</u>	
	<u>Stems Distilled Oil</u>	<u>Oil</u>	<u>Bud Distilled Oil</u>	<u>Oil</u>	<u>Grass Distilled Oil</u>	<u>(in litres)</u>
1983	735.5	24.40	--	--	--	--
1984	425.0	22.70	--	--	--	--
1985	311.9	17.74	--	--	--	--
1986	195.3	10.00	--	--	--	--
1987	606.7	27.10	--	--	--	--
1988	422.8	20.31	6.40	0.90	--	--
1989						
Jan/June	194.6	8.00	7.19	0.96	--	--
July/Dec	464.9	18.77	7.10	1.03	--	--
Total	659.5	26.77	14.29	1.99	5.60	6.13
1990	1215.9	51.83	54.61	7.61	128.38	304.59
1991						
Jan.	67.80	3.54	2.80	0.38	14.30	25.65
Feb.	139.30	5.68	4.70	0.62	29.50	86.05
March	129.50	5.40	19.88	2.83	14.25	31.60
May	96.63	3.78	33.95	4.78	9.14	23.40
Total	433.23	18.40	61.33	8.61	67.19	166.70

- a) During 1990 there was no production for 4 months (April - July) due to boiler furnace breakdown.
- b) Production started from 15 May 1991 after repairing 2 boiler pumps.

TOTAL MATERIAL DISTILLED (IN TONNES)
(Clove stem + bud + lemongrass)

<u>Year</u>	<u>Material Distilled (Tonnes)</u>
1983	735.50
1984	425.00
1985	311.90
1986	195.30
1987	606.70
1988	429.20
1989	675.92
1990	1398.89
1991 (Jan/15 June)	626.55

S U M M A R Y:

Raw Material Processed

During 1983 - 1988 (6 years)

During 1989 - 1991 (2 years &
4 months)

Total 2703.65 tonnes
Average/year 450.60 tonnes

2636.56 tonnes
1129.95 tonnes

MACHINE AND TOOLS FOR WORKSHOP

1. Milling machine, medium column & knee type (with all necessary accessories, attachments and tools).
2. Lathe machine (medium size) with all necessary attachments and tools.
3. Tool and cutter grinder - with all necessary accessories.
4. Shaper (medium size) mechanical with all necessary accessories, attachments and tools.
5. Medium size horizontal hacksaw machines.
6. Megger tester.
7. Mechanical spanner box with various tools.
8. Injector tester.
9. Stainless steel welding rods.
10. Aluminium welding rods.
11. Drawing board and drawing instrument set.
12. Differential protection - Electronic
Vigirex RH 113
Merlin Gerin France.
220 V. 0 40 mm.
13. Electrovalve - RAV 12, IEC 158.1
14. Contactor - 20A 500V 50/60 HZ
15. Contactor - RAV 8, IEC 158.1
16. Contactor - 20A 500V 50/60 HZ
17. Contactor - RCC V R DV
18. Water pump - BLOC AC 11
500V 8A
Breguet - K5B
type WKL 32-8
NO T 981000/1 - 061
Q 3.65 m³/h H146m.c.l.
n 3000 tr/mn.
19. Chain Block - 2 tones
20. Vacuum pump - LOHE 25309
BN 131 010
NO 2 678.877
Vacuumeter 0.760
21. Hydropump - Type HLS/IP
No. 103263 S Annes 81
KW 0.3791 05 HZ 50
Tr/mn 1500 PHI
22. Drain valves - 100 PN 10
23. Step down transformer - 50 HZ 160 VA Class E
Norme 052210
No 4544

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

This is the Technical Report of the fourth mission of the Chief Technical Adviser. The report is comprehensive and describes in detail the work carried out and the outputs achieved during this short mission.

He has assisted in the diversification of the cultivation of aromatic plants and improved the processing technology to produce essential oils of export quality. As a result the export earnings from essential oils have been increased. The production of clove stem oil is a notable contribution that has been made.

The report also includes the report of the CTA and his recommendations for the TPR meeting held in June 1991. His recommendations which were favourably considered at the TPR meeting resulted in the extension of the project duration with some additional funds. Further a Techno-economic study has been agreed to in order to study the feasibility of extending the project's activities to Unguja.

The BSO agrees with the recommendations made in the report and hopes that the Government and UNDP will consider them favourably to add to the success of the project.