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# **DATES PROCESSING,**

**IS/PDY/74/004**

**DEMOCRATIC YEMEN.**

**TERMINAL REPORT**

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



**United Nations Industrial Development Organization**

United Nations Development Programme

DATES PROCESSING

IS/PDY/74/004

DEMOCRATIC YEMEN

Project findings and recommendations

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

Based on the work of Baha H. Shubbar, expert in date processing

United Nations Industrial Development Organisation

Vienna, 1976

Explanatory notes

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

The monetary unit in Democratic Yemen is the dinar (YD). There are one thousand fils to a dinar. During the period covered by this report, the value of the dinar in relation to the United States dollar was \$US 1 = YD 0.343.

A slash between dates (e.g. 1974/75) indicates a crop year or financial year.

Use of a hyphen between dates (e.g. 1974-1975) indicates the full period involved, including the beginning and end years.

In this report, the term "production year" means one hundred days unless otherwise specified.

A full stop is used to indicate decimals.

References to "tons" are to metric tons unless otherwise specified.

References to gallons are to British imperial gallons; one British imperial gallon equals 4.545 litres.

The following forms have been used in tables:

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

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

A blank indicates that the item is not applicable.

Totals may not add precisely because of rounding.

UCM refers to the Union of Co-operative Marketing of Fruits and Vegetables.

Besides the common abbreviations, symbols and terms, the following have been used in this report:

behar	136 kg (approx.)
kWh	kilowatt hour
1 acre	0.4 hectare (ha)
ppm	parts per million
Btu	British thermal unit
c and f	cost and freight

Figures in square brackets are keyed to references listed at the end of the report.

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SUMMARY

The project "Dates Processing" (IS/PDY/74/004) of the United Nations Development Programme (UNDP) in Democratic Yemen was carried out by an expert from the United Nations Industrial Development Organization (UNIDO) which was the executing agency. The mission lasted four months, starting on 18 November 1975 and ending on 17 March 1976. UNDP contributed \$14,080 toward the project.

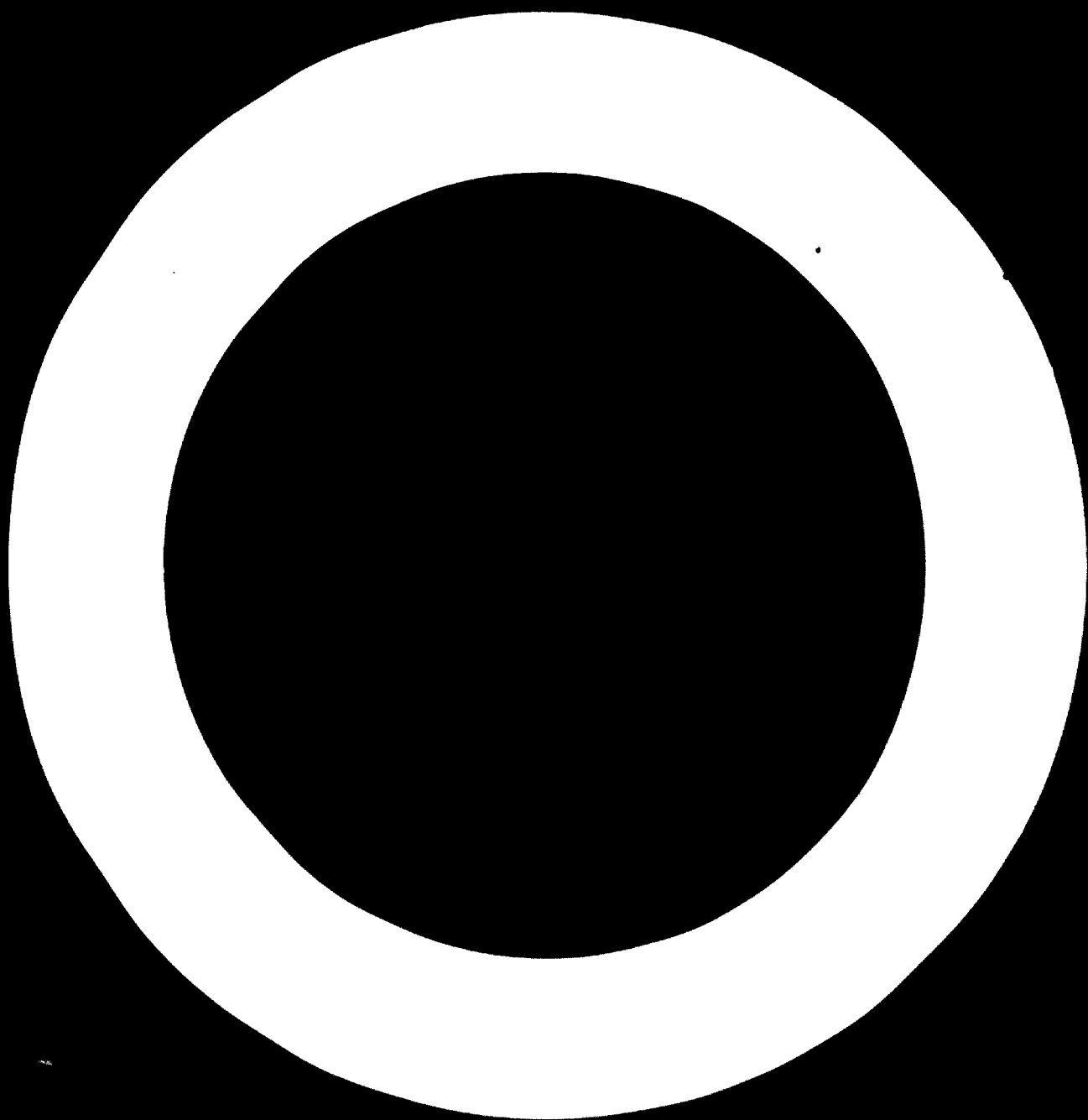
The main objectives were (a) to study the feasibility of setting up facilities for the processing and packing of dates; and (b) to study the economics of setting up an associated distillery based on the wastage of such dates.

Dates are a staple food in Democratic Yemen and good varieties exist, but for various reasons there has been a decline in their quantity and quality. The expert studied the methods of harvesting, transportation, packing and storage of dates and evaluated market procedures. He also investigated the feasibility of establishing a brewery, as during 1975 Democratic Yemen imported an estimated 118,000 l of distilled alcohol valued at YD 65,000 and paid for in hard currency. Over half of this quantity was in the form of alcoholic beverages; the rest was industrial alcohol.

The expert recommended that three date-packing plants be established; one in the present Five Year Plan for 1974/75-1978/79 and two during the next Five Year Plan for 1979/80-1983/84. He also recommended that an associated distillery be established.

The establishment of the plants and distillery would (a) enable Democratic Yemen to meet local demand for dates and alcohol and have a date surplus to export; (b) provide employment; and (c) achieve considerable savings in hard currency which is presently being spent on the importation of dates and of alcohol.





## INTRODUCTION

An expert in date processing arrived in Democratic Yemen on 18 November 1975 to start work (annex) on a project of the United Nations Development Programme (UNDP) entitled "Dates Processing" (IS/PDY/74/004). The duration of the project was four months; and the executing agency was the United Nations Industrial Development Organization (UNIDO). UNDP contributed \$14,080 toward the project.

The economy of Democratic Yemen is mainly agricultural although the Government is attempting to diversify it. Priority for industrialization is given to locally available raw materials. So far, little attention has been paid to date growing although dates are a staple food and the country's only source of raw sugar. The total palm acreage is estimated at 15,000 ha (most of it in the fifth governorate) which represents 16% of the cultivated area of the country. Although good varieties of dates exist, there has been a noticeable decline in both quantity and quality owing to: (a) the absence of preventive measures against pests and plant diseases; (b) inadequate irrigation; (c) lack of fumigation, packing and storage facilities; and (d) the fact that there is no specific ministerial department responsible for the development of date growing.

As a result of this decline, production costs have increased and dates are being imported at the rate of 7,000 tons/year at a value of YD 375,000 and paid for in hard currency.

The expert recommended that:

1. A specific department of the Ministry of Agriculture be made responsible for efforts to increase and to improve palm tree plantations, to provide adequate irrigation facilities and to institute pest and disease control.
2. Three date-packing plants be established in the important date-growing area in the fifth governorate; the first during the present Five Year Plan for 1974/75-1978/79 at Seyoun in the fifth governorate and the other two during the next Five Year Plan for 1979/80-1983/84.
3. An associated distillery be established whose output would be based on wastage of dates from the nearby packing plants.

During 1975, Democratic Yemen imported an estimated 118,000 l of distilled alcohol valued at YD 65,000 and paid for in hard currency. Over half of this quantity was in the form of alcoholic beverages; the rest was industrial alcohol. The estimated output of the proposed distillery would be 210,000 l of ethyl alcohol to be used for human and industrial consumption. This production capacity would satisfy the country's requirements for the next ten years. Initially, the distillery will run at one-third capacity; as production increases costs will be reduced accordingly.

The establishment of the plants and distillery would (a) enable Democratic Yemen to meet local demand for dates and alcohol and have a date surplus to export (there are also limited opportunities for the export of alcohol); (b) provide employment; and (c) achieve considerable savings in hard currency which is presently being spent on the importation of dates and alcohol.

## I. DATE PACKING AND PROCESSING PLANT

### A. Findings

#### Economic background

The development of the agricultural sector is of considerable importance in the current Five Year Plan of Democratic Yemen [1]. The aims of the Plan include an increase in the total cultivated area, reclamation of new land and diversification of agricultural production such as cereals, cotton, tobacco and vegetables. Much attention is given to the establishment of industries utilizing locally available raw materials with a view to reducing imports. The current Five Year Plan includes the establishment of a date-packing plant of 1,000 tons/year capacity to be completed in 1979. The total cultivated area in Democratic Yemen during 1973 was 227,400 acres (91,000 ha) and the total agricultural production was valued at YD 13.59 million. The annual tonnage of dates harvested was 40,000 valued at YD 1.08 million [1]. The acreage of palms was 4,000 ha [1]. The major date-growing area is located in the fifth governorate; less important areas are scattered in the second, fourth and sixth governorates.

The ratio of the date-growing area to the total cultivated area is 4.4% whereas the ratio of date value to the total value of agricultural production is 7.9%. The current Five Year Plan does not include any stipulation for the development of date production in the country.

According to available statistics and estimates, the total date production for the fifth governorate during 1974 and 1975 was 7,500 and 6,600 tons respectively. This represents a large decrease from the usual figures for good seasons which fluctuate between 20,000-25,000 tons annually [2]. Palms are cultivated on an area estimated at 12,175 ha and having 1.5 million palms which are irrigated by both ground water and flood water.

#### Growing areas

The date-growing areas are:

1. The Hadramaut valley (northern and middle districts including Sah, Seyoun, Shebam, Terim and Qatan).
2. The western district (including Wadi AL-Ain, Douan, Hareetha, Wadi Amad, Al-Hajrain).
3. Wadi Hadjar (the revolution district including Al-Goul, Al-Sadarah and Al-Geswel).
4. The coastal area (southern and eastern districts including Ghail-Bawasir, Al-Fuwah and Al-Shahar).

The estimated palm acreage and date production for 1975 are shown in table 1.

Table 1. Date production in the fifth governorate (1975)

Date-growing area	Production (tons)	Number of palms	Area (ha)	Density of palms (palms/ha)	Yield (kg/palm)
Wadi Hadramaut	2,484	494,700	3,982	124	5
Wadi Hadjar	1,485	450,000	3,820	118	3.3
Wadi Al-Ain, Douan, Amad	2,500	400,000	3,400	117	6.25
Coastal area	<u>131</u>	<u>155,300</u>	<u>973</u>	159	0.85
Total	6,600	1,500,000	12,175		
Over-all				123	4.4

The date crop of Wadi Hadramaut in 1973 was reported [3] to be 9,330 tons which represents nearly four times the yield of 1975. The difficulties facing date production include:

- (a) Insufficiency of water especially in areas which are irrigated by flood water;
- (b) Crop loss during ripening caused largely by insects but partly also by winds and rain;
- (c) Shortage of manpower and an increase in wages in some date-growing areas which leads to a high cost of production.

The estimated number of palms in Democratic Yemen is 2 million. The total palm acreage is estimated at 15,000 ha which is 16% of the total cultivated area as against 4.4% reported in the current Five Year Plan. The 1975 date tonnage is estimated at 10,000 tons valued at YD 450,000 which is 2.9% of the total agricultural production. In a good season, the total date production is estimated to be 30,000 tons [4]. The production of 1975 is only 33% of this figure.

The actual and estimated statistics of date-growing areas, date consumption and varieties in the fifth governorate are listed in table 2.

Table 2. Date production, consumption and crop difficulties in the fifth governorate (1975)

Date-growing area	Production (tons)	Number of palms (thousands)	Area (ha)	Daily consumption kg/capita	Varieties	Crop difficulties
Wadi Hadjar	1,485	540	3,820	0.36	Suktry	Insects and crop diseases
Seyoun	410	132.9	1,128	0.12	Hamrah Hashidy Hajiry	Insects, insufficient care due to manpower shortage
Sah	550	73.6	625	0.23	Hamrah Hashidy Jizaz Mijrif	Insects and crop diseases
Shebam	354	57.4	270	0.12	Madiny Hamrah Mijrif	Insects, manpower shortage and floods
Terim	641	56.8	482	0.12	Hamrah Madiny Mijrif	Insects, insufficient care and water
Qatan	529	174	1,477	0.12	Hamrah Jizaz Hajiry Mijrif	Insects, insufficient care and water, manpower shortage
Wadi Al-Ain, Anad, Duan, Hareetha	2,500	400	3,400	0.36	Jizaz	Insects, diseases and water shortage
Fuwah and Ghail-Bawasir	131	155.3	973	less than 0.25	Suktry Hamrah	Insufficient care due to manpower shortage
<b>Total</b>	<b>6,600</b>	<b>1,500</b>	<b>12,175</b>			

### Varieties and grades

The date varieties produced in Democratic Yemen include the following: Hamrah, Hashidy, Jizaz, Hajiry, Suktry, Madiny, Mijrif and Arkadi. All varieties belong to the soft and semi-dry date groups and are dark fruit (brown, and dark brown to black) with the exception of Jizaz and Arkadi which are light brown. The Hamrah date is the dominant variety in the fifth governorate, especially in Wadi Hadramaut, and constitutes more than 70% of the total crop [2]. The Jizaz and Hamrah dates are the dominant varieties in the western district, and the Suktry and Hamrah dates constitute the major crop in Wadi Hadjar and the coastal area. As far as size, weight, taste and colour of the dates are concerned, investigation shows that the standard quality of the Hamrah and Suktry dates is not as high as that of the Jizaz dates. Results of grading tests carried out on Hamrah, Suktry and Jizaz dates are given in table 3.

Table 3. Grading results  
(%)

Variety	High quality (selected)	Good average quality (GAQ)	Low grade
Hamrah and Suktry	10	70	20
Jizaz	40	50	10

Hamrah and Suktry dates are mostly suitable for selling in bulk in the local market whereas Jizaz dates are suitable also for fancy retail pack and for export markets.

### Consumption

In many rural areas in Democratic Yemen, dates are still considered to be a staple food and are consumed daily either whole or as a paste or sweet mixed with other food. The rate of consumption varies from 0.12 to 0.36 kg/day per capita according to the availability and prices of substitutes such as tea, sugar, sweets and fruits. Growers store in their houses up to three behars (approximately 400 kg) for annual consumption which amount fluctuates with

seasonal production. Local demand for dates is higher than the present local production. To compensate for the shortage approximately 7,000 tons of dates are imported annually from Iraq. These are valued at YD 375,000 and paid for in hard currency.

#### Evaluation

The Government of Democratic Yemen is making effective efforts for the agricultural development of the country but these exclude palm growing and date production. As a result, date production has been left, for many years, to the private growers and the agricultural co-operatives neither of which are technically or financially capable of managing the development of palms and dates without the guide and support of a responsible agricultural department.

Many growers are shifting their attention to other, more profitable, crops and giving less care to date production which leads to a low yield of dates and a high cost of production. The longer this situation continues the more growers leave date production and shift to other crops. As a result, the country will continue to be dependent on the importation of dates. In addition, a decrease in date production will impede the establishment of industries dependent upon dates which are at present the only available source of raw sugar in the country.

The potential for increasing date production in Democratic Yemen is as follows:

- (a) Climatic conditions in many areas of the country are suitable;
- (b) Growers have experience in growing palms;
- (c) Dates are still considered in many rural areas to be a staple food which is consumed all year round;
- (d) The local demand for dates is higher than production. This leads to importation from abroad and the spending of hard currency;
- (e) Increasing date production should lead to the successful establishment of new food industries which will contribute to reducing importation;
- (f) Producing more dates creates better opportunities for the exportation of good varieties to neighbouring countries;
- (g) An increase in palm plantations will make available more cellulose raw material for future fibreboard and paper industries.



Handling, packing and marketing

Dates are harvested every August by hand. The crop is left to dry for some time in the sun to preserve it. It is then packed in a primitive, unhygienic way in locally-made baskets of different sizes. Part of the crop is manually pitted and packed tightly inside ceramic jars, tin canners etc. No proper cleaning, washing, grading or fumigation is carried out. Due to the absence of proper fumigation and storage facilities, considerable deterioration in date quality occurs. Some of the dates are harvested while in the rutab (fresh) stage, packed in 18-20 kg boxes and sold locally to the Union of Co-operative Marketing of Fruits and Vegetables (UCM) which is a public sector organization. Since 1972 date growers have been gradually recruited into production co-operatives and there are now nine co-operatives scattered in all date-growing areas (excluding the western district).

After the harvest, the growers receive their share either in cash or fruit. A duty of 6% of the value is imposed by the Government. The surplus is packed manually into baskets of 35 kg each and sold to UCM. The following prices are for 1975.

<u>Variety</u>	<u>YD/ton</u>
Hamrah	35
Jizaz, Hajiry, Mijrif, Madiny	45
Suktry (a special price for Wadi Hadjar which is a remote area)	54
Rutab (fresh) dates	50

These prices are fixed annually by the Government.

Of the total net income of the date crop, 70% goes to the growers and the remaining 30% is kept for the development of the co-operatives. Growers often sell their share of dates, especially when there is a shortage, to private buyers as they pay better prices than the Government. However no wide fluctuations have been reported in the Hamrah date price in the Hadramaut valley. The private selling prices of the 1975 date crop in various growing areas are listed in table 4.

Table 4. Private selling prices, 1975

Area	YD/behari	YD/ton	Variety
Al-Goul (Wadi Hadjar)	2.25 <sup>a/</sup>	65	Suktry
Ghail-Bawazir	7.0	51.3	Hamrah
	8.25	60	Jizas
Sah	7.5	55.0	Mijrif
	6.5	45.8	Hamrah
Terim	5.0	36.6	Hamrah
Hareetha	12	88	Jizas
Shebam	5.0	36.6	Hamrah
Seyoun	5.0	36.6	Hamrah
Qatan	5.25	38.5	Hamrah

<sup>a/</sup> Price per gerab (1 gerab = 33 kg).

Selling prices for the same variety vary considerably from area to area which is probably due to the difference in the rate of consumption. The areas of Seyoun, Terim, Shebam and Qatan seem to have similar prices for the Hamrah date. The Jizas date is very expensive and although it is of a good quality the prices charged are abnormally high. It is reported that the Jizas date was sold in normal season at a price of 6 YD/behari i.e. 44 YD/ton. The UCM receives the dates gathered and packed in the growing areas. In spite of difficult road conditions, dates are transported without delay and efficiently distributed to retailers. The cost of transportation from Seyoun to Aden is 10 YD/ton. An additional 15% of the purchase price of dates is paid as taxes and duties to the State. The amount of dates purchased from the fifth governorate and marketed in Democratic Yemen from 1972 to 1975 is listed in table 5.

Table 5. Domestic dates marketed by UCM

Year	Quantity (tons)
1972	1,200
1973	300
1974	619
1975	500

The big decrease in the date crop during 1974-1975 was the reason for the decline in the quantity marketed. To compensate for this shortage, in 1974 and again in 1975, the UCM imported 7,000 tons from Iraq valued at YD 375,000. The cost of Iraqi dates is \$120/ton f.o.b. Basna plus \$45 for freight and insurance which totals 165 \$/ton c and f Aden. Added to this is 25 \$/ton (15%) for customs duties and taxes and \$15 for transportation and handling expenses which make a total cost of 205 \$/ton = 70 YD/ton. The selling price in the retail market is 85 YD/ton and the consumer price is 110 YD/ton. Locally produced dates are being sold at the same price as imported Iraqi dates.

B. Proposed packing plant

The packing plant should provide efficient hygienic and economical handling of dates ensuring:

- (a) Quality improvement;
- (b) Preservation of the crop;
- (c) Uniform packing practices;
- (d) Improvement of hygiene;
- (e) Reduction in packing time.

The principal functions of the plant are: cleaning, grading, fumigation, washing, packing - in suitable bulk and retail packs - and storage till marketed.

### Preparatory work

Staff at the packing plant will observe the ripening of the dates and reports will be submitted to the management of the plant and to other agricultural officials. Any necessary action will be taken in close co-operation with the growers. Each year in June or July the management of the plant should be able to estimate quantitatively and qualitatively the expected date crop and to modify work schedules accordingly. At least two weeks prior to the start of packing operations, wire trays, covers, field boxes etc. should be provided to the growers according to the size of their crop. At the same time, the packing plant should be prepared to receive and store the supply of dates.

Cleaning and disinfecting of the storerooms, operation field and environments should take place and machinery and fumigation rooms tested and kept ready.

### Operating procedure

Effective management of harvesting, other field operations and transportation is necessary to preserve the quality of the dates.

The plant should be provided, as far as possible with clean, pregraded dates with the proper moisture content, in wooden boxes of 15 kg each. The cleaning and pregrading processes should be carried out in the orchards by the growers labourers.

On arrival at the plant, dates are manually unloaded using roller conveyors, clamp trucks or fork lift trucks. They are sampled and inspected for quality and weigh-scales are used for checking the quantity delivered. Dates are then subjected to atmospheric fumigation using methyl bromide gas to destroy insects in all stages of life. After the room has been degassed and checked with gas detectors, the dates are transferred to wire trays for further cleaning and grading.

Low grade dates are gathered in jute sacks, boxes or any available containers and delivered to the distillery.

Selected and good average quality grades (GAQ) are transferred to the washing and final inspection unit where they are dumped manually into a washing machine and sand, dust and other impurities are removed with water. Dates are finally inspected on a conveyor belt connected to the washing machines.

Dates for bulk pack are received in a holding pan from which are filled baskets of 25 kg. Each filled basket is weighed and compressed in one step by the machine ensuring a denser finished pack with fewer air pockets between the fruit. The baskets are manually stitched, closed and fumigated then transferred to the store or delivered to the market. The retail pack dates coming from the inspection conveyor belt are discharged into the holding pan, weighed and packed in bags which are sealed by the vacuum-sealing machine. These bags are in turn packed into cartons (holding 40 bags) which are sealed, fumigated and stored or delivered to market. To minimize reinfestation of dates, it is advisable to cover them with tarpaulins etc. during storage and transportation.

Production capacity

	Amount (tons)	No. of baskets	No. of bags
Annual production capacity <sup>a/</sup>	3,200		
Daily projected capacity of two shifts	32		
Hourly projected capacity	2		

Bulk pack<sup>b/</sup>

Annual production	2,800		
Daily packing rate of two shifts	28		
Hourly packing rate		70	
Daily packing rate of two shifts		1,120	

Fancy retail pack<sup>c/</sup>

Annual production	400		
Daily packing rate of two shifts	4		
Hourly packing rates			500
Daily packing rate of two shifts			8,000

<sup>a/</sup> The date-packing season lasts about 100 days and usually starts during the harvesting in August or September.

<sup>b/</sup> In polyethylene lined baskets of 25 kg each.

<sup>c/</sup> In laminated cellophane bags of  $\frac{1}{2}$  kg each.

Site

The city of Seyoun is located in the centre of the date-growing area of Wadi Hadramaut. Palm orchards are scattered around the city at distances varying from 10 to 70 km. The existing four-room building of the old packing-house in Seyoun is not recommended for use as a modern reception and packing centre. In any case, it is occupied by another governmental department. The local authority in Seyoun has reserved a site for the erection of planned industrial projects which has an approximate area of 9 km<sup>2</sup> and is located in the southern part of the city. It is recommended that the reception and packing plant (tables 6-11) should be located there. Electricity and water would be easy to obtain and the central workshop in Seyoun could provide assistance to the plant. The site is not threatened by seasonal floods and effluent water disposal is available. As the packing plant is a part of the public sector, the Government will probably ask for a nominal price for the proposed site which has an area of 3,330 m<sup>2</sup> (74 x 45 m of level land). In order to calculate the investment costs (table 12) it is estimated that 1 m<sup>2</sup> of land costs YD 0.5 therefore the cost of the total site area will be YD 1,665.

Table 6. Estimated cost of reception and packing centre

Site	Price (YD/m <sup>2</sup> )	Total YD
Land 3,330 m <sup>2</sup>	0.5	1,665
Plant buildings, 1,270 m <sup>2</sup>	12	15,252
Internal roads, 880 m <sup>2</sup>	4	3,520
Receiving and despatching ramp, 432 m <sup>2</sup>	5	2,160
Fence, 233 m	1.5 <sup>a/</sup>	350
Electrical connexions to Seyoun (including plant transformer and internal connexions), 2 km	2.5 <sup>a/</sup>	5,000
Water tank, pipeline connexions		2,000
Septic tank, 36 m <sup>3</sup>	5 <sup>b/</sup>	180
Total		30,127

<sup>a/</sup> YD/m.  
<sup>b/</sup> YD/m<sup>3</sup>.

Table 7. Buildings for the reception and packing centre

No. Item	Area (m <sup>2</sup> )	Specifications
1 Operations floor	700	Sloping concrete floor with drainage channels and gratings allowing easy passage for date clamp trucks and forklift truck etc., flat roof, ceiling 5 m high, screened windows
2 Store-room for raw dates (15 x 8 m each)	240	Good foundation, slightly sloping, cement floor, flat roof, ceiling 4 m high, screened windows properly distributed allowing good air distribution
1 Store-room (15 x 4 m) for packed-dates	60	
2 Fumigation room for raw dates (6 x 4 m each)	48	Good foundation with concrete floor, flat roof, ceiling 3 m high, all surfaces coated with chemicals impenetrable to fumigant
1 Fumigation room for packed dates (9 x 3 m)	27	Doors must be completely air-tight, no windows
1 Store-room for packing material (4 x 4 m)	16	Concrete floor, flat roof, ceiling 3 m high, screened windows
1 Workshop (8 x 3 m)	24	Concrete floor, flat roof, ceiling 3 m high, screened windows
1 Cafeteria and toilets (8 x 8 m)	64	Tile-mosaic floor with tiled wall (toilets), flat roof, ceiling 3 m high, screened windows, good ventilation
5 Offices (5 x 3 m each)	75	Cement floor, flat roof, ceiling 3 m high, screened wide windows
1 Guardroom (6 x 2.5 m)	15	Cement floor, flat roof, screened wide windows
1 Transformer room (2 x 3 m)	6	Simple floor, flat roof
Total area of buildings	1,275	
Ramp	432	Slightly sloping concrete floor where dates are received, weighed and dispatched
Paved road	880	
Fence with one gate	233 <sup>a/</sup>	Mud wall
Septic tank	36 <sup>b/</sup>	According to hygienic conditions

<sup>a/</sup> Length (m);  
<sup>b/</sup> Volume (m<sup>3</sup>).

Estimated requirements for plant utilities

Water

Rate of use by washing unit	2,900 l/h
For cleaning and drinking etc.	<u>2,900 l/h</u>
Total	5,800 l/h
For two shifts	96 m <sup>3</sup> /day
Estimated price of 1 m <sup>3</sup>	110 fils
Cost of water per year	YD 1,056
	= 0.330 YD/ton of dates produced

Effluent water can be used for irrigation of the orchards.

Electricity

Rate of use including lighting	20 kW
Daily requirements	320 kWh
Annual cost (unit price 25 fils/kWh)	800 YD
	= 0.25 YD/ton of dates produced

There is plenty of electricity available at the Seyoun power station which has a capacity of 1,115 kVA, i.e. 1,000 kW. The present consumption in Seyoun during the evening does not exceed 350 kW, and is much less during the day.

Fuel

Estimated cost	800 YD/year
	= 0.25 YD/ton of dates produced

Fumigation

Gas	750 kg
Price of fumigant c and f Seyoun	765 YD/ton
Total annual cost	YD 558
	= 0.17 YD/ton of dates produced



Table 8. Equipment specifications

Work description	Equipment specifications	Quantity	Unit price (YD)	Total (YD)
Removal in the orchard of unripe fruit and foreign matter, rough pregrading, manual filling of containers transport to reception centre, sampling for quality control, weighing, transport to fumigation room	Wire trays of 1.5 m <sup>2</sup> with wooden edges and wooden legs, 15 cm high	40	20	800
	Wooden field boxes of 15 kg or crates made of date-palm frond midrib, other shallow containers etc.	20,000	0.5	10,000
	Roller conveyor, non-powered, 60 cm wide and 6 m long with steel rollers and legs	8	200	1,600
	Clamp trucks suitable for carrying 5-6 boxes	20	50	1,000
	Forklift truck 0.5 ton capacity	2	2,000	4,000
	Sampling table of stainless steel 90 cm wide and 150 cm long	1	50	50
	Weighing-machine, platform type, movable, 250 kg and 500 kg capacity	2	250	500
Fumigating, transporting, dumping, grading, washing, and grading check	Two fumigation rooms 6 x 4 x 3 m and one 9 x 3 x 3 m operating under atmospheric pressure with air-tight doors, exhaust fans of 1.5 hp each, complete with piping, valves, gas testers, gas applicator sets and gas masks for personnel safety	3	800	2,400
	A washing and grading unit. The washer with variable speed air blower 1.2 m wide, 3.5 m long and 1 m high for washing dates and adjusting moisture content, with spray nozzles, stainless steel belting, circulating pump with motors of 1.5 hp, water consumption 10 gallons per minute. The quality grading belt is 0.75 m wide and 9 m long with a middle divider lane	1	15,000	15 000

Table 8 (continued)

Work description	Equipment specifications	Quantity	Unit price (YD)	Total (YD)
Basket filling, weighing, pressing, stitching, stacking, transporting, storing and/or direct market delivery	Movable scales of 100 kg capacity	4	100	400
	Basket press machines with variable plunger discs with accessories and controls for stroke length and stroke pressure, motors of 3 hp each	2	750	1,500
Bag filling, weighing, vacuum sealing, casing, sealing, transporting, storing and/or direct market delivery	Stainless steel date-holding pans of 250 kg capacity (two for fancy pack and eight for bulk)	10	100	1,000
	Portable scales of 1 kg and 10 kg	10	45	450
	Weighing-pan of aluminium or plastic	20	5	100
	Packing tables of stainless steel 1 m wide and 5 m long	4	500	2,000
Transportation	Vacuum-sealing machine complete with vacuum system and motors of 1.5 hp and accessories, cartons for manual filling and sealing	2	2,500	5,000
	Vehicle	1	2,500	2,500
Maintenance workshop	Wooden pallets of 1 m <sup>2</sup> each	100	10	1,000
	Tools and movable welding machine, carpentry tools and tables			700
	Covers (tarpaullins etc.)	20	50	1,000
Water supply	Water tanks of 24 m <sup>3</sup> capacity	2	1,500	3,000
	Total			54,000

Staff

Table 9. Permanent staff

No.	Position	Qualifications	Monthly salary (YD)	Annual salary (YD)
1	Manager	University graduate in agricultural industries	53	636
1	Agricultural advisor	University graduate in agriculture (entomology)	42	504
1	Accountant	Secondary school graduate in book-keeping and accountancy	42	504
1	Assistant accountant	School graduate with many years practical experience	32	384
1	Mechanic	School graduate with experience	24	288
1	Driver	Experience in driving and car maintenance	24	288
2	Guard	Ability to read and write	15	<u>360</u>
8				2,964

Labourers are employed every season for four months, that is, 100 days for actual production and a total of 20 days for preparatory and closing services. Shown in table 10 are the workers required for one shift.

Table 10. Seasonal employees

No.	Position	Qualifications	Monthly payments (YD)	Total seasonal payments (YD)
2	Supervisor	Average education	32	256
2	Forklift driver	Driving and truck maintenance	24	192
1	Assistant mechanic	Some experience	20	80
160	Unskilled worker	-	15	<u>9,600</u>
	Total			10,128

Estimated costs

Table 11. Annual depreciation

Item	%	YD
Machines and equipment	10	3,470
Vehicle, field boxes, pallets, wire trays, forklift truck etc.	20	3,860
Buildings	5	1,423
Office furniture	10	<u>100</u>
Total		8,853

Table 12. Estimated investment costs

Item	Local currency (YD)	Foreign currency (in YD)
<b>(a) Fixed assets</b>		
Land	1,665	
Building and related installations	28,462	
Machines, equipment and tools (including field boxes, pallets, covers, workshop, vehicle)		54,000
Office furniture	<u>1,000</u>	
Subtotal fixed assets	31,127	54,000
<b>(b) Working capital</b>		
<b>(i) Stock</b>		
Dates (25% of yearly supply)	31,500	
Vehicle	1,800	
Baskets	4,410	
Bags		8,400
Cartons		3,500
Fumigant gas		<u>558</u>
Subtotal stock	37,710	12,458

Item	Local currency (YD)	Foreign currency (in YD)
(ii) Cash		
Wages	6,752	
Administration	1,976	
Utilities and miscellaneous	1,952	
Subtotal cash	10,680	
Subtotal working capital	48,390	12,458
(c) Preinvestment and start-up costs		
General expenses and wages for one year	3,000	
Trial period expenses	<u>2,000</u>	
Subtotal pre-investment etc.	5,000	
Total	84,517	66,458
Grand total		YD 150,975

Estimated operating costs

The plant will produce two finished products which differ in their quality, quantity, packing processes and selling prices. Both have similar operational costs except at the packing stage. The differing costs are symbolized as follows:

- P denotes the combined costs for both products
- P1 denotes additional direct costs of the bulk pack in baskets
- P2 denotes additional direct cost of the retail pack in cellophane bags.

Combined costs (P)

Raw dates (estimated quality is 10% selected, 70% GAQ and 20% low grade)

	<u>YD</u>	<u>YD/ton</u>
Cost per day of 40 tons	1,500	
Less 8 tons low grade <sup>1/</sup> at 30 YD/ton	<u>240</u>	
Cost per day	1,260	
Cost per production year	126,000	39.37

<sup>1/</sup> To be sold to a distillery.

		<u>YD</u>	<u>YD/ton</u>
<b>Transportation</b>			
Cost per bahar (including the return of empty boxes)	250 fils  = 1.8 YD/ton	7,200	2.25
<b>Fumigation</b>			
Gas consumption	16 lb/day		
c and f price Aden	750 YD/ton		
c and f price Seyoun	765 YD/ton		
Annual cost		558	0.17
<b>Electricity</b>			
Annual cost		800	0.25
<b>Water</b>			
Annual cost		1,056	0.33
<b>Labour (excluding packing)</b>			
Total requirements	254 workers		
Total seasonal payments		15,696	4.90
<b>Annual depreciation</b>			
Machines and equipment (less special equipment used only for P1 and P2)	10%	2,425	0.76
Vehicle, boxes, pallets etc.	20%	3,860	1.20
Buildings	5%	1,423	0.44
Furniture	10%	<u>100</u>	0.03
Total		8,853	
<b>Insurance</b>			
Annual cost at the rate of 0.4%		340.5	0.11
<b>Interest</b>			
5% annually		7,548.7	<u>2.36</u>
	Combined costs (P)		52.17
	Cost of date transportation, fumigation, grading, washing, and final inspection		
	52.17 - 39.37		12.8

Estimated additional costs bulk pack (P1)

		<u>YD</u>	<u>YD/ton</u>
<b>Baskets</b>			
Daily consumption	1,120 (28/ton)		
Plus 5% damages	<u>56</u>		
Cost per production year	1,176 at 150 files each x 100	17,640	6.3
<b>Labourers</b>			
Annual cost of 40 workers each paid 0.5 YD/day for 120 days		2,400	0.85
<b>Annual depreciation</b>			
Baskets, machines and accessories		270	<u>0.09</u>
Total			7.24

Estimated additional costs fancy retail pack (P2)

<b>Bags</b>			
Daily consumption	8,000		
Plus 5% damages	<u>400</u>		
Cost per production year	8,400 at 10 files each x 100	8,400	21.00
<b>Cartons (holding 40 bags)</b>			
Daily consumption	200		
Cost per production year	200 at 175 files each x 100	3,500	8.75
<b>Labourers</b>			
Cost of 36 workers each paid 0.5 YD/day for 120 days		2,160	5.4
<b>Annual depreciation</b>			
Bag machine and accessories		775	<u>1.93</u>
Total			37.08

Total costs of finished products

<b>Bulk pack</b>			
Combined costs (?)			52.17
Additional costs (P1)			7.24
Overhead costs (see table 14)			<u>2.17</u>
Total			61.58

	<u>YD/ton</u>
Fancy retail pack	
Combined costs (P)	52.17
Additional costs (P2)	37.08
Overhead costs	<u>2.17</u>
Total	91.42

Estimated factory costs

Table 13 shows the factory costs of dates from the orchards to the packing centre and from there to UCM, the distributors and table 14 shows the annual overhead costs.

Table 13. Factory costs  
(YD/ton)

Product	Purchase price of raw dates	Transportation, fumigation, grading, washing and final inspection	Over-head costs	Additional costs	Total factory costs	Profit	Selling price ex-factory
Retail pack	39.37	12.8	2.17	37.08	91.42	13.58 (14.8%)	105
Bulk pack	39.37	12.8	2.17	7.24	61.58	13.42 (21.7%)	75

Table 14. Annual overhead costs

	Annual costs (YD)	YD/ton
Salaries	2,964	0.92
Maintenance and spares	1,600	0.50
Fuel	800	0.25
Miscellaneous	<u>1,600</u>	<u>0.50</u>
Total	6,964	2.17

Estimated marketing costs and prices

Additional distribution cost of packed dates and consumer prices are shown in table 15.



Table 15. Marketing costs  
(YD/ton)

Product	Bulk pack	Fancy retail pack
Ex-factory selling price in Seyoun	75	105
Average transportation cost to other areas	10	10
Total duties and taxes (15% of purchase price)	5.6	5.6
Cost of packed dates (including handling charges) in VCM stores	92.6	122.6
VCM profit	7.4 (8%)	7.4 (6%)
Retailers selling price	100	130
Retailers gross profit	10	13
Retailers net profit in % (after deduction of 2.5 YD/ton costs)	7.5	10.5
Consumer price	110	143
<u>Annual profit</u>		<u>YD</u>
Operating costs including the cost of raw materials, packing materials, administration and labour, depreciation, utilities, overheads etc.	Costs	209,115

Income

(a) Bulk pack	210,000
(b) Retail pack	<u>42,000</u>
Total	252,000

Profit YD 252,000 - 209,115 42,885

According to Law No. 23 issued in Democratic Yemen during 1971, Article (21), paragraph B, newly-established plants are exempt from income tax for a period of from three to eight years. The decision to exempt is taken by the Ministry of Industry.

Pay-back period  $\frac{\text{YD } 150,975}{\text{YD } 42,885 + 8,853} = 3 \text{ years}$

Employment

Workers	20,256
Staff	<u>2,964</u>
Total (338 employees)	23,220

Contribution to the national economy

Total income	252,000
Depreciation and outlay on materials	<u>-180,971</u>
Net value	71,029

### 3. Conclusions and recommendations

#### Conclusions

1. There are no hygienic and efficient facilities for reception, grading, fumigation, packing and storage of dates. The crop consequently suffers much damage in quality.
2. The consumer is paying a high price for a commodity which is neither clean nor free from insect infestation nor of standardized quality.
3. Although the quality of some date varieties is high enough for export, the shortage in date production necessitates an increase to meet local demand before exporting.
4. The marketing of dates by UCM is carried out efficiently.
5. The establishment of packing plants will (a) prevent loss of quality and afford fumigation and storage facilities for other available crops; (b) provide training and educational facilities for the growers, especially for insect and disease control; and (c) provide employment for many workers, especially women, which will aid the development of social and economic life in the growing areas.
6. The techno-economic study of the packing plant indicates that the project is feasible and the pay-back period is three years.
7. The suggested production capacity is 3,200 tons/annum, which represents 50% of the 1975 yield of dates in the fifth governorate. Therefore, more than one packing plant should be established.
8. These packing plants will enable the local consumer to get clean, graded, hygienic and fumigated dates at the same prices that are now being paid for dates of inferior quality.

#### Recommendations

1. Considering that date palms are an important part of the agricultural wealth of the country, more effort should be devoted to the steady development of date production. This can be achieved through establishing a governmental office to follow up all matters relating to palm plantations, date growing, and the training of growers in insect and disease control. The permanent staff of the proposed date-packing plant in Seyoun could be engaged by this office. At the end of the date season, the duties of the whole staff would be related to date production.

2. Local employees should be trained in the best methods of insect and disease control applied in other date-growing areas such as Iraq and Algeria.
3. More experimental stations should be established in the northern district of the fifth governorate to concentrate on the best available varieties such as Jisaz, Mijrif etc. These experimental stations should cover all important date-growing areas in the fifth governorate.
4. Three packing plants should be established in the main date-growing areas in Seyoun, Douan (Wadi Al-Ain), and Wadi Hadjar. During the present Five Year Plan for 1974/75-1978/79, the Seyoun packing plant should be established. The other two packing plants should be established during the next Five Year Plan for 1979/80-1983/84.

## II. DISTILLERY

### A. Findings

It is a common practice in the date-growing countries to use both good and low-grade dates for various products such as paste, syrup, liquid sugar, protein yeast, alcohol etc.

Dates rejected by the packing industry because of quality defects and not acceptable for direct human consumption are called low-grade dates. There is no beet- or cane-sugar industry in Democratic Yemen and low-grade dates constitute the only available raw sugar. The distillery will use an estimated 800 tons of low-grade dates from the adjacent packing plant in Seyoun.

### Economic background

The Five Year Plan for 1974/75-78/79 of Democratic Yemen has given priority to increasing industrialization particularly of products using locally available raw materials as this would lead to a reduction in imports. The distillery will depend on the use of low-grade dates, obtained from the projected packing plant, for producing distilled alcohol. At present, the major date-growing areas are in the fifth governorate at Wadi Hadramaut, Douan-Amad and Wadi Hadjar. Many local individuals produce some kind of alcoholic drink e.g. arak, without a licence. There is no technical control, or quality specifications and production facilities are primitive. Low-grade dates and sugar are used for fermentation and the product is sold in second-hand bottles of different sizes. The selling price of one bottle of arak fluctuates from YD 0.75 to YD 1.5 according to availability and demand. The quantity of arak produced annually in Democratic Yemen is estimated at 25,000 bottles valued at YD 25,000. The number of individuals engaged in this industry is estimated at 50. There is a continuous demand for industrial alcohol (denatured alcohol) for the local cosmetic industry but local individuals are not technically in a position to meet such demands.

### Demand for distilled alcohol

#### Drinking habits

There are no official restrictions on drinking alcohol beverages in Democratic Yemen. However, drinkers are concentrated in the big cities rather

than in the rural areas. Since the British occupation and after independence, high-income groups drink all available beverages such as beer, whisky, vodka, brandy, wine etc. Sales of alcoholic beverages may increase during winter (the cool season) as well as on holidays and festivals but there is no marked seasonality of sales. The most popular locally-made alcoholic beverages are arak, made by date fermentation and taria, a weak (1.5 alcohol) drink made by fermenting palm-tree sap which is obtained by slicing off the top of the tree.

Distilled alcoholic beverages

The country imports various kinds of distilled alcoholic beverages. These are consumed mainly in Aden where plenty of foreigners, visitors, governmental officials, high-income groups and transit passengers and sailors are present. The quantity and value of these imports are listed in table 16.

Table 16. Imports of distilled alcoholic beverages

	1967	1968	1969	1970	1971	1972	1973	1974 <sup>a/</sup>	1975 <sup>a/</sup>
Quantity (1)	16,618	11,426	6,964	-	67,472	63,355	64,947	65,000	68,000
Value (YD)	45,953	33,805	16,480		50,169	45,261	46,455	47,000	50,000
Excise duty (YD)	30,747	21,140	12,885		124,838	117,221	120,166	120,264	125,815

a/ Estimated.

The quantity and value of imported alcoholic beverages has been kept stable since 1971. Only the public sector deals with foreign trade, therefore imports are regulated by the state importation policy and the availability of hard currency which means imports do not meet demand. High taxes and high retail selling prices are imposed on alcoholic beverages to control consumption. Importation is carried out by the State Company for Foreign Trade and local distribution by the State Company for Home Trade. The Victory Trading Company imports alcoholic beverages that are sold for hard currency in the free zone in Aden and to ships and planes etc. The cost of a bottle of whisky c and f

Aden is YD 0.567. The excise duty on distilled alcoholic beverages is 8.4 YD/gallon. This makes 1.39 YD/bottle plus 10% of this amount for the Pricing Adjustment Fund plus 20% profit for the Home Trade company. Whisky is provided to bars, hotels and restaurants which belong to the public sector at a retail price of 3.7 YD/bottle. The selling price to the consumer is 6.5 YD/bottle. After the re-opening of the Suez Canal there was an increase in the number of ships and, therefore, transit passengers visiting Aden. It is expected that there will be increase in the consumption of distilled alcoholic beverages. The establishment of the distillery requires two and a half years i.e. till the end of the present Five Year Plan. Assuming a 6% increase on 1975 import figures, the consumption of distilled alcoholic beverages in 1979 is estimated at 80,000 l valued at YD 58,824 which means an excise revenue of YD 148,018.

#### Industrial alcohol

This is used mainly in the cosmetic industry and to a smaller degree in the paints industry and for medical purposes. The total importation in 1975 was 50,000 l of 96 vol % ethyl alcohol estimated at YD 15,000. Of this amount, 40,000 l valued at YD 13,000 were used for the cosmetic industry. The State Company for Cosmetics is presently selling imported perfumes which were in stock side by side with its own product. It expects to sell all its stock within two years and then depend upon its own product. The amount of industrial alcohol required in 1979 is estimated at 60,000 l valued at YD 18,000

#### Plant operation

The plant is composed of the following sections:

- (a) Juice preparation, 1 shift/day;
- (b) Fermentation, 3 shifts/day;
- (c) Distillation and rectification, 3 shifts/day;
- (d) Bottling of alcoholic beverages, 1 shift/day;
- (e) Barrelling of denatured industrial alcohol, 1 shift/day;
- (f) Boiler house operating 3 shifts/day;
- (g) Laboratory operating 2 shifts/day;
- (h) Workshop and low tension electrical equipment.

Dates in jute sacks or in boxes are moved by a lifting device from the store to the extraction tanks. Steam and water are used for extraction of the essence of the dates in a batch system. The water-date mixture (ratio 4:1) is agitated by an electrical stirrer to promote extraction. The time for extraction is from one and a half to two hours and the temperature of extraction is 90°C. The water-date slurry is then fed by gravity to the pitting machine where the pits are separated from the date pulp. The date pulp and juice mixture are collected in an intermediate tank and pumped to the continuous separator (de-sludger) where the juice is separated from the pulp. The pulp can be washed if necessary to reduce its sugar content. The pits and exhausted pulp are collected separately in containers and transported manually outside the building. The pulp can be sun-dried and sold for fodder or mixed with ground pits and other components to make semi-fodder or complete fodder. The raw juice flowing from the separator is collected in an intermediate tank from where it is pumped to a storage tank. The pit of the date concentrate and the juice is adjusted and it is sterilized in an autoclave. The juice is then cooled to 30°C with a heat exchanger and collected in fermentation vats where already prepared Saccharomyces cerevisiae yeast culture and urea nutrients are added. Fermentation is carried out in batches.

After completion of the fermentation (24 hours), the mash, containing 8-8.4 vol % alcohol, is collected in tanks. It is preheated to 70°C and then to 90°C, delivered for distillation and then to the rectifier columns which are steam-heated. The ethyl alcohol is first distilled off and separated as raw alcohol which is delivered to the intermediate tank. The remaining non-alcoholic fluid (slop) leaves the bottom of the rectifier (stripping) column as effluent to the drainage. From the top of the column the most volatile components, aldehyde and ketone, are separated. The raw alcohol is then distilled in the second column where further separation is made of the volatile components from the top of the column. The remaining pure alcohol and diluted water is fed to the rectifier column where pure alcohol is separated from the alcohols with higher boiling points (fusel oil as amyl and butyl alcohols etc.). The rectified alcohol is refined further by distilling it in another repurifying column where the remaining impurities are separated and very fine alcohol is obtained and collected in separate tanks. The fusel oil may be used for the paint industry or thrown away. The alcohol with high aldehyde content may be used with other chemicals for denaturing alcohol for industrial uses.



The amount of alcohol intended for the cosmetic industry is denatured and barrels of 200 l, or other suitable containers, are filled manually. The fine alcohol specified for drinking purposes (arak) is mixed with distilled water and natural anise oil extract in the ratio of 1 l extract/1,000 l alcohol, then bottles of 0.75 l are filled manually, sealed, collected in cartons of 12 bottles each and sold. The distilled water used in the preparation of arak is obtained by steam condensation from the boiler house. A cooling tower is used for this purpose.

The distillery can produce gin and vodka in a similar way to arak by changing the type and ratio of flavours and distilled water to fine alcohol. For the production of whisky, scotch-malt concentrate and colourants should be imported, mixed with distilled water and fine alcohol, and the whisky aged for more than six months in oak barrels

#### Production

	Capacity
Annual production capacity	210,000 l 96 vol % ethyl alcohol
Annual consumption of dates	800 tons
Annual working days	100
Daily production capacity (24 h)	2,100 l
Daily consumption of dates	8 tons

#### Filling of containers

Barrels of 200 l each - or any other available containers - are filled manually with 60,000 l of denatured alcohol for use mainly by the cosmetic industry.

Distilled water and anise oil extract are mixed with 150,000 l of 96 vol % ethyl alcohol to produce 300,000 l of 48 vol % arak which is put into bottles holding 0.75 l.

#### Chemical composition of the raw material

Chemical analysis of low grade Hamrah date samples have been carried out in the laboratory of the High College of Education in Aden during the period 3-8 January 1976. Below are the results of the analysis:

	<b>2</b>
Moisture	17.8
Pits	12.2
Inverted sugars	50.0
Insolubles	9.9
Soluble non-sugars	10.1

Specifications of the alcohol produced

It is expected to produce high quality alcohol of the following specifications:

Specific gravity	0.81 <b>2</b>
Appearance	colourless
Miscibility with water	no opalescence
Alcohol by volume	96 <del>6</del>
Acidity	max 16 ppm
Aldehyde and keton	max 20 ppm
Methyl alcohol	nil
Higher alcohol	max 30 ppm
Residue on evaporation	max 4 ppm

Staff

Table 17. Permanent staff

Position	No.	Qualifications	Monthly salary (YD)	Salary (YD)
Manager	1	Chemist (food technologist with experience in fermentation industries)	80	960
Head of production	1	Chemist (food technologist with experience in fermentation industries)	60	720
Accountant		Accountancy and book-keeping experience	42	504
Salesman	1	Marketing and selling experience	30	360
Storekeeper	1	Experience	24	288
Foreman	3	Sufficiently experienced to supervise work inside the plant	30	1,080
Laboratory assistant	1	Sufficiently experienced to carry out daily analysis and quality control tests	30	360
Technician	2	Experience of running boilers	30	720
Technician	2	Experience in maintenance	24	576
Electrician	2	Experience in maintenance	24	576
Clerk	1	Experience in general administration	24	288
Driver	2	Driving of car, truck and fork-lift	24	576
Guard	2		15	360
Cleaner	<u>1</u>		15	<u>180</u>
<b>Total</b>	<b>21</b>			<b>7,548</b>

To produce 2,100 l of alcohol (i.e. 4,000 bottles of arak and 600 l of denatured industrial alcohol) every day, three shifts are required totalling 58 seasonal workers; 28 workers for bottling and barrelling, the rest for other sections of the plant. The annual working period is 120 days; 100 days for effective production and 20 days for starting and shutting the plant. The average payment is 0.6 YD/day for each worker which gives

$$0.6 \times 58 \times 120 = 4,176 \text{ YD/year}$$

$$7,548 \text{ plus } 4,176 = 11,724 \text{ YD/year for wages and salaries}$$

The selection of permanent personnel, especially technical staff, should precede the establishment of the distillery. This is of great importance as time must be allowed for technical training at home and abroad. Also, this enables the staff to participate in the construction, erection and start-up activities. During the first three years of production it is necessary to obtain technical assistance in order to guarantee the smooth running of the distillery and the proper training of staff. Technical assistance may be requested from UNIDO or specialized companies, or Yemeni staff might be trained in the distilleries of Iraq.

Estimated pre-investment and start-up expenses

	<u>YD</u>
Training, technical supervision, wages and general expenses	20,000
Trial period expenses	3,000
Expenses for erectors, experts and other technical staff	<u>8,000</u>
Total	31,000

Raw materials

Dates

Low-grade dates in sacks or other containers are collected from the adjacent packing plant and used in the fermentation process. Price of 800 tons at 30 YD/ton = YD 24,000. Annual production is 210,000 l alcohol

$$\frac{\text{YD } 24,000}{210,000} = 114.3 \text{ fils/l}$$

Water

Water is pumped from the plant's well and collected in a basin in the ground. Then it is pumped to the high tank from where it is distributed to various parts of the plant.

Water is used for the following:

- (a) Juice preparation;
- (b) Steam production;
- (c) Preparation of distilled water for making arak;
- (d) Various heating and cooling purposes;
- (e) Washing and cleaning.

The cost of water is included in the cost of electricity.

#### Anise oil extract

This is used as flavouring material for arak.

Estimated cost price	15 YD/kg c and f Seyoun
Annual consumption	1.5 tons = 1,500 kg
Annual expenses	1,500 x 15 = YD 22,500
Anise oil consumption alcohol	1 kg/1,000 l alcohol, i.e., cost per litre of alcohol
	15 fils/l
	or 7.5 fils/l arak
	or 5.6 fils/bottle arak

#### Packing materials

Bottles of 0.75 l capacity are recommended to be used for arak. Till the establishment of a glass industry in Democratic Yemen bottles will have to be imported. During the first year of production 400,000 will be required, and assuming re-collection and usage of these bottles, and a shelf-life of five years, an annual import of 20% (80,000 bottles) of this figure will be needed during the next four years.

The c and f Aden price for 1,000 trade-marked bottles of 0.75 l capacity, packed into cartons holding 12 bottles, is YD 50. Allowing 10 fils/bottle for transportation costs to Seyoun, this amounts to 60 fils/bottle. 400,000 bottles are required to hold 300,000 l of arak. Annual expenses 400,000 x 60 = YD 24,000.

The buyers must pay for barrels and other containers for industrial alcohol as these are not supplied by the plant.

Metal screw caps are used for sealing the bottles. The trade mark of the product is printed on the caps in two colours.

Price of 1,000 units c and f Aden    YD 3  
Price of 1,000 units c and f Seyoun    YD 10  
Annual expenses 400,000 x 10 fils =    YD 4,000

### Chemicals

Urea is used as a nutrient for yeast propagation. Estimated consumption is 20 kg/day i.e., 10 g urea/l alcohol. Price of one ton urea c and f Seyoun is YD 350. Annual cost is  $100 \times 20 \times 0.35 = \text{YD } 700 = 3.5 \text{ fils/l alcohol}$ .

Small amounts of sulphuric acid (for pH adjustment of date juice) and of a defoaming agent are sometimes used. Estimated annual total expenses YD 210 = 1 fil/l alcohol.

### Power

#### Electricity

The installation of a transformer and of electrical connexions to the plant will be carried out by the electricity authority in Seyoun at a cost of 2.5 YD/m.

1 kWh costs 25 fils

Estimated total cost is YD 5,000

The cost of electricity includes pumping water from the well and the cost of the water

Daily expenses 1,360 kWh x 25 = YD 34

Annual expenses 34 x 100 = YD 3,400

Cost/l alcohol = 16.2 fils

#### Fuel

The fuel oil used for the boiler house is provided by the British Petroleum Company in Aden and is of an average calorific value of 18,300-19,500 Btu/lb and costs 175 fils/gal.

Annual expenses 280 gal x 175 x 100 = YD 4,900

23.3 fils/1 alcohol

Total annual utilities expenses = YD 8,300

### Site

The site of the distillery will be in the industrial area in Seyoun near the proposed packing plant. This proximity will facilitate interaction, i.e. the transportation of dates from the plant to the distillery. As the public sector will own the distillery the land will be sold to it at a nominal price by the local authority in Seyoun.

The site is 2,000 m<sup>2</sup>. In order to calculate a price, it is estimated that the land will cost 0.5 YD/m<sup>2</sup> = YD 1,000

### Buildings

Building area of 680 m<sup>2</sup> includes:

	<u>Area</u>	<u>YD</u>	<u>Total amount (YD)</u>
Raw-dates store	8 x 4 m	30	960
Juice preparation room (2 floors)	12 x 8 m	50	9,600
Fermentation room (2 floors)	3 x 8 m	50	6,400
Laboratory	8 x 3 m	30	720
Bottling room	8 x 7 m	30	1,680
Corridor	34 x 2 m	30	2,040
Electrical low-tension equipment	7 x 2 m	30	420
Workshop	7 x 3 m	30	630
Boiler room	7 x 5 m	30	1,050
Distillation and rectification area (2 floors)	7 x 10 m	50	3,500
Administration offices	12 x 10 m	30	3,600
Cafeteria and bathroom	4 x 10 m	30	1,200
Store-room	10 x 4 m	30	1,200
Guard room	3 x 4 m	20	240
Transformer room	3 x 2 m	20	120
Processed water ground basin	8 x 5 x 2.5 m	50	5,000
Water well			5,000

	<u>Area</u>	<u>YD</u>	<u>Total amount (YD)</u>
Septic tank	36 m <sup>3</sup>	7	252
Roads	900 m <sup>2</sup>	4	3,600
Fence with one gate	185 m	1.5	278
Electrical connexion to the Seyoun power station			5,000
Drainage system for effluent water			<u>6,000</u>
Total expenses for buildings			58,490

Machinery and equipment

All estimated prices are c and f Seyoun.

Juice preparation

- 1 weighing machine of 200 kg capacity
- 1 lifting device of 500 kg loading capacity, lifting height 8 m, for lifting date sacks or containers up to the extraction tanks
- 3 vertical enamelled steel extraction tanks each of 7 m<sup>3</sup> capacity with connected water and steam pipes and motor-driven central stirrer
- 2 pitting machines each of 3 ton capacity with inside sieve of 4 mm mesh and motor, brushes and accessories. All juice contacting surfaces are made of stainless steel
- 1 intermediate enamelled steel tank of 7 m<sup>3</sup> capacity for collecting pitted dates and juice from the pitting machine
- 2 pumps each of 4,000 l/h capacity, for delivery of date pulp and juice to the separator (desludger). All juice contacting surfaces are made of stainless steel
- 1 separator for continuous separation of exhausted pulp from raw juice with automatic juice discharge control of 5,000 l/h capacity, with a motor of 18 kW, pressure valves and accessories
- 1 intermediate storage tank of 7 m<sup>3</sup> capacity made from enamelled steel
- 1 pump of 4,000 l/h capacity for delivery of raw juice to the pasteurizer. All juice contacting surfaces of stainless steel
- 1 pasteurizer for raw juice treatment of 2,000 l/h capacity, with steam-heating and water cooling systems and temperature control device. All juice contacting surfaces of stainless steel
- 2 vertical cylindrical enamelled steel closed tanks of 12 m<sup>3</sup> capacity each for storing cooled pasteurized raw juice, with level indicator, sight glass and necessary fittings etc.



- 1 heat exchanger of 3,000 l/h capacity using water as a cooling agent. All juice contacting surfaces are made of stainless steel
- 1 air-compressor unit of 12 m<sup>3</sup>/h and 6 kg/cm<sup>2</sup> operating pressures made of carbon steel
- 1 set of technological pipelines, fittings and supports. Electrical fittings for the supply of energy and other electrical accessories.

Estimated cost

..YD 50,000

#### Fermentation

- 1 pure strain fermenter of 1,000 l capacity with aeration system, jacket cooling and other accessories
- 1 pre-fermenter of 5,000 l capacity made of enamelled steel with cooling and aeration systems, sight glasses etc.
- 2 pumps for juice (1 is a stand by) of stainless steel of 2,000 l/h capacity
- 2 mash pumps of stainless steel of 5,000 l/h capacity
- 1 mash filter of small filtration surface area of stainless steel
- 2 fermenters of 25,000 l capacity each of enamelled steel with cooling and aeration systems, washers of waste air, sight glasses and accessories
- 1 unit for preparing nutrient solution consisting of an enamelled steel tank with mixer of 1,000 l capacity, pump and measuring tank
- 1 mild steel antifoam tank of 250 l capacity with pump of 250 ml/h capacity of stainless steel
- 1 tank for sulphuric acid dilution made of polypropylene of 250 l capacity
- 1 dosing pump for sulphuric acid of 250 l/h of stainless steel
- 1 hot water tank of 1,500 l capacity of mild steel
- 1 pump for hot water of 5,000 l/h
- 1 refrigerating machine of compressor type of 30,000 kcal/h
- 1 tank for cooling water of 1,000 l capacity of mild steel
- 1 pump for cooling water of 5,000 l/h

Necessary pipelines, fittings, supports and valves. A complete set of instruments for measuring and controlling pH, temperature, pressure, volume of juice, mash, water and steam. Steam pressure reduction valves etc.

Estimated cost

YD 25,000

#### Distillation and rectification

- 1 complete mash column unit for liquid and gas separation, of stainless steel and copper with bubble-cap plates. Aldehyde, ketone and alcohol fractions are separated from the top of the column and non-alcoholic fluid (slop) drains from the bottom. Dephlegmator, condenser, and gas cooler of stainless steel and copper. Foam separator mash filter and preheater of stainless steel are also included

- 1 heads column of stainless steel with bubble-cap plates and perforated plates for separating the aldehyde and ketone (top products) as industrial alcohol with condenser and cooler made of stainless steel
- 1 separating column of stainless steel with bubble-cap plates for separating volatile top products from the raw alcohol leaving diluted alcohol flowing from the bottom of the column to the rectifier, with condenser of stainless steel
- 1 rectifier column for separating pure ethyl alcohol from fusel oils (higher alcohols) of stainless steel with bubble-cap plates with dephlegmator, condenser, gas cooler and fusel oil separator
- 1 repurifying column for separating traces of heads and fusel oil and leaving very fine and concentrated ethyl alcohol, of stainless steel with perforated plates with heater, condenser and gas cooler of stainless steel

The columns are equipped with the necessary coolers for fine and industrial alcohol, fusel oil, washing water and other accessories including vessels of stainless steel for alcoholic mash, raw, industrial, and fine alcohols and cooling water as well as storage tanks for industrial and fine alcohols. Pumps for mash, slop, columns, raw and fine alcohols etc. are also included

- 1 cooling tower of cast iron of 15-20 m<sup>3</sup>/h flow rate with pumps of 25 m<sup>3</sup>/h capacity and 30 m head, including water collection container, ventilator etc.

All necessary measuring and controlling equipment, pipes, valves, steel structure, supports, gridiron platform, stairs, hand-operated portable fire extinguishers (10 pieces) etc.

Estimated cost

YD 70,000

#### Denatured industrial alcohol

- 2 tanks of 10,000 l capacity each of enamelled steel with level indicator, piping and other accessories

#### Alcoholic beverages (arak)

- 2 diluting tanks of stainless steel of 2,000 l capacity each with flow meters, for preparation of alcoholic beverages
- 4 tanks of stainless steel of 12,000 l capacity each for storage of fine alcohol for arak with pumps, piping and other accessories
- 1 small filter of frame-and-plate type with a stainless steel contacting surface
- 1 tank of stainless steel for the storage of anise extract of 500 l capacity equipped with level indicator
- 1 complete set of piping, fittings, cocks, movable pumps and other accessories
- 1 manual bottle-sealing machine
- 1 rotating table for the collection of filled bottles
- 1 light inspection device for filled and sealed bottles
- 3 packing tables of 1 x 3 m each used when packing bottles into cartons

Estimated cost

YD 15,000

### Boiler house equipment

- 2 steam boilers (1 is a stand by) each of a capacity of 3 tons/h saturated steam at 8 kg/cm<sup>2</sup> with water and fuel pumps, armatures and regulating devices for temperature, water level and steam pressure as well as the necessary insulation
- 1 burner using fuel oil with steam and electric heaters with all the necessary safety devices and the necessary chimney
- 1 platform with a steel structure for the feed water tank and the degassing unit
- 2 fuel storage tanks of 25 m<sup>3</sup> capacity
- 1 concrete ground basin of 100 m<sup>3</sup> capacity and two pumps of a capacity of 20 m<sup>3</sup>/h each to pump water from the well. The water distribution tank of 20 m<sup>3</sup> capacity with necessary pumps and accessories will provide the factory with water for processing, cooling and drinking purposes
- 1 distilled-water condenser and cooling unit of 200 l/h for arak production with tanks and pumps
- 1 water softener of a capacity of 4 tons/h composed of water softening device, feed water tank, degassing unit, dosing system for chemicals, neutralizer and the necessary armatures

Estimated cost

YD 40,000

### Workshop

- 1 drilling machine
- 1 welding machine
- 1 lathe
- 1 battery-charging unit
- 1 pair of metal shears with bench
- Carpentry tools and working table

Estimated cost

YD 6,000

### Laboratory

Equipped with the necessary analytical instruments and apparatus, reagents and glassware for carrying out necessary chemical analyses to, and quality control tests of the finished products

Estimated cost

YD 3,000

Spare parts

Supplies for two years	YD 9,650
Installation cost	YD 31,350
Handling and transportation equipment	
1 lifting truck of 1 ton loading capacity	
10 clip trucks	
100 pallets	
1 vehicle	
1 truck of 8 tons capacity	
Estimated cost	<u>YD 10,000</u>
Total cost of machinery and equipment	YD 260,000

Table 18. Consumption

Requirements	Per day	Per ton of dates	Per litre of alcohol
Water for extraction, distillation, the boiler house, distilled water for arak production, and cleaning etc. (m <sup>3</sup> )	120	15	0.060
Water for cooling (m <sup>3</sup> )	240	30	0.120
Electricity (kWh)	1,360	170	0.7
Fuel oil (gal)	280	35	0.14
Nutrients (kg)	20	2.5	0.010

Table 19. Annual depreciation

	\$	YD
Building	5	2,925
Machines and equipment	10	25,000
Handling and transportation equipment	20	2,000
Office furniture	10	<u>300</u>
Total		30,225
		= 143.9 fils/1 alcohol

Table 20. Estimated investment costs

Item	Local currency (YD)	Foreign currency (in YD)
<b>(a) Fixed assets</b>		
Land	1,000	
Building	58,490	
Machinery and equipment	31,350	218,650
Transport equipment		10,000
Office furniture	<u>3,000</u>	<u>          </u>
Subtotal fixed assets	93,840	228,650
<b>(b) Working capital</b>		
<b>(i) Stock</b>		
The extraction of dates, fermentation, distillation and bottling and barrelling usually requires two days. As the product is new and needs some time to become known in the market, it is suggested that the stock should suffice for 50 days (i.e. half the production time). However, imported materials (bottles, caps, anise oil and chemicals) for arak should suffice for the annual requirements.		
Dates	12,000	
Anise oil		2,250
Bottles		24,000
Caps		4,000
Chemicals		<u>910</u>
Subtotal stock	12,000	31,160
<b>(ii) Cash</b>		
Wages	3,346	
Utilities	4,150	
Social welfare	1,000	
Experts	<u>5,000</u>	
Subtotal cash	<u>13,496</u>	<u>          </u>
Subtotal working capital	25,469	31,160
<b>(c) Pre-investment and start-up costs</b>		
Wages, training and general expenses	10,000	10,000
Trial period expenses	3,000	
Experts	<u>4,000</u>	<u>4,000</u>
Subtotal pre-investment etc.	<u>17,000</u>	<u>14,000</u>
Total	136,336	273,810
Grand total		410,145

Estimated annual operating costs

Arak and industrial alcohol have similar operating costs from the juice preparation to the distillation of alcohol. However, their costs differ in the filling section.

<u>Item</u>	<u>YD</u>	<u>Fils/1</u>
(a) Combined costs		
Dates	24,000	114.3
Electricity and water	3,400	16.2
Fuel	4,900	23.3
Chemicals	910	4.3
Labour, 30 x 0.6 x 120	2,160	10.3
Personnel costs	7,548	35.9
Depreciation	30,225	143.9
5 years amortization of pre-investment costs	6,200	29.5
Maintenance and spares	2,000	9.5
Miscellaneous	2,035	9.7
Annual common operating costs	83,378	396.9
(b) Additional costs for industrial alcohol:		
3 workers for filling and transporation, 3 x 0.6 x 120	216	3.6
Factory cost of industrial alcohol, 396.9 + 3.6		400.5
(c) Additional costs for arak		
	<u>YD</u>	<u>Fils/bottle</u>
25 workers for filling, packing and transporting 4,000 bottles (0.75 l capacity) of arak per day, 25 x 0.6 x 120	1,800	4.5
Anise oil	2,250	5.6
Bottles, 60 fils x 400,000	24,000	60
Caps, 10 fils x 400,000	4,000	10
Total	32,050	80.1
Factory cost		230.1
Total annual operating costs 83,378 + 216 + 32,050 = YD 115,644		

Table 21. Additional marketing costs for arak (YD/bottle)

Ex-factory price	Transportation, storage and handling	Excise duty	Pricing Adjustment Fund	Total cost	Profit	Retailer price	Profit	Consumer price
0.371	0.010	1.389	0.139	1.909	0.041	1.950	0.050	2

Table 22. Costs for the production of alcohol (YD)

Type of product	Common costs	Additional costs	Factory costs	Profit	Ex-factory selling price
Industrial alcohol (per l)	0.3969	0.0036	0.4005	0.0045	0.405
Arak (per bottle)	0.150	0.0801	0.2301	0.1409	0.371

The by-products (pits and exhausted date pulp etc.) collected in the distiller can be mixed with other components for fodder. However, it is recommended that this be given free of charge to the date growers.

Recommended ex-factory selling price

Industrial alcohol 0.405 YD  
Arak 0.371 YD/bottle

The marketing of the distillery products will be carried out by the State company for Home Trade.

Annual income

	<u>Area</u>	<u>YD</u>
Income from industrial alcohol	60,000 x 0.405	24,300
Income from arak	400,000 x 0.371	<u>148,400</u>
Total annual income		172,700
Profit	172,700 - 115,644	57,056
Annual excise revenue	<u>300,000 x 8.4</u> 4.54	555,066
Annual revenue from Pricing Adjustment Fund		55,506
Total excise and duties income		610,572

Pay back period

$\frac{410,146}{30,225 + 57,056}$  5 years

Economic justification

Employment

79 workers and employees are earning annually 11,724

Contribution to the national economy

Profit	57,056
Wages and salaries	11,724
Depreciation and amortisation	<u>36,425</u>
Gross value	105,205
Net value 105,205 - 36,425	68,780



B. Conclusions and recommendations

Conclusions

1. The distillery will require 300 tons of low-grade dates. Such dates are deemed unsuitable for packing and their use will not affect the supply to the consumer.
2. The annual production of the distillery will be limited by the availability of low-grade dates and by the market demand for alcohol.
3. Initially, the distillery will work with 33% of its nominated capacity; any increase will reduce the cost of production and increase the profit.
4. The nominated production capacity of the distillery will meet the requirements of Democratic Yemen for the next ten years.
5. A reduction in the spending of hard currency will be achieved due to a decrease in imports of industrial and drinking alcohol.
6. The total importation of distilled alcohol during 1975 is estimated at 118,000 l valued at YD 65,000: 65,000 l valued at YD 50,000 was for beverages and 50,000 l valued at YD 15,000 was industrial alcohol used mainly by the cosmetic industry. These imports were paid for in hard currency which factor, rather than market demand, limited the importation of alcoholic beverages.
7. During 1975, excise revenue of an estimated YD 125,815 was levied on the importation of alcoholic beverages. Assuming a 6% annual increase of exports, the excise tax for 1979 would be  $\frac{80,000 \times 8.4}{4.54} = \text{YD } 148,018$  plus 10% (YD 14,800) Pricing Adjustment Fund which totals YD 162,818.

The distillery will produce an estimated 210,000 l of distilled alcohol from which 300,000 l of arak and 60,000 l of industrial alcohol can be made. The estimated excise tax from arak will be  $\frac{300,000 \times 8.4}{4.54} = \text{YD } 555,066$  plus 10% (YD 55,506) Pricing Adjustment Fund which totals YD 610,572.

8. The most important social gain will be the hygienic production of distilled alcohol and the elimination of home-made alcohol which is produced under unhygienic conditions and is a health hazard.

Recommendations

1. A distillery based on the utilisation of low-grade dates from the proposed packing plant is feasible and should be established in spite of the relatively high cost of production. The end products are planned to meet local demand.
2. There is a limited possibility of exporting arak to neighbouring countries. Further studies in this respect are required.
3. The site should be near the packing plant at Seyoun in the fifth governorate.
4. The project should be established during the present Five Year Plan in order that its operation may start during 1979.
5. There is no one available in Democratic Yemen who is capable of managing the date processing plant, therefore, it would be advisable for the Government of Democratic Yemen to request the aid of a date-processing expert for at least one year. He would participate in the implementation of the recommendations made in this report and assist in setting up the proposed office in Seyoun. Training of local staff is of great importance to ensure the proper running of the plant and distillery. The expert could assist with this. Also, staff could be sent for training to distilleries abroad.

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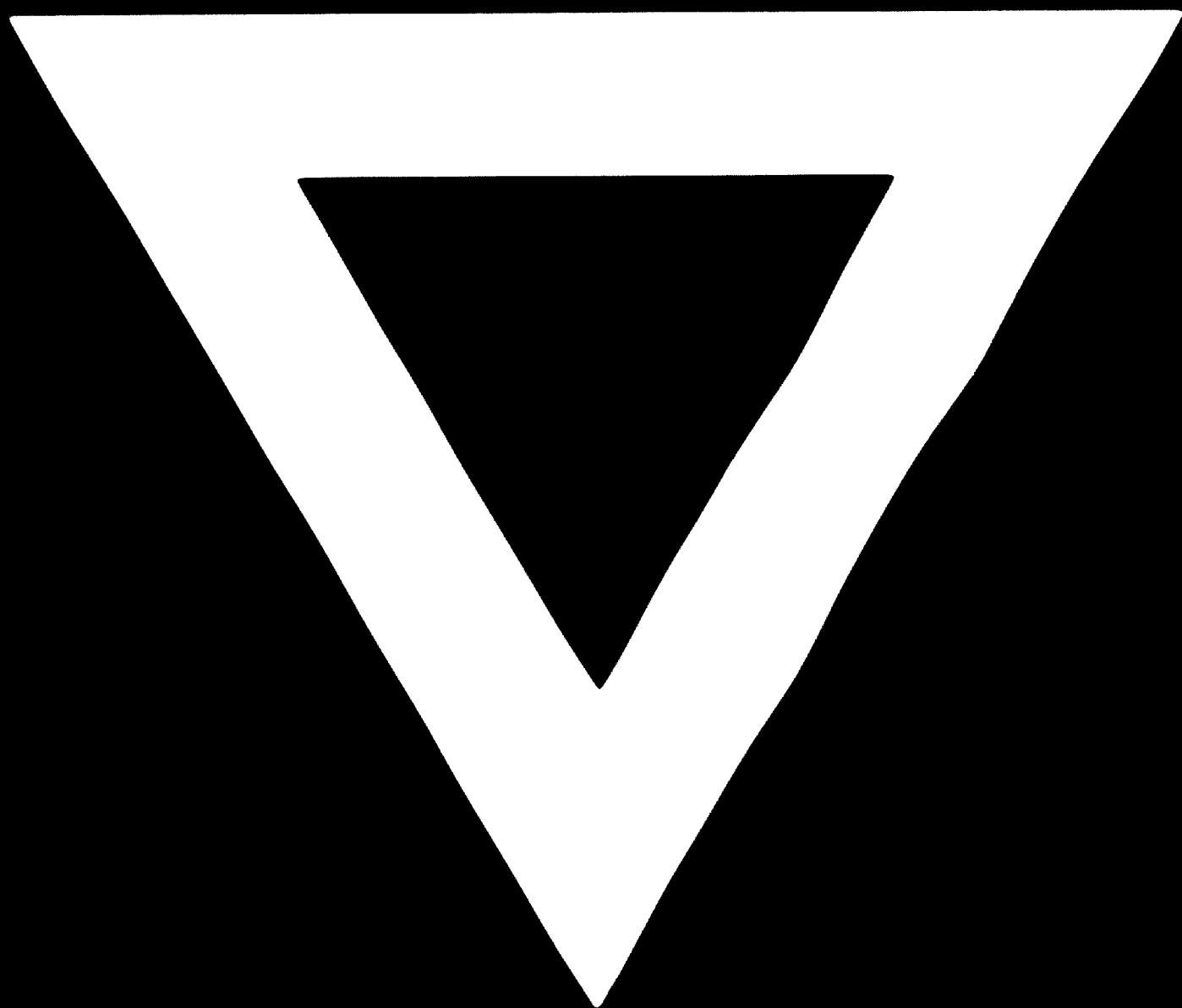
Annex

JOB DESCRIPTION  
(IS/PDY/74/004/11-01/06)

- Post:** Expert in date processing.
- Duration:** Four months.
- Date required:** As soon as possible.
- Duty station:** Aden, with travel within the country.
- Purpose of project:** To study the possibility of setting up facilities for the processing and packing of dates catering primarily for export markets, and to investigate the economics of setting up an associated distillery based on the wastage of such dates.
- Duties:** The expert will be attached to the Department of Industry of the Ministry of Economy and Industry and, under the close supervision of the Team Leader of the Industrial Advisory Unit in the Ministry, will be expected:
1. To assess the present and prospective quantities and varieties of dates produced in the country.
  2. To study the methods practised in harvesting, transporting, packing and storing dates and evaluate the existing procedures involved in buying and selling and in other business transactions.
  3. To conduct a market survey to determine the present and projected demand for dates in local and in export markets.
  4. To prepare a study on the facilities required for the processing and packing of dates to make them suitable for export markets and to formulate detailed recommendations on such facilities (including the specifications and cost of any plant or equipment required) and on the preservation and transportation facilities necessary.
  5. To investigate the possibility of setting up an associated distillery based on the wastages of dates; to prepare a techno-economic study for such a distillery and to formulate recommendations on the best economic size, and on the specifications, location and lay-out of the distillery.



**E-271**



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