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RESTRICTED

DP/ID/SER.B/41
28 January 1976
English

07022

BREWERY EXPERT

IS/PDY/74/006

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

id.76-886

United Nations Development Programme

BREWERY EXPERT

IS/PDY/74/006

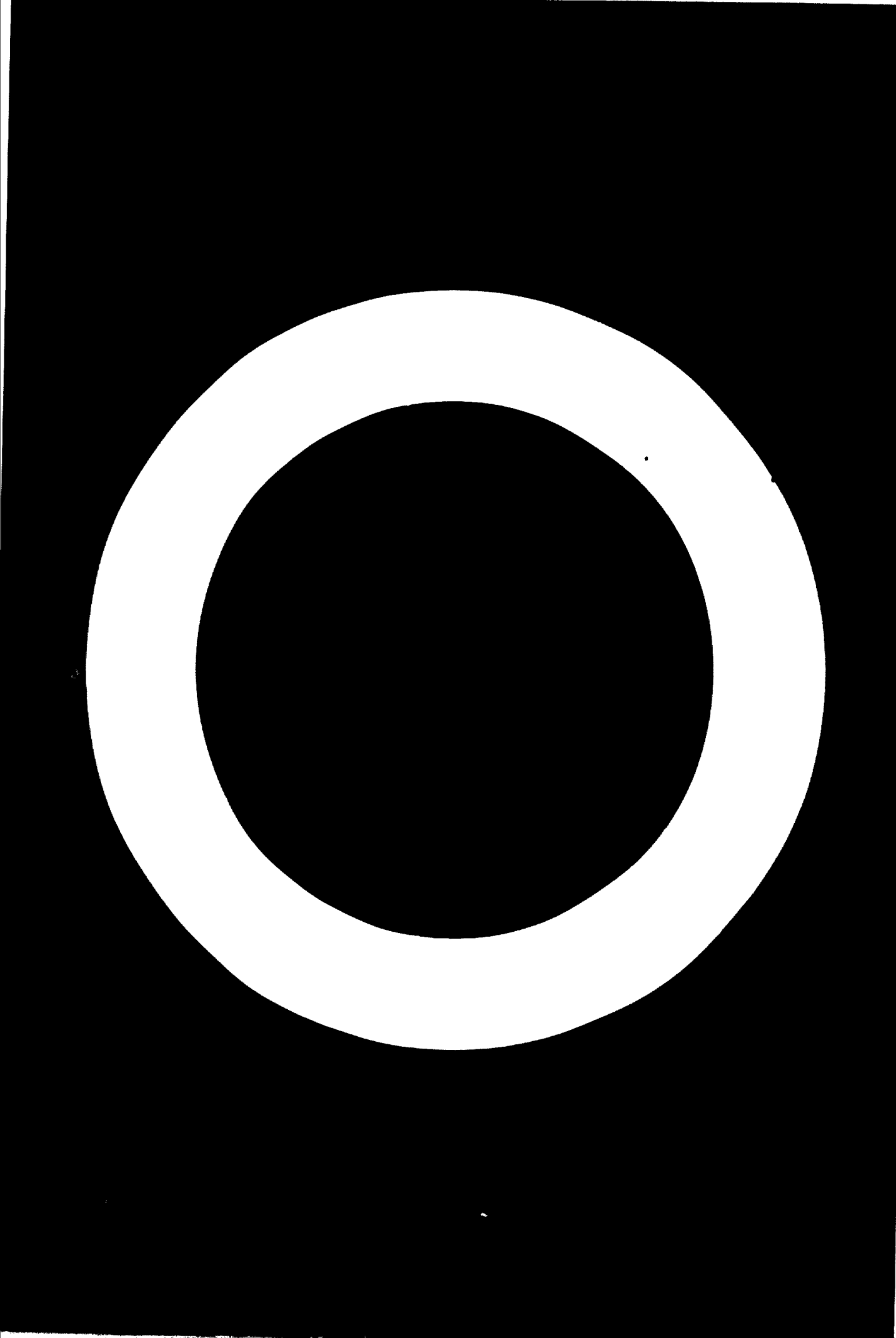
DEMOCRATIC YEMEN

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 M. R. Awad, brewery expert

United Nations Industrial Development Organization
Vienna, 1976



Explanatory notes

A slash between dates (e.g. 1975/76) indicates a crop year or financial year.

Use of a hyphen between dates (e.g. 1978-1982) indicates the full period involved, including the beginning and end years.

A full stop (.) is used to indicate decimals.

A comma (,) is used to distinguish thousand and millions.

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

References to "gallons" are to British imperial gallons (4.545 litres) unless otherwise specified.

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 the report, the value of the dinar in relation to the United States dollar was $US 1 = YD 0.343.

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.

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

Hz	hertz (cycle per second)
hl	hectolitre
kW	kilowatt
ppm	parts per million
c & f	cost and freight

feddan	1 feddan = 4,201 m^2 or 1.038 acres
GNP	Gross National Product
EBC	European Brewery Convention
IPU	Internation Pasteurization Units

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SUMMARY

The project "Brewery Expert" (IS/PDY/74/006) of the United Nations Development Programme (UNDP) in Democratic Yemen was launched on 11 September 1975, after a request for assistance for a study in beer production was made by the Government in August 1975. The United Nations Industrial Development Organization (UNIDO) was the executing agency. UNDP contributed $US 12,000 towards the project.

The main objectives of the project were to make a market survey of the present and prospective demand for beer in Democratic Yemen, study the feasibility of using locally-grown barley, and prepare a techno-economic study for the establishment of a brewery.

Presently, beer is imported by Democratic Yemen from many countries. The average consumption over the last few years has been around 10,800 hl/year. With the re-opening of the Suez Canal in 1975 the demand for beer by tourists, crews and ships' suppliers is likely to rise considerably.

It was found that the establishment of a new brewery of 30,000 hl/year capacity would be feasible although the expert recommended that the initial production be 18,000 hl/year. Preliminary calculations of the investment costs and profit are contained in the report.

The expert concluded that the barley grown locally was of a poor quality and malt for beer production would have to be imported. However, a study might be made, after the brewery is established, of a malting plant.

The Government of Democratic Yemen is interested in the establishment of the plant as it would provide employment and considerable savings would be made of foreign exchange that is presently spent on beer importation.

INTRODUCTION

A brewery expert arrived in Democratic Yemen on 11 September 1975 to start work on the United Nations Development Programme (UNDP) project "Brewery Expert" (IS/PDY/74/006). The duration of the project was two months and the executing agency was the United Nations Industrial Development Organization (UNIDO).

The main objectives of the project were to investigate the possibility of utilizing the barley grown in Democratic Yemen for production of beer, study the present and prospective domestic demand and export opportunities for beer, and prepare a techno-economic study for the establishment of a brewery.

The economy of Democratic Yemen is mainly agricultural although the Government is attempting to diversify it. The expert made a study of the barley grown there and the feasibility of growing other varieties. He concluded that locally-grown barley was of a poor quality and malt for beer production would have to be imported. However, a study could be made, once the brewery is established, of a malting plant.

Present consumption of beer amounts to around 10,800 hl/year. Supply does not meet demand and sales are expected to rise when beer is fully available. The opening of the Suez Canal in 1975 is also expected to contribute to a considerable increase in sales.

The expert recommended that only one type of beer be made to start with but after one or two years another brand could be introduced for export sales. Other beverages such as non-alcoholic and draft beer could be considered later for production. New sources of extra income will be provided by the by-products from the beer factory such as ice-blocks, carbon dioxide, and yeast.

It was also recommended that a brewery be established with a capacity of producing 30,000 hl/year although initial production should be 18,000 hl/year. The higher capacity would ensure that future demands could be met without additional investment. Preliminary calculations of the investment costs and profit are contained in the report.

If the brewery produces 18,000 hl for each of the first two years the investment required for the brewery will be repaid in two years. If it produces only 12,000 hl/year (average consumption for the last few years has been 11,000 hl/year), then it will take three years to repay the investment.

Project Background

The Government of Democratic Yemen has a policy of diversification of the economy to achieve a balanced growth and increase income through industrialization and other development. The study for the establishment of a brewery was proposed in the Five-Year Plan 1974/75-1978/79 with the intention of benefitting from local agricultural produce. All the beer sold in Democratic Yemen is imported (annexes I and II) and paid for in hard currency. At the end of 1972 several countries were asked to submit plans for a brewery. Here are the main proposals received.

Yugoslavia (Ingra)

It is understood from existing documents that Yugoslavia proposed a brewery with an initial minimum capacity of 30,000 hl/year although the Government of Democratic Yemen considered 16,000-20,000 hl/year sufficient. The Yugoslavs believed that such a reduction of the output of the brewery would reduce the price of the brewery by only 15% while increasing the price of the product and thereby the margin of profit. They asked for a market survey in order to be able to make a report. They offered a turn-key project, technical assistance, training etc. The price for machines and their erection would be $US 1,225,000 f.o.b. The estimated cost of the building was $US 250,000.

Czechoslovakia

Democratic Yemen and Czechoslovakia signed a Mutual Economical and Technical Agreement. On 29 May 1973 delegates from Techno-Export Praha visited Aden and, within the framework of this Agreement, signed a preliminary agreement, for a brewery, the main points of which are as follows:

1. Minimum output will be 20,000-40,000 hl/year.

2. Production depends upon imported malt rather than malt made of local barley.

3. Democratic Yemen asked for technical assistance, training etc. and wanted to produce, under licence, Czechoslovak beer. The Czechoslovak offer was to establish a brewery as a joint venture.

4. Democratic Yemen asked that the Czechoslovak offer should include: c.i.f. price for each machine, best raw material available, a complete civil engineering plan for the whole project, basic information on layout and all other technical requirements, provision of technical staff to erect the machinery, training of staff, and the cost involved. The Czechoslovaks then decided that the minimum economic output would be 100,000 hl/year. Democratic Yemen answered by telegram, asking for a feasibility study for 100,000 hl/year and stated they would pay for the study, as requested by the Czechoslovaks.

Lebanon

An offer from the "Grand Brasserie du Levant" arrived in October 1973 offering a turn-key project, training of people in their firm, royalties from making their beer "Laziza" in Aden etc. The contract would be for 15-20 years, and the cost would be as follows:

$US 25,000/annum for the first two years
$US 25,000 for each following year

Royalties on Laziza beer

$US 0.5/hl first 8,000 hl
$US 0.3/hl 8,000 to 40,000 hl
$US 0.25/hl 40,000 to 60,000 hl
$US 0.20/hl 60,000 hl or more

The calculations for the plant were based on an output of 2,000 cases of 24 bottles each every 8 hours of work, one shift consisting of 5 to 6 days/week. The cost of establishing a brewery was calculated as follows:

Machines for bottling plant	$US 850,000
Brewhouse, cellars, boilers etc.	$US 900,000
Building	$US 100,000-250,000

Money would also be needed for planning the electrical system, and workshops. After careful consideration, it was decided that the productivity of the brewery would be more than required and also it was too expensive.

The German Democratic Republic (Radeberger)

The first page of the offer is missing but it appears to be based on production of 15,000 hl or 30,000 hl of beer per year as they gave two alternatives for raw materials and malt silos. No prices are feasible in the existing report.

Gestle

Gestle is a firm of engineering consultants which offered its services. This firm claims to be knowledgeable and experienced in the field of beer and malt production and its is prepared to make an offer for a turn-key factory.

I. FINDINGS

The fundamental task that has to be achieved in Democratic Yemen during the next five years is the increased production of foodstuffs and materials which can be manufactured to reduce imports and supply the developing industries with raw materials. The Five-Year Plan for 1974/75-1978/79 envisages that an increase of 54% will be achieved in agricultural production and 164% in industrial production. The figures relating to capital investment for the five-year period in agriculture and industry can be seen in table 1.

Table 1. Distribution of capital investment for the Five-Year Plan

Sector	Total capital investment	Studies and design	Machinery and equipment	Construction and installation
Gross total of national economy	75,358.5	2,456.1	25,982.5	46,919.9
Industry	13,456.8	572.3	7,987.6	4,986.9
Agriculture	27,711.2	923.6	12,588.0	14,199.6

It has been planned to increase irrigated and cultivated land by 50,000 to 55,000 feddans of which 40,000 feddans will be reclaimed as new land and 10,000 to 15,000 feddans will be better supplied with water.

It is expected that the increase in irrigated and cultivated land used for cereals will be 35,000 acres including 1,000 acres for barley. Over the five-year period the barley crop will increase from 2,000 to 2,800 tons.

Since any development of land in Democratic Yemen depends mainly upon well and surface water, YD 16,750,000 (60% of the investment-funds of the Ministry of Agriculture) was directed to improve irrigation.

Priority in the industrial sector is given to projects that depend upon local raw materials and those whose products help to reduce imports. A provision is made in the reserve projects list of the Ministry of Industry for a techno-economic study of the feasibility of a brewery as both priorities would cover such a project. It is believed that if such a project is deemed feasible, it will be included in the current Five-Year Plan.

Care has been taken to ensure that the public sector plays a major role in the national economy. It should achieve an increase of 280%.

A. Barley

The barley-growing area does not exceed 1.4% of the total cultivated area and 2.4% of the total cereals area (annex III). The value of the barley crop is 0.6% of the total value of agricultural production (annex IV).

It is the policy of the Government to develop the area cultivated by the public sector as well as that of the co-operatives. The private sector of barley growers is now 5% (annex V).

Barley is presently used to make bread (as in the fourth governorate) and to feed goats, asses and other domestic animals.

Barley-growing areas

Bihan (3,600 ft above sea level)

In Bihan in the fourth governorate, almost 2,00-2,500 feddans are used for growing barley. They are divided into small scattered areas of from one to five feddans. The co-operative sector runs almost 90% of the area, while the rest is privately owned. The soil is sandy loam. The barley grown is two-row but the variety cannot be detected. Seeds are sown in October or November, irrigated four or five times, and sometimes organic manure is added but no chemical fertilizers are used. The crop is harvested manually in February. A primitive machine pulled by a camel is used to crush the crop. The process is completed manually. The plant is subject to some rust although its effect is limited due to the relatively high temperature. Since the growth is weak, the plants lean on each other and this is the main reason for the low quantity and poor quality of the crop. Sometimes there is a strong wind which increases the loss as some of the plants are blown away.

The crop does not exceed 0.5 ton/feddan. It is usually poor in starch but rich in husks and protein. The humidity in the crop is approximately 10%. Barley is grown only once a year.

Mukeiros (6,700 ft above sea level)

In Mukeiros, in the third governorate, about 600 feddans are cultivated in small scattered areas. The barley is sown in October and harvested in February, and a second crop sown in March and harvested in June or July. The soil varies from sandy to silty loam. The crop is irrigated three or four times and no chemical fertilizers are added. The work is done manually. Yellow and black rusts attack the plants but the damage is limited. The variety is six-row, no analysis exists. Humidity is from 15% to 17%. The crop per feddan varies between 0.4-0.5 tons.

Seyiun Hadarmout Valley

In the fifth governorate barley is grown in only a few, privately-owned areas and no records of this crop are available. The land varies from silty to sandy loam.

Standard varieties

Six-row barley can grow in weak soil fortified by fertilizers and correct irrigation and give a good crop of one ton/acre. It also gives left-overs (barley unsuitable for malting because it is shattered or too small etc.) which are useful for feeding cattle. The value of the left-overs equals the value of the barley. However it is important to choose the correct variety and avoid alkaline soil. Good varieties of six-row barley give malt which can be used to make beer.

Two-row barley needs good soil and fertilization and careful harvesting as it shatters if this is delayed. It has much less husk than the six-row and a better starch content. Its crop in good soil with fertilization reaches one ton/acre. Its value in the international market is about 20% more than the six-row variety. It can be easily exported and gives good malt. Good varieties should be selected and continuous care given to the seeds which should be treated before sowing.

New varieties

Two trials have been made, one with two-row Australian Klipper and one with six-row Giza. It was found in 1975 that the Klipper was more successful. Experts from the Food and Agriculture Organization of the United Nations (FAO) with the help of local specialists are running 25 trials in Behan (annex VI), with six-row and two-row barley. Results were anticipated in 1975 but a delay occurred.

It is expected that these trials will proceed for two years, then it will take another two years to develon the seeds. The actual area for each trial is 0.1 feddan, increased to 1 feddan the second year, 10 feddans the third year, and finally 20 feddans the fourth year. The trials may extend over six years rather than four. The experts believe they will be able to develop a successful variety by 1979 or 1980.

Crop storage

The crop is stored in three different ways:

1. It is buried (an old custom) to keep it from insects and humidity.
2. It is stored in big tin barrels (used oil barrels).
3. Very rarely it is stored in sacks.

The Ministry of Agriculture has built enough silos to stock about 1,700 tons of wheat in the new mill in Maalla which was finished by the last quarter of 1975. Also 32 metallic silos were bought from E. H. Bental & Co. Ltd, United Kingdom, for wheat. Only 12 were erected, the others are still on their way. A silo consists of four cells, each holding 102 tons and measuring 16' 3⅛" x 16' ⅛" x 17' 7¼".

Evaluation of the present situation

The Government declared its willingness to increase the area of barley cultivation if that would help industry or decrease imports. However, the emphasis remains on increasing the area of wheat growing as bread is the staple of all meals. Thus, less care was given to barley cultivation by the Government and by the farmers who shifted to other crops.

It may take from four to six years to select suitable varieties, and grow them commercially. A feasible study for a malting plant will not be possible before 1980. The quantity of malt needed will not exceed 450 tons which will take 760 tons of good barley. It should always be possible to export barley or malt assuming that prices are favourable.

Specific recommendations

Climate

As barley can adapt itself to different climates, the most suitable variety should be selected. Barley for making malt should not be grown in humid areas as it needs artificial drying before storing. Therefore the best areas for two-row is where summers are warm and dry, and winters are mild.

Soil

Six-row barley may grow in slightly salty soil while two-row needs a moderately good soil.

Irrigation

Since barley needs irrigating four to five times a crop, the barley area should be where water is permanently available, also barley for fodder can be grown in areas where there is rainfall. To achieve better harvesting, irrigation should cease one month before maturation of barley.

Fertilizers

As the soil is poor in nutritive substances, organic manure, added before sowing, is of vital importance. Chemical fertilizers such as superphosphate and urea are essential. Superphosphate is added while ploughing at the rate of 20 kg/acre calculated as P_2O_5. Urea is added 20, 45, and 70 days after sowing and after irrigation, 10 kg/acre of nitrogen is used.

It is possible to vary this schedule but not advisable to add fertilizers later than 75 days after sowing as this leads to overgrown vegetation which means less crop and more shattering of seeds.

Varieties of barley

The trials that took place in 1975 should be continued. It is believed that six-row barley would be most suited to the country as it better resists the climate and soil of Democratic Yemen. Grading will provide the malting plant with seeds and if the two-row shows promise, it can also be graded and used for the same purposes as the six-row. It is recommended to make the same trials as took place in India, Egypt etc.

Harvesting

Harvesting should take place at the proper time. Barley harvested wet is of no use to beer as it quickly loses it germination power. On the other hand if it is too dry, the crop drops enormously due to shattering of seeds during harvesting. For the two-row type particularly, it is recommended to harvest it when almost one third of its stem near the soil turns yellow. Also great care should be given during crushing in order not to split the grains as this weakens germination during the malting process.

Conservation

As the crop is very small and used mainly for making bread it is possible to keep it in clean sacks stowed in shelters. It should be treated to keep insects away. However, once the crop is of large quantities and is used to make malt or exported, it is necessary to build cement silos for storage. It should be cleaned to get rid of impurities, treated against insects, and stored in silos. It should also be aerated from time to time either by pumping it from one silo to another or injecting dry air through pipes inside the silos. Wheat silos can be used, if available.

Agricultural policy

In annex V it is shown that while production in the private sector will decrease in 1978/79 to 96% of its value in 1973/74, both the public and the co-operative sectors will increase production.

The increase of the public sector will be 275% more than 1973/74 while the increase of the co-operative sector will be 15% more than in 1973/74. It is clear that the co-operative sector will still be the main agricultural sector after the Five-Year Plan.

It is believed that by following the correct policy of irrigation, fertilization, harvesting etc. the crop per acre will be between 1 to 1.2 tons of barley. This will encourage the private sector to adopt the plan of the co-operatives and the public sector. The farmers can be helped to use the correct

method at the correct time by the distribution of pamphlets written in simple language and by advertising on radio and television. However, the most convincing argument is when they see that by more work and care, the quantity and quality of neighbouring crops improve which means better income.

B. Beer and other alcoholic drinks

Imported beer and other alcoholic drinks are paid for in foreign currency. The taxes on these beverages are shown in table 2. Since 1971 there has been no re-exportation of beer or other drinks.

Table 2. Taxes on imported beer and distilled spirits
(YD)

Year	Import duty			Excise duty
	Beer	Distilled spirits	Total	
1971	120,715	50,169	170,884	209,000
1972	167,168	45,261	212,429	...
1973	196,930	46,455	243,385	270,000
1974	122,972	40,000[a/]	162,972	270,000
1975	250,000[a/]	45,000[a/]	295,000	270,000

a/ Estimated.

In September 1974, a new tax was introduced labelled "Price Balancing Fund" which is 10% more than the old one. This led to an increase in the price of goods of 16%.

Sales

In November 1967 British troops left the country which led to a drop in beer consumption of almost 30% from the previous year (annex I). As there are no breweries all beer is imported. The importers are two firms which belong to the public sector: the Victory Trading Company and the National Company for Foreign Trade. The imports are listed in annex I.

The Victory Trading Company

This company imports goods either to be sold for foreign currency to free zones or re-exported to ships, planes etc. They import many brands with different prices. Table 3 shows the number of brands and quantity of beer imported.

Table 3. Available import data

	1973	1974	First half of 1975
Number of brands	8	6	5
Quantity (hl)	2,212	1,773	980

The National Company for Foreign Trade

According to the policy of the Government, a fixed amount of money is given to the National Company for Foreign Trade to import all necessary goods. The sum fixed for beer imports is not subject to market needs but only to the availability of foreign currency.

Imported beer is kept in dockyards and when a quantity is withdrawn the company pays the excise duty which is YD 0.846 per imperial gallon and 10% of this amount for a "Pricing Adjustment Fund" and about 2% for other purposes. The beer is then handed over to the National Company for Home Trade.

The National Company for Home Trade

The policy of the National Company for Home Trade is to supply the bars, restaurants, clubs, and hotels of the public sector, the remainder is then given to the private sector. A weekly quota is given to everyone which, for the last few years, was below demand.

The main factors that may affect sales in the future are the domestic demand for beer and the possibility of exporting it.

Domestic sales

The domestic demand for beer is influenced by the economy of Democratic Yemen. This is centrally planned and priority is given to industrial development rather than consumer spending. It is believed that the Gross National Product (GNP) per capita may have increased by 25% at the end of the Five-Year Plan in 1979. Sales of aerated water during 1974/75 increased by 25% although the deposit per bottle went up 75%. This increase may be due to more money being available. There are hundreds of thousands of Yemeni people working in Kuwait, Saudi Arabia, Somalia etc. Who are earning enough money to support their families in Democratic Yemen. This unseen flow of cash and goods may explain the consumption of "qat" (see page 24) although its price is rising steeply. There may be an increase of 10% in beer sales by 1978 if money becomes available.

Existing price policy

The public sector is allowed credit but the private sector is treated on a basis of "cash and carry". All retailers have to take the broken bottles in cartons, bottles of flat beer etc.

The policy of the National Company for Home Trade in fixing prices seems to benefit the Government. Each bottle of beer should sell to retailers for YD 0.284. The retailer is supposed to sell it to the consumer at the bar for YD 0.325 or to take home for YD 0.305. This gives a retail margin of 14.4% and 7.4% respectively. In fact, the actual selling price is YD 0.350 for both types of consumer, which gives a margin of 23%. No deposit is required for the bottle.

Recommended price policy

As the proposed brewery will belong to the public sector the price of beer should benefit first the consumer (being lower than that of imported brands), and second the Government. Suggested prices for an 0.5 l bottle of beer are YD 0.200 to the retailer, YD 0.250 at the bar, and YD 0.225 to take home. This will achieve savings of 25% to the retailer, and 12.5% or 29% to the consumer. The margin of profit for the Government is still good.

Existing marketing policy

As the policy of marketing beer is subject to the availability of foreign currency not much attention is paid to it. Added to this is the fact that all imported beer is consumed although prices are high.

Recommended marketing policy

The brewery should have its own store in every main city. These stores will replace the brewery in selling to retailers.

An advertising campaign is necessary and should at least reach the main cities of each governorate by means of newspapers, television flashes, movies, etc. This should be continuous. A careful study should be made of the background of anyone who wants to sell beer. The brewery should decorate the stores attractively and beer should always be available. Care should be taken that fixed prices are respected. Stores should be allowed to sell cartons only, the price of which is suggested as YD 4,500 (i.e. YD 0.225 per bottle). The private sector should pay cash as it is paid in cash. To co-operatives and the public sector, credit can be extended. Incentives should be offered to brewery salesmen, inspectors, and stores salesmen in the form of commission. Monthly meetings with main retailers, salesmen, and technicians from the brewery should be held to exchange ideas and views about market reception of the product. If necessary, a new brand could be made to sell for YD 0.150 instead of YD 0.200. This brand may be sold only for foreign currency and export.

Beer should always be available in the market but this is not the case in Democratic Yemen due to financial reasons. It is believed that the correct figures for beer consumption, if they were always available, would be at least 15%-20% above the actual figures.

Climate

The warmest season throughout the country (excepting the town of Mukerias) is July to September. April to June and October to December are somewhat cooler and January to March is the coolest season.

These seasonal changes are reflected in aerated water sales for 1973/74, and even more strongly in 1974/75.

Geographical distribution of beer

Figures for the sale of beer in 1975 in the different governorates are not available but the owners of bars and restaurants belonging to both the public and private sectors estimate them as shown in table 4.

Table 4. Estimated sales of beer by area in 1975

Area	No. of bottles	Population	Bottles/ head
1st governorate	1,850,000	306,900	6.03
2nd governorate	60,000	287,900	0.21
3rd governorate	80,000	328,000	0.24
4th governorate	10,000	170,900	0.06
5th governorate	-	475 700	-
6th governorate and Thamood	-	107 600	-
Total	2,000,000	1,677,000	1.19

It is clear that the consumption per head in the first governorate is much higher than any of the other governorates for several reasons (annex VII). Aden, the capital of Democratic Yemen, lies in the first governorate, thus ministries, main banks, offices, and commercial enterprises are located there and all foreigners live there (including sailors, transit passengers, United Nations staff and experts).

All big hotels, restaurants, and bars are found in Aden and its surroundings. The standard of living in the first governorate is relatively much higher than in the others because of the above-mentioned reasons. In the fifth governorate, although the standard of living is just below that of the first governorate, beer is not allowed to be sold, partly because they prepare their own distilled and non-distilled drinks but mainly because a large quantity of beer once sent there was consumed in a few days and the results caused trouble. It was decided therefore to ban the sales of beer in this area. The Government found that this ban helped to reduce the loss of foreign exchange used to import beer. In the other governorates the standard of living, problems of transportation, and lack of stores account for the low consumption of beer which differs enormously between the first and the other governorates. Even if it were permitted to drink beer in the fifth governorate, the problem of transportation would make it expensive. In the Five-Year Plan the sum of YD 16 million was

ear-marked by the Ministry of Public Works for the construction and improvement of roads which means that by 1979 transportation between the first, third, fourth, and fifth governorates will be greatly improved.

Quality of beer

The Victory Trading Company imports many different brands of beer. The expert found that some of these were not of good quality (the beer was cloudy), which may have been due to the fact that they were imported more than six to eight months previously or that beer is incorrectly stored.

Packaging

The Yemeni people believe that 0.3 l and 0.5 l bottles are too small and prefer the 0.75 l bottle which used to be sold for YD 0.600. One reason they may prefer this bottle is they believe that the figure of 12% on the label referred to the percentage of alcohol although actually it was the original extract in balling. For the last two years the National Company for Foreign Trade has concentrated on importing beer from the German Democratic Republic called "Radeberger" in 0.5 l bottles. This may be the result of trade agreements between the two countries. The Victory Trading Company keeps importing the numerous brands previously mentioned.

Beer consumers

A market survey was made on beer drinkers from which certain conclusions were drawn concerning the age, sex and other characteristics of the beer consumer. Males consume more than 99% of Democratic Yemen's beer imports. About 95% is consumed in urban districts, 4% in rural districts, and 1% at home. Consumer age varies between 25 and 50 years. In summation, 76,798 persons consum 95% of beer imports and 93,844 persons consume another 4%.

It is believed that the present minimum age of beer consumers will drop from 25 to 20 as is the trend in Arab countries where beer is not prohibited. As a result, beer consumption is expected to rise by about 10% by 1978.

Foreigners living in Democratic Yemen

Foreigners live in Democratic Yemen for differing lengths of time. Usually they earn more money than local citizens and are good consumers of beer. Some of them pay for beer in foreign exchange. The quantity of beer consumed by foreigners is almost 15% of the total consumption of the country and amounts to YD 126,000, of which 70% is in foreign exchange. Thus, 10.5% of beer sales are paid for in foreign exchange.

Local beverages

There is no law in Democratic Yemen prohibiting alcohol. The most popular drink is beer then distilled spirits. However, many varities of alcoholic beverages are made locally. No licence is given to make these drinks yet they are made and sold cheaply.

Some varieties are:

Taria. The top is cut off a plant similar to a palm tree, and a bottle put below the opening to collect the juice. When the flow stops a thin layer of the cut part is removed to restart the flow, this is continued until no more juice is available. The bottles are loosely covered and fermentation takes place and the juice becomes an alcoholic white drink. The percentage of alcohol is about 1%-1.5%. This drink is usually made in the first governorate as the plant from which Taria is made grows in the desert.

Chokkor is made of sugar, water, yeast, and plant leaves. The sugar is fermented and left for almost eight days. Green plant leaves are added to colour the drink and cover the yeast smell. It is sold in whisky bottles and is rather expensive (YD 1 per bottle). It is strong and half a bottle will intoxicate a person. This drink is found mainly in the second and third governorates but called "Damoran" in the third governorate.

Araki is made of dates, mainly inedible ones that are boiled in water to extract as much sugar as possible. Then yeast is added. When fermentation has taken place it is distilled and sold. The price of a bottle varies from YD 0.5 to YD 0.7.

These are the principal local alcoholic drinks made by individuals under no licence and under no control. Their trade is unofficial and they are sold in the governorates where they are prepared.

Qat

In the first, second, third and fourth governorates almost 85% of males over 16 years old and 10%-15% of females over 20 years old chew the green leaves of a plant called qat. As they chew they drink cold, or aerated, water, beer or whisky depending on their financial status. This is a social habit

practised in groups of 2 to 20 people. It is so serious that some people prefer qat to food. The Government is aware of this problem and does not permit any increase in the planting area for qat. This leads to an increase in price and decreases the number of "qatting" days. The cost of one "qatting unit" varies between YD 0.3 and YD 0.5 and may reach YD 0.5-0.8 on non-work days. The price may double for good varieties.

Tumbul

The habit of taking Tumbul came from India and has spread all over the country. It is made of one betel leaf, one solid slice of supari (betel nut), small ground particles of limestone, kattaha kronfill, cardamom, tobacco, and mohini. Then it is folded and eaten. These are the main ingredients of tumbul, yet sometimes a lot of other things are added. It is called a stimulant. The price is YD 0.010 per unit and the consumption per person varies from 2 to 10 units daily.

Export opportunities

Export of domestic beer and re-export of imported brands will be made to visiting ships and neighbouring countries. However, a market survey should be made before any decisions are taken on exporting to neighbouring countries.

The last recorded figure for re-exportation was in 1970 for the value of only YD 20 (annex II). This may have been due to the enormous drop in the number of ships and transit passengers passing through the Port of Aden after the closing of the Suez Canal in 1967.

Since the re-opening of the Suez Canal in 1975, the number of ships and therefore the number of sailors and passengers in Aden increased. It is estimated that 80,000 passengers will be in transit through Aden in 1980 (table 5). By 1978 it is estimated that sales of beer to crew members and ships will increase total sales by 16% and 2% respectively.

Sales estimates

As establishing a brewery requires at least two years, 1978 is taken as a starting point to estimate five years beer consumption either by importation or local production (table 6).

Table 5. Traffic forecast for the Port of Aden

Year	Ships	Net registered tonnage (thousands of tons)	Transit passengers
1976	3,019	9,100	8,000
1977	7,612	24,546	25,000
1978	9,742	31,001	55,000
1979	9,887	31,405	70,000
1980	10,011	31,896	80,000

Table 6. Estimated beer sales for 1978

	Litres
Beer sales January-December 1975	1,200,000
Increased sales due to availability (25%)	300,000
Increase sales due to better transportation (15%)	180,000
Increase sales due to more consumers (10%)	120,000
Increased sales to crew members (16%)	192,000
Increased exportation to ships (2%)	24,000
Total	2,016,000
It is estimated that about 10% of the total sales will be sold for foreign currency	216,000
Beer bought in local market	1,800,000
Excise tax of YD 0.846/imperial gallon (4.546 l) paid locally in 1978	YD
$= \frac{1\,800\,000}{4.546} \times 0.846$	334,976
Pricing Balancing Fund (10%)	33,498
Miscellaneous (2%)	6,700
Profit of National Company for Home Trade	169,020
Total governmental direct profit (not including expenses)	544,194

The market survey indicated a possible annual increase of 6%-8%; to allow a safe margin 5% is taken as the basis for the estimated figures for the five years 1978-1982, which are shown in table 7. It is assumed that the c.i.f. price will not increase.

Table 7. Estimated beer sales for 1978-1982

Year	Local market consumption (thousands of l)	Excise duty (YD)	Other taxes (YD)	Profit of National Co. for Home Trade (YD)	Total Government profit (YD)	Foreign currency in YD
1978	1 800	334 976	40 198	169 020	544 194	381 600
1979	1 890	351 724	42 208	177 471	571 403	400 680
1980	1 990	370 335	44 441	186 861	601 637	421 880
1981	2 080	387 083	46 451	195 312	628 846	440 960
1982	2 190	407 554	48 908	205 641	662 103	464 280

Comparing the last two columns of the table, it can be seen that for every YD 100 a profit of YD 42.6 will be made.

Plans for a brewery

A study has been made for a brewery that can produce up to 30,000 hl of beer per annum.

Labour requirements

The normal working week in Democratic Yemen consists of 46 hours, as follows:

Saturday to Wednesday	7 a.m. to noon and 2-5 p.m.
Thursday	7 a.m. to 1 p.m.
Friday	Day off

Those working on shifts should not work more than five continuous hours, followed by a period of rest, then work the remainder of the eight working hours. It is not permitted to ask anyone to work on holidays or days off or even during his period of rest except in such emergencies as fire, floods etc.

Medical treatment is free for everyone in Democratic Yemen. Annual leave is one month every working year. Factories may provide their workers with uniforms. Each worker is provided on working days with bus tickets covering the return distance between his house and the factory. Management is paid YD 60.720-66.792 monthly and workers are paid as shown in table 8.

Table 8. Monthly salaries

	YD/month minimum	YD/month maximum
Grade I.	40,000	60,500
Grade II.	22,000	40,000
Grade III.	12,000	22,000

Special allowances are granted to engineers and assistant engineers of YD 2-25 monthly.

Prospective owners

It is the intention of the Government that the brewery should belong to the public sector as it will achieve a quick net profit and save over 80% of foreign currency spent every year.

Financial management

Care should be taken in the selection of a financial manager particularly in view of the fact that beer production is a new industry - although similar to the production of aerated water - in Democratic Yemen. It requires a special study to organize the work, and help reduce expenses especially the first year when strict control is essential.

Technical management

Running a brewery from the technical point of view needs specialized knowledge, experience in the same field, an ability to make decisions, and authority. A suitably qualified person may not yet be available but training could be given to the right man.

Business management

Business and personnel managers are available and easy to find.

Staff recruitment and training

As it takes at least two years to establish a brewery, it is recommended that recruitment and training of staff should commence immediately the project is started. Listed in table 9 are the number of workers required together with qualifications necessary and salaries offered.

Table 9. Brewery staff

Total annual pay (YD)	Monthly pay (YD)	No. and title of post		Qualifications
960	80	1	General manager	B.Sc. Agriculture (food industry). 10 years experience.
636	53	1	Chief quality control	Chemist or B.Sc. Agriculture (food industry). 3 years experience.
636	53	1	Chief production	B.Sc. Agriculture (food industry). 3 years experience in brewing, fermentation, storage and bottling.
636	53	1	Power engineer	Power engineer. 3 years experience.
636	53	1	Chief accountant	Economist. 5 years experience.
504	42	1	Accountant	Knowledge of social laws
480	40	1	Foreman bottling	10 years experience in similar work Under 40 years old, reading and writing skills.
384	32	1	Electrician	Mid education. 5 years experience.
1 152	32	3	Technician	To run refrigeration carbondioxide plant. 10 years experience. Reading and writing skills. Under 40 years old.
768	32	2	Technician	Maintain boiler. 10 years experience. Reading and writing skills. Under 40 years old.
768	32	2	Maintenance	Mechanic. 5-10 years experience on bottling machines
1 152	32	3	Technician	To run workshop. One to 10 years and two - 5-10 years experience.
864	24	3	Skilled worker	Malt reception and brewhouse. Intermediate school. Age 20-25 years. Intelligent.
576	24	2	Skilled worker	To work in cellars. Primary school education. Under 30 years old.
1 152	24	4	Skilled worker	Machine drivers for bottling plant. Experience in similar work.
288	24	1	Store-keeper	5 years experience in work.

Table 9. (continued)

Total annual pay YD	Monthly pay YD	No. and title of post	Qualifications
864	24	3 Drivers	Experience and general knowledge of car maintenance.
720	30	2 Sales-men	Experience in marketing, selling etc.
4 680	15	26 General	To work in cellars, bottling, conveyors, cleanliness and guards. Good health. 20-25 years old.
17 856			

Foreign assistance

Foreign assistance is necessary for a minimum of four years or at least until a technical manager is trained. Another assistant may be of great help but this will be necessary for only two years. The technical manager will be paid about YD 4,500 per annum and his assistant about YD 2,000 plus lodging for both of them which will cost about YD 2,000 per annum. It is also advisable that the brewery should be run under the technical supervision of a reputable company as this may help in:

(a) Training the necessary people before the opening of the brewery;

(b) Securing the right technical manager;

(c) Making tenders;

(d) Helping to purchase goods, machines, etc.

Technical supervision may cost from YD 5,000 to 7,000 per year depending on services required, number of visits, number of people to be trained, length of contract, and the reputation of the firm and its interests in the Gulf area. An extra YD 1,000 per annum is estimated for social obligations.

Unskilled workers

Unskilled workers are available but it is recommended that their recruitment takes place 12 months before the opening of the brewery. They should be well-built, aged between 20 and 30 years, healthy, and have preferably finished military service. Their jobs in the brewery will be cleaning, loading and unloading cars, removing bottles from crates to feed the washer, filling crates with bottles of pasteurized beer,etc. After recruitment they should be sent for training to one of the aerated water factories to replace people on leave. They should be watched carefully to eliminate unsuccessful candidates and attend a weekly meeting to receive instructions on their work, behaviour and hygiene in dress, hands, etc. One year is considered sufficient for training.

Machine operators

Machine operators are skilled labourers. They are expected to run the bottling machines and work on filters in cellars and the brewhouse. They should be able to read and write and preferably have finished their studies in an industrial preparatory school. They should be between 20 and 30 years of age. Machine operators should be recruited 18 months before the brewery opens and be trained in aerated water companies which have machines similar to those used in a brewery. Such training will take six months during which the operators should help in repairing the machines and assisting in their operation. Machine operators are expected to know their machines quite well and help to erect them when the brewery is started. They should be encouraged to ask questions of the experts and a good translator is of major importance.

Technicians

Electricians, boilermen, machine operators (condensers, compressors etc), and maintenance and workshop mechanics should be people with a minimum experience of 10 years in their field. Graduates from a polytechnical school after one

year's training can also be accepted. The latter should be recruited a year before graduation and trained in various factories during the summer holidays (with pay), with an eye kept on them in their last year of study, after which they should be engaged to the brewery to assist in erection and/or be trained till the brewery starts running.

Other jobs

Workers are available to fill vacancies for drivers, guards, storekeepers, book-keepers, etc. It is not hard to recruit power engineers, agricultural engineers, and chemists who should be trained for one year. They should instruct workers under their supervision and act as translaters for the expert.

C. Raw materials for beer production

Malt

Malt is the main ingredient of beer. It is made from certain varieties of barley which are specially treated. This product does not exist in Democratic Yemen and has to be imported. The main exporting countries are Czechoslovakia, Denmark, the Federal Republic of Germany, France, the German Democratic Republic, the Netherlands and the United Kingdom. It can also be imported from nearer countries such as Egypt and Turkey. The price varies between $US 250 and $US 280 f.o.b. The analysis of malt to be imported should read:

Moisture content: not more than 4.5%
Protein in dry matter: 10% $\pm$ 1.5%
Extract yield from dry matter: not less than 80% (corrected to pH 5.60)
Colour of wort: 3.5 $\pm$ 0.5 European Brewing Convention (EBC) units
Attenuation limit: 81% $\pm$ 3%
Soluble protein in extract: 5.5% $\pm$ 0.5% (corrected to pH 5.60).
Extract difference between coarse (3.5% maximum) and fine grinding (EBC mill)
Diastatic power: 200 W.K. units mimimum

It should state in the order that during storage and/or transporation treatment with insecticides is not allowed. When imported from Europe, the phrase "The malt should be made of summer barley" should be included in the order.

Hops (Humulus lupulus)

This plant does not and cannot grow in Democratic Yemen as the weather and soil conducive to its growth are not available there. Nor can it be replaced as it helps to give the beer its characteristic taste, odour, and flavour.

There are many varieties of the hop and their use depends entirely upon the chemical analysis and aroma. In purchasing fresh hops note should be taken of the following:

1. When the cones are pressed they should be elastic, not dry.
2. Cones should be small, well closed, and uniform.
3. Leaves and branches are useless and should not be mixed with the cones.
4. Hops should have a high content of lupulin and be rich in smell.
5. Preferably there should be no grains as their presence means waste.
6. The colour should be a nice green.
7. The aroma should be fine and mild with no strange smell of sulphur or smoke.

There are many ways of adding hops to the beer but it should always have the same taste. All the hops may be fresh or only some of them fresh. In countries such as Democratic Yemen where the weather is warm and the cost of shipping fresh hops is high, it is advisable to use 50% of fresh hops, powder or pellets and 50% hop extract.

The price of hops in their different forms varies according to alpha acids and aroma. A ton of fresh hops is calculated at YD 1,500.

Adjuncts

Adjuncts are used all over the world in beer production (except in the Federal Republic of Germany for local beers). The percentage of adjuncts varies from 10 to 40. The main reason for using them is their low price, therefore, the use of one adjunct or another depends on price factors.

1. Broken rice should be clean, with a humidity of less than 13%. The extract of 90-95% of dry matter should not contain more than 1% fats. Its importation price is YD 120/ton.

2. The extract of maize flakes should be 85-90% of dry matter and should not contain more than 1% fats.

3. Sugar is usually added during the boiling of wort, and sometimes it is added before the second fermentation to accelerate the process. It is added in different forms such as glucose, inverted sugars, and crystallized saccharose. Sugar is economical at present as it is YD 440/ton.

Water availability

Water is supplied by the Public Water Corporation. In Mansourah where the "New Industrial Area" exists, water is provided from high tanks which receive it from bore holes at Bir Nasir. The water pressure now is approximately 2.0 kg/cm^2. A drop is expected in the pressure when consumption of water increases. Pumps have already been requested. For industry, the price of water is YD 0.250/imperial gallon.

Water quality

Bacteriologically: a bacteriological check-up is carried out every week, the results are negative for Escherichia coli.

Chemically: the latest analysis made by the British Petroleum laboratory in Aden on 9 November 1975, is as follows:

Appearance	Clear
pH	7.6
Free CO_2 parts per million (ppm)	nil
Total dissolved solids	1 332 ppm
Chloride (Cl)	312 ppm
Total alkalinity as $CaCO_3$	326 ppm
Total hardness	270 ppm
Iron (Fe)	0.04 ppm
Copper (Cu)	0.2 ppm

Lead (Pb)	2.0 ppm
Sulphates (SO_4)	311 ppm
Sodium (Na)	310 ppm
Calcium (Ca)	28 ppm
Magnesium (Mg)	77 ppm

It is clear that such water needs treatment before being used to make beer or used in the washer in the bottling plant.

Drainage

Usually the quantity of water needed to make 1 hl of beer is 1 m^3 but it may go as high as 2 m^3 for 1 hl of beer. This may be the case in Democratic Yemen for several reasons. First, returned bottles are used which require special treatment in the washer and the water may have to be changed twice daily. Second, small-scale production needs more water per unit. Third, hot weather and sandstorms lead to more water consumption.

This means an effective and efficient drainage system is necessary. Up till now, such a system did not exist. Yet a study was made by the Government and permission given to John Taylor & Co. to start a sewage system for the new industrial area. This project will be finished before 1978.

Carbon dioxide

As the only carbon dioxide plant in Sira hardly satisfies requirements for aerated water and the plant itself is run-down and liable to stop at any time, a carbon dioxide recovery plant in the brewery becomes a necessity. The quantity to be recovered is calculated as follows:

> 1.0 kg of maltose produces (theoretically) 0.514 kg of CO_2 assuming that the produced beer has 12.0% extract, fermented to 60% of attenuation limit.

The production of CO_2 = 12.0 x 0.6 x 0.514 = 3.70 kg/hl.

From this, the following amounts are used in production:

CO_2	kg/hl
Remaining in the beer	0.35
Mixed with air at the beginning and end of fermentation	0.50
Lost during process	0.10
Total used	0.95

Thus the actual amount to be recovered is 3.70 - 0.95 = 2.75 kg/hl.

The quantity of CO_2 required to saturate the beer is 0.50 kg/hl and 1.25 kg/hl is required to force the beer from storage to the filtering and bottling processes. The amount remaining is 2.75 - 1.75 = 1.00 kg/hl and this will be used when production begins of special types of aerated water and non-alcoholic beer.

Packing materials

Bottles

No glass factory exists in Democratic Yemen and though it is possible one may be established it will take three years at least. However, there are already over two million 0.5 l beer bottles scattered as trash in the desert in the first governorate. It can be estimated that another 4 million bottles will be dumped during the next two years. A suggestion has been made that these bottles be collected; YD 1 per 100 is offered for their return but they are mostly thrown away. The brewery will require 600,000 bottles the first year which would cost for bottles collected locally YD 6,000. To import 1,000 bottles would cost about YD 27 c.i.f.

Cans

There is a small tin-can factory in the country. It imports tin sheets and produces tins for varnish and polishing materials. It cannot produce tins for the tomato-canning factory now under construction and tins have to be imported for tomato paste.

The tin for 0.3 l of beer would cost YD 37/1,000 (c.i.f.) and is more expensive than the 0.5 l beer bottles. Also, tins can only be used once but bottles can be re-used. In Democratic Yemen people prefer large containers so the best economic plan would be to use a large bottle for beer.

Crates

Crates are either made of wood or hard plastic. A wooden crate costs about YD 1 and its lifetime is almost two years. This lifetime would be adversely affected by long trips made by car to provide the different governorates with beer. The world trend is to replace wooden crates with plastic ones which have half the weight and twice the durability. The only drawback is that they cost 50% more than the wooden crates. However, taken all round, plastic crates are more economical than wooden ones. Also there is a plastic factory in Democratic Yemen but bigger machines will be needed to make plastic crates for beer and tomato tins. However, the purchase of such machines would achieve:

(a) Savings in foreign exchange as only the plastic powder would have to be imported;

(b) Better output for the plastic factory;

(c) An increase in the number of workers and a corresponding decrease in unemployment;

(d) The possibility of making crates for milk bottles. (Studies are being made of bottling milk instead of using polyethylene or paper sacks.)

The price of one plastic crate for 20 0.5 l bottles will drop to YD 1.25 for the first five years then to YD 1.00 for the second and third periods of five years each.

Crown corks

Crown corks are imported by the National Company for Foreign Trade. They are used mainly in the aerated water plant. The price is YD 14 for 100 gross. In the Canada Dry factory in the Al Mansourah in Aden there exists a complete crown cork plant given by Hungary. The machines are unpacked but not erected. The plant is designed for cork only there is no possibility of producing crowns lined with an alternate compound, unless the production line is completed. It is said that when the necessary sheets of tin and cork arrive, Hungary will be asked to send an expert to run the plant.

Labels

Labels can be made here but of only one or two colours and it may be advisable at the beginning to present the product equally well as the imported one.

Chemicals

There is no difficulty in importing the chemicals necessary for the production of beer. The only chemical commonly used in Democratic Yemen is the sodium hydroxide used as a detergent in the aerated water factories. The price is YD 270/ton f.o.b. Bleaching powder is also imported and the price is YD 130/ton from the United Kingdom and YD 90/ton from the Republic of Korea. The remaining chemicals such as enzymes and activated carbon (norit) may be imported easily as they are available in the market.

Fuel

Fuel is locally produced by British Petroleum. The price is YD 0.165/imperial gallon for diesel oil and YD 0.148/imperial gallon for fuel oil.

The analyses are as shown in table 10.

Table 10. Chemical analyses of diesel and fuel oil

	Diesel oil	Fuel oil
Specific gravity at 60° F	0.845-0.900	0.990 max
Flash point, °F	150 min	150 min
Total sulphur, wt%	1.5 max	4.0 max
Viscosity Redwood 1 at 100° F	3.8-11.0	118 max
Pour point, °F	3.5	70 max
Carbon residue wt%	0.2 max	-
Total acid mg KOH/g max	3.0 max	-
Strong acid mg KOH/g	-	-
Ash wt%	0.01 max	-
Sediment wt%	0.01 max	0.1 max
Diesel index	4.0 min	-
Water vol.%	-	0.75 max

Electricity

Democratic Yemen can provide the necessary electric power, machines for measuring the power, distributers of high voltage, and transformers. It will provide maintenance and have full responsibility for the distribution station. The standard unit is 440 V, 50 Hz. The charge is YD 8/m from the distributing station to different parts of the factory and there is a special tariff for industry of:

8 fils for 1kWh from 2330-1730 hours
12 fils for 1kWh from 1730-2330 hours

Expenses for raw materials and utilities

It is estimated that one quality of beer will be produced for the local market containing 12% balling and that the brewery will produce up to 30,000 hl/year.

1. Raw material for beer production (18,000 hl)

		YD
Malt (16.5 kg/hl)	= 296 tons x YD 110	32,560
Hops (250 g/hl)	= 4.5 tons x YD 1,500	6,750
Water (2.0 m^3/hl)	= 36,000 m^3 x YD 0.055	1,980
		41,290

2. Chemicals and auxiliaries

		YD
Hydro-chloric acid (commercial 60 g/hl)	= 1.08 tons	35
Enzymes (2.0 g/hl)	= 36 kg	300
Kieselguhr (120 g/hl)	= 2.16 tons	190
Norit (25 g/hl)	= 0.45 tons	215
Sodium bisulphite (3 g/hl)	= 54 kg	108
Sodium hydroxide (300 g/hl)	= 5.4 tons	972
Sodium chloride	= 15.0 tons	15
Formaldehyde	= 0.5 tons	78
Glue (20 g/hl)	= 300 kg	162
		2,075

3. Bottling materials

Labels	3,960,000 at YD 0.3/1,000	YD 1,188
Crown corks	27,500 at YD 1.5/1,000	YD 5,940

Price of bottles is calculated at YD 1 per 100 bottles collected from trash.

4. Electricity, fuel oil, diesel oil

Electricity	YD 21,600
Fuel oil	YD 3,000
Diesel Oil	YD 600
Total raw materials and utilities	YD 75,693

Land

The new industrial area is situated to the north of the Canada Dry factory for aerated water (see annex VIII). No. 81 was chosen as the site for several reasons.

1. It is on two main roads facilitating traffic to and from the brewery.

2. It is close to the main drainage canal.

3. It is far from unpleasant odours from the slaughter house and the oil and fodder plant which lies to the far west of the new industrial area.

4. It is convenient to a supply of water and electricity.

5. The Port of Aden can be reached in 15 minutes by car which will minimize transportation expenses for imports and exports. Also Aden is the main area of consumption.

6. The site selected is about 25,000 m^2, which will permit extensions for the next 10 years and admits the possibility of a malting plant with a capacity of up to 5,000 tons.

According to Law No. 21 issued in 1971, the necessary land can be rented for a new project for a nominal sum of money for a maximum of ten years. Also the project can buy the land for a low price which can be paid in cash or in instalments.

It is believed that the price will be nominal as the brewery will belong to the public sector. Anyway, to be on the safe side, the price will be calculated as YD 1/m^2 which will amount to YD 25,000.

D. Machinery and equipment

Prices include the cost of erection of machinery and spare parts for two years.

Malt reception and treatment area

1 Bucket elevators capacity 3 tons/h, 20 m high

1 Screw conveyor, capacity, 4 tons/h, 10 m long

1 Automatic weighing machine, 20 tons/h

1 Malt and rice mill (dual purpose) 2 tons/h complete with cleaning machine, dust separator, automatic weighing machine with stop and accessories

1 Malt bin, capacity 2 m^3

1 Milled malt bin capacity 5 m^3

Valves, tubes, and necessary connexions for malt silos

Total estimated cost YD 13,600

Brewhouse

The brewhouse is fed by steam at 7 kg/cm^2. One kettle has an effective capacity of 20 hl. It is made of copper with insulated steam-heating jacket and steam central heating for boiling with a central agitating propellor, valves, fittings, etc., which accessories are needed for a mash and wort kettle.

1 Mash filter complete with pump, valves, etc., and all accessories, capacity ± 2.5-3.0 tons of malt

1 Hop strainer 1.2 m x 2.2 m

1 Hot and cold water mixer

1 Water heater using steam-heating coil for heating 20 m^3 of water/h from 30° to 90° C

2 Hot wort pumps, capacity 50 m^3/h at 5 kg/cm^2, preferably of bronze

1 Spent hops pump, capacity 10 m^3/h of wet spent hops at 2 kg/cm

2 Three-way valves for transferring the contents from one kettle to another or to a filter, preferably of bronze

1 Water tank reservoir, capacity 30 m^3

1 Hot-water tank, capacity 30 m^3

Total estimated cost YD 33,400

Wort treatment area

1 Whirlpool for wort reception, effective capacity 200 hl

1 Wort plate cooler, first stage with water to cool wort from 95° to 50° C, second stage with brine -5° C to cool the wort from 50° to 6° C, capacity 75 hl/h, complete with water pump, wort pump, measuring instrument, values, fittings, and accessories

1 Disinfecting tank, capacity 2 m^3

Total estimated cost YD 17,500

Fermenting cellar

6 Vertical enamelled steel closed fermenting tanks, capacity 200 hl at 1 kg/cm^2 working pressure, inside cooling coil using alcoholic water at 0° C complete with CO_2 recovery instruments, valves, fittings, and all accessories

1 Beer pump, capacity 15 m^3/h at 3 kg/cm^2 preferably of bronze

1 Sterile air injection apparatus to oxidize wort after cooling valves, tubes, rubber hoses etc.

Total estimated cost YD 19,100

Yeast room

3 Stainless steel tanks, capacity 5 hl, double jacket, cooled with cold water for collecting yeast

1 Yeast vibrating screen, capacity 15 hl/h

1 Yeast injecting vessel, capacity 2.5 hl, 2 kg/cm^2

Total estimated cost YD 3,500

Yeast propagating room

1 Stainless steel tank with double jacket to resist heating and cooling capacity 10 hl with thermometer, sample cock, etc.

1 Stainless steel tank with double jacket to resist heating and cooling, capacity 5 hl with thermometer, manometer, sample cock, etc.

1 Stainless steel pump, capacity 25 hl/h, motor and fittings, valves, tubes, registering thermometers etc.

Total estimated cost YD 5,000

Storage cellar

12 Horizontal enamelled steel storage tanks, capacity 200 hl each at 2 kg/cm^2 working pressure with pressure regulating valves, fittings and accessories

2 Horizontal enamelled steel storage tanks, capacity 100 hl each at 2 kg/cm^2 working pressure with pressure regulating valves, fittings, and accessories

1 Beer pump, regulated speed, capacity 50-75 hl/h at 3 kg/cm^2 preferably of bronze. Tubes, valves, rubber hoses and connexions, etc.

Total estimated cost YD 36,500

Filtration and clear beer department

1 Set of show glass for clarity inspection

1 Beer kieselguhr filter, capacity 50 hl/h with dosing pump, fittings, reserve tank, and accessories

1 Beer plate filter, capacity 50 hl/h with pump, fittings, and accessories (The kieselguhr and plate filter can be one unit.)

1 Carbon dioxide injection apparatus

1 Plate cooler of stainless steel with pump to cool beer from 6° to 3° C by cold water, capacity 50 hl/h, with pump, fittings, and accessories

2 Vertical enamelled steel tanks, capacity 150 hl each, with level indicator, pressure regulating valves, fittings, and all necessary accessories

1 Vertical enamelled steel tank capacity 50 hl/h with level indicater, pressure regulating valves, fittings, and all necessary accessories

Total estimated cost YD 25,600

Bottling plant

A complete line for bottling and pasteurizing beer with an effective capacity of 5,000 50 cl bottles, crate washing machine, inspection station, chains, etc.

The line should consist of:

1 Fully automated bottle-washing machine preferably single end, to handle more than 5,000 50 cl bottles/h to feed the filler/crowner. Pre-soaking

and detergent soaking should be of maximum duration to ensure thorough washing as dirty bottles are used.

1 Combined filler/crowner (monoblock) to fill and seal 5,000 50 cl bottles. (The filling machine should use beer filling tubes and not air tubes with guards between each filling valve.) The supply should include all control elements: starting switch for the driving motor, instant safety stop, driving motor with variable speed system for the drive of the monoblock as well as all necessary accessories.

1 Pasteurizer, fully automatic, capacity of 5,000 50 cl bottles, with loading and unloading conveyor. Automatic thermal control of temperature in different zones should be included, safety switches, etc. A minimum standard of 70 International Pasteurization Units (1PU) should be set.

1 Labelling machine capacity of 5,000 50 cl bottles/h, one or two labels per bottle with the possibility of a strip on the neck, variable speed. Chain conveyors of stainless steel, 3¼ " wide, 120 m long

1 Label removing device

1 A washing machine for handling plastic crates 300 crates/h

1 Tank for concentrated sodium hydroxide solution, capacity 4 m^3 with valve, cover, inner heating coil, and pump 10 m^3/h 3 kg/cm^2

One firm should do the drawings, layout and designs for the flow of empty, and full, bottles and crates and supply all necessary equipment

Total estimated cost YD 120,000

Cooling system for fermenting and storage cellar

1 Air fan with brine cooling coil, capacity of 20,000 m^3/h, to be cooled at a rate of 2° C/h

1 Alcoholic water cooler using brine at -5° C to cool fittings and accessories

1 Carbon dioxide recovery plant for the recovery of 40 kg of CO_2/h with accessories, valves, fittings, accumulating tank, and distribution station

Total estimated cost YD 24,000

Power station

1 Steam boiler, capacity 2 tons/h of super heated steam at 7 kg/cm^2 complete with fuel pumps, water pumps, valves, burner using heavy oil with steam-heater, water-softner with all safety devices and measurements

2 Ammonia refrigerating set - complete packed unit, compressor with condenser and evaporator of refrigerating capacity 75,000 kcal/h for cooling brine. The evaporation temperature of ammonia will be -12° C and the condensing temperature + 35° C. The unit should be complete with all necessary instruments and safety devices etc.

2 Brine pumps, capacity 50 m^3/h, one for the cellars and one to cool the sweet-water tank

2 Oil-free air compressors, capacity 150 m^3/h at 7 kg/cm^2 directly coupled to squirrel cage AC motor, 3 phase 380/220 V, 50 Hz complete with motor-starter, air cooler, water trap etc.

1 Steel air tank, capacity 5 m^3

Total estimated cost YD 47,200

Electricity

The local government will install transformer station distributer, electrical connexions, etc.

Total estimated expenses (local) YD 8,000

Water treatment plant

2 Water-softeners for fabrication of beer, each 15 m^3/h with valves and all accessories

Total estimated cost YD 4,000

Laboratory

The laboratory can cover the work of the brewery and the aerated water factories.

Electrical balances (accurate)

1 Balance (laboratory normal)

1 Autoclave with thermostat

Distilled water apparatus, water bath, cover, tubes, petri dishes, thermometers etc.

Total estimated cost YD 3,000

Workshop

1	5 ft lathe	
1	Drill	
1	Welding machine	
1	Small foundry oven etc.	
	Tools and other materials for painters, carpenters etc.	
	Total estimated cost	YD 10,000

Spares

A supply of the main spare parts needed for two years are included in the price list of machines, yet separated when itemizing

Transportation and transportation equipment

2	Diesel trucks, 6-8 tons each	
1	Diesel truck and trailer 8-10 tons each	
1	Land Rover (10 persons)	
	Small workshop for minor repairs	
	Transportation costs per hl average YD 0.200	YD 3,600
	Transportation equipment	YD 20,000

Office requirements

Bureau, calculating machine, typewriter etc.	YD 3,500

Buildings

Cement and construction iron were imported at a high price in 1974. Prices have now dropped by almost 40%. As there is a stock of these materials the price/m^2 is based on the 1974 prices

	YD/m^2
Silos	450
Brewhouse	60
Fermenting and storage rooms	50
Bottling plant	40
Offices and stores	35
Miscellaneous	30
Roads	42

Depreciation

Normal depreciation rate.

	Yearly %	YD
Machines and equipment	10	35,740
Industrial building	4	7,617
Office furniture	5	100
Office equipment	10	150
Transportation equipment	33	6,270
Crates and bottles	20	10,200
Total depreciation		60,077

Building expenses

		YD/m^2	YD
Two silos 3 x 3 x 12 m	x	450	8,100
Brewhouse, 3 floors 11 x 15 m	x	60	29,700
Fermenting room, yeast propagation and yeast store 13 x 16 m	x	50	10,400
Storage room Filtering room and clear beer cellar 13 x 27 m	x	50	17,550
Bottling plant (with space left to erect a new line after 5 years with a capacity of 7,000 - 10,000 bottles/h) 20 x 60 m	x	40	48,000
Power station and refrigeration 15 x 25 m	x	30	11,250
Electricity room 8 x 8 m	x	30	1,920
Stores 10 x 12 m	x	35	4,200
Garage 12 x 15 m	x	30	5,400
Offices and laboratory 2 x 12 x 20 m	x	35	16,800

(First floor: personnel office, management and cashier; second floor: management offices, laboratory and book-keeping offices)

		YD/m^2	YD
Workshop	8 x 12 m	x 30	2,880
Gate room	4 x 5 m	x 30	600
Spent grain reservoir	3 x 3 m x 2	x 20	180
Spent hops reservoir	2 x 2 m x 1	x 20	80
Roads	5 x 80 m	x 42	16,800
Social centre	12 x 8 m	x 30	2,880
Fence	320 x 1.5	x 3.5	1,680
Water connexions and drainage system			12,000
	Total building expenses		190,420

Investment cost estimates

	Currency (in YD)	
	Foreign	Local
Land	-	25,000
Building, including services	-	190,420
Machinery and equipment	357,400	-
Spares	5,000	-
Laboratory	2,700	300
Transportation equipment	19,000	1,000
Offices	1,500	2,000
Bottles and crates	45,000	6,000
Workshops	9,000	1,000
Total fixed assets	439,600	225,720

Working capital

Stock

The production process needs 43 days:

Brewing	1 day
Fermenting	10 days
Storing	30 days
Filtering	1 day
Bottling	1 day
	43 days

As all raw materials and chemicals are imported, to be on the safe side it is estimated that sufficient stock to last three months should be carried except for hops which are seasonal.

	Currency (in YD)	
	Foreign	Local
Malt	8,143	-
Hops	6,750	-
Chemicals	665	-
Labels	300	-
Crown cork	1,485	-
Total	17,343	-

Liquid cash for running expenses

	Currency (in YD)	
	Foreign	Local
Wages and social obligations	-	4,750
Experts	-	2,125
Water	-	500
Electricity	-	5,400
Fuel	-	900
	-	13,675

Total working capital requirements

	Currency (in YD)	
	Foreign	Local
Stock	17,343	-
Liquid cash	-	13,675
	17,343	13,675

Pre-investment and start-up costs

	Currency (in YD)	
	Foreign	Local
General expenses and wages for two years	-	20,000
Experts and erector	10,000	5,000
Expenses for trial period	-	4,000
Total	10,000	29,000

Table 11. Estimated total costs of the project

	Currency		
	Foreign (YD)	Local (YD)	Total (YD)
Fixed assets	439,600	225,720	665,320
Working capital	17,343	13,675	31,018
Pre-investment and start up	10,000	29,000	39,000
Total	466,943	268,395	735,338

Annual operating costs and profits

As was previously suggested the selling price for an 0.5 1 bottle of beer should be YD 0.200.

	Currency (in YD)	
	Foreign	Local
Net income		720,000
Material costs including utilities	75,693	
Personnel costs	23,852	
Interest	-	
Indirect taxes and royalties	7,000	
Depreciation	60,077	
Administrative expenses and sales office expenses	11,504	
Five years amortization of preliminary expenses	8,000	
Contingency fund and rounding off (7.5%)	13,874	200,000
Taxable profit		520,000

Net cash profit

	YD
Annual net profit	520,000
Less taxes of 40%	208,000
	312,000
Depreciation	60,077
Net cash profit available	372,077

Pay back period

Total costs	735,338	
Annual net profit less tax	372,077	Two years pay-back period

Economic justification at the national level

Employment and other income distribution effects

59 Workers and employees earning annually as salaries, commission etc.	YD 20,000
50 New retailers and retailers' assistants earning (including presently established retailers)	YD 180,000
Total	YD 200,000

The consumer will save YD 0.100 on each bottle of beer which releases YD 360,000 of consumers income into the economy.

Foreign exchange earnings

As previously stated a special market survey should be carried out in neighbouring countries, but only after two years. When the brewery has become established and acquired a good reputation in the market there should be an opportunity of selling about 2,000 hl to ships and non-residents which will be paid for in hard currency.

As can be seen from table 12, the amount of foreign currency spent on beer importation is increasing annually. This money could be saved - less the cost of importation of raw materials and spare parts - if a brewery were established.

Foreign exchange savings

Table 12.
Estimated savings of foreign currency if beer importation ceases

	1978	1979	1980	1981	1982
Sales of beer in hl	18,000	18,900	19,900	20,800	21,900
Foreign exchange used to import beer in YD	381,600	400,680	412,880	440,960	464,280
Imported raw materials and spare parts in YD	54,122	56,578	59,157	61,865	64,708
Savings in YD	327,478	344,102	362,723	379,095	399,572
Percentage of savings	86	86	86	86	86

Contribution to national economy

	YD	YD
Net income	-	720,000
Expenses		
Materials	75,693	
Royalties	7,000	
Foreign wages	7,000	
Depreciation and round off	60,307	
	150,000	150,000
Contribution to national economy		570,000

II. CONCLUSIONS AND RECOMMENDATIONS

1. The project under study is likely to be technically, economically, and financially sound.

2. The market survey indicates that the total consumption of beer in 1978 will amount to 20,000 hl of which 18,000 hl will be consumed by residents and 2,000 hl by non-residents and tourists. It is expected that the demand for beer after 1978 will increase by 5%/annum. However, to allow a margin of safety the profitability of the project is assessed on the basis of producing and consuming only 18,000 hl despite the fact that the installed capacity will be 30,000 hl/annum. Consequently, the pay-back period of the project is estimated at two years (i.e., on the basis of producing 18,000 hl/annum).

The project will still be profitable in the event annual production output is reduced to 12,000 hl/annum which was the consumption in 1975. In such a case, the pay-back period would be three years instead of two.

The project will save approximately 86% of the total cost in foreign exchange, of importing beer. It is recommended to establish a brewery with a nominal capacity of 30,000 hl (i.e., enough for the next ten years) in order to match future demand for beer without additional investment.

3. Democratic Yemen can obtain the patent of lining compound for crowns, and make use of some of the machines which have remained idle for many years at the Canada Dry factory. This will undoubtedly save 50% of the total cost of foreign currency needed for procuring crown corks.

4. The possibility of expansion to three times the initial capacity is feasible, particularly considering the vast area available at the factory site which could, by horizontal expansion, be used for fermentation and storage tanks.

New technological methods are to establish dual-purpose tanks in the open air under a shelter but the expert considers it preferable to start by using closed cellars.

5. One type of beer is suggested to start with, yet after one or two years, another type could be introduced and sold to non-residents and for exportation at a price of YD 0.150 in the equivalent foreign exchange. If only 2,000 hl are sold of this beer (i.e., the same amount sold in 1975) the brewery will achieve

2,000 x 200 x YD 0.150 = YD 60,000 in foreign currency which is more than the amount needed for one year's raw materials and spare parts for the whole production of the brewery.

6. The production of non-alcoholic beer is postponed as is the production of malt beverages other than beer.

7. Production of draft beer will be feasible if there is a demand for it.

8. By-products including iceblocks, carbon dioxide cylinders, and yeast as well as drying spent grains will all be new sources of extra income. It is suggested that, to start with, the spent grains should be sold wet and the yeast pressed.

9. If the project is approved, a quick tender should be made to benefit from the drop in machinery prices. It is recommended that UNIDO be requested to provide Democratic Yemen with an expert to assist with all matters pertaining to the tender.

10. UNIDO should also be requested to provide help in training technicians from Democratic Yemen on a one-year course in a brewery.

Annex I

IMPORTATION AND RE-EXPORTATION OF BEER

Years	Importations		Re-exportation	
	Quantity (litres)	Value (YD)	Quantity (litres)	Value (YD)
1965	3 249 182	344 956	20 584	3 716
1966	3 561 744	375 497	8 850	2 118
1967	1 732 721	190 124	4 554	873
1968	934 520	144 935	24 147	2 371
1969	1 344 998	109 145	1 368	264
1970	616 948	102 912	20	30
1971	801 655	120 715	-	-
1972	1 034 948	167 168	-	-
1973	1 034 172	196 930	-	-
1974	796 879	140 248	-	-
1975	1 200 000[a/]	250 000[a/]	-	-

Note: Prices are c & f without duty. Quantity and value include all beers imported.

a/ Estimated.

Annex II

BEER IMPORTATION ACCORDING TO EXPORTING COUNTRIES

Country	1971		1972		1973		1974 b/		1975 a/ b/	
	litres	YD	litres	YD	litres	YD	litres	YD	litres	YD
Federal Republic of Germany	443 532	63 912	281 416	40 390	31 776	6 138	44 125	8 516	-	-
United Kingdom	145 227	19 582	132 153	32 749	256 622	37 986	80 000	11 840	-	-
Netherlands	37 581	5 116	46 492	7 397	23 535	3 696	-	-	-	-
Denmark	162 979	23 831	544 066	82 418	344 575	73 262	6 324	1 341	-	-
Czechoslovakia	6 336	1 230	3 960	825	-	-	-	-	-	-
China	-	-	23 059	2 901	30 749	4 082	-	-	-	-
Norway	-	-	3 802	488	32 760	5 265	-	-	-	-
German Democratic Republic	-	-	-	-	310 287	65 832	666 430	101 275	500 000	106 000
Total	795 655	113 671	1 034 948	167 168	1 030 304	196 261	796 879	140 248	500 000	106 000

a/ Imports in 1975 cover only six months.

b/ Value of imports for 1974 and 1975 is estimated as no concrete figures are available (estimation based on the same prices as obtained in 1973).

Annex III

CULTIVATED AREA
(in thousands of acres)

Agricultural produce	1972/73	Estimated in Five-Year Plan					Increase between 1972/73 and 1978/79	
		1974/75	1975/76	1976/77	1977/78	1978/79	Net	Percentage
Wheat	24.0	28.8	31.6	35.4	40.2	45.0	21.0	87.5
Maize and millet	108.0	112.0	115.0	118.0	121.0	124.0	16.0	15.0
Barley	3.0	3.2	3.4	3.6	3.8	4.0	1.0	33.0
Other cereals	2.0	2.0	2.0	2.0	2.0	2.0	-	-
Total cereals	137.0	146.0	152.0	159.0	167.0	175.0	38.0	27.5
Total cultivated areas	227.4	244.0	253.2	268.6	285.4	303.7	76.3	33.6

Source: Five-Year Plan 1974/75-1978/79.

Annex IV

VOLUME AND VALUE OF AGRICULTURAL PRODUCTION

Agricultural produce	Actual 1972/73		1974/75 a/		1975/76 a/		1976/77 a/		1977/78 a/		1978/79 a/	
	Production (thousand tons)	Value (YD in thousands)	Production (thousand tons)	Value (YD in thousands)	Production (thousand tons)	Value (YD in thousands)	Production (thousand tons)	Value (YD in thousands)	Production (thousand tons)	Value (YD in thousands)	Production (thousand tons)	Value (YD in thousands)
Indian Corn	57.7	4 240	58.5	4 300	60.3	4 432	63.5	4 667	67.5	4 961	73.5	5 402
Maize	10.0	525	12.0	630	13.0	683	14.0	735	15.0	787	16.0	830
Wheat	16.8	1 344	20.8	1 664	23.3	1 864	26.9	2 152	31.3	2 504	36.0	2 880
Barley	2.0	90	2.1	95	2.2	99	2.2	99	2.3	103	2.8	126
Other cereals	1.7	77	1.5	68	1.5	68	1.5	68	1.5	68	1.5	68
Cereals total	88.2	6 276	94.9	6 757	100.3	7 146	108.1	7 721	117.6	8 423	130.0	9 306
Cereals left-overs	132.0	798	143.0	858	150.0	900	162.0	972	177.0	1 062	195.0	1 170
Total cereals and cereals left-overs		7 074		7 615		8 046		8 693		9 485		10 476
Total value of all agricultural production		13 593		15 411		16 755		18 358		20 258		22 761

a/ Estimated in Five-Year Plan 1976/75-1978/79.

Annex V

VALUE OF AGRICULTURAL PRODUCE BY SECTOR
(Thousand YD)

Agricultural produce value	1973/74	Five-Year Plan 1974/75	1975/76	1976/77	1977/78	1978/79	Value of agricultural produce 1974/75-1978/79 (average)	Value of agricultural produce 1974/75-1978/79 in comparison to 1971/72-1973/74 (average)
Public sector	1 003	1 688	2 446	3 438	4 697	6 480	3 750	375.0
Co-operative sector	11 444	11 880	12 466	13 077	13 718	14 438	13 115	115.0
Private sector	1 916	1 843	1 843	1 843	1 843	1 843	1 843	96.0
Total	14 363	15 411	16 755	18 358	20 258	22 761	18 708	130.2

Source: Five-Year Plan 1974/75-1978/79.

Annex VI

VARIETIES OF BARLEY TESTED AT BEHAN

No.	Designation	Country of origin
1	Giza 121	Egypt
2	Giza 120	Egypt
3	Arrivat x Local D8	Jordan
4	Beecher	United States of America
5	Trikedritt	
6	Stain 205	Egypt
7	7028/2895	Lebanon
8	Aurore x Esperance LB 21-9L	Lebanon
9	Cr.115.por x 6-LY-103C	Mexico
10	As 54-Trax (Cer-Tol-1) (CAVTTol.1 x B2) HIPRO-TOL IXV-2780-IC-5r-2m	Mexico
11	Aurorex Esperance LB-21-IL	Lebanon
12	WI2231	Australia
13	WI2197	Australia
14	Rekac1 327895	Sweden
15	Giza 68 x 7028 L26-IL	Lebanon
16	Dayton	United States of America
17	Por-Larxpor XV.3704-2c-ir 2m-or	Mexico
18	CI.03863	Egypt
19	Valadi Bahtim	Egypt
20	Esperance two-rows L24.5L	Lebanon
21	Polmella blue	Egypt
22	Clipper	Australia
23	Roho	Egypt
24	Composite 259	Egypt
25	Local chock	Democratic Yemen

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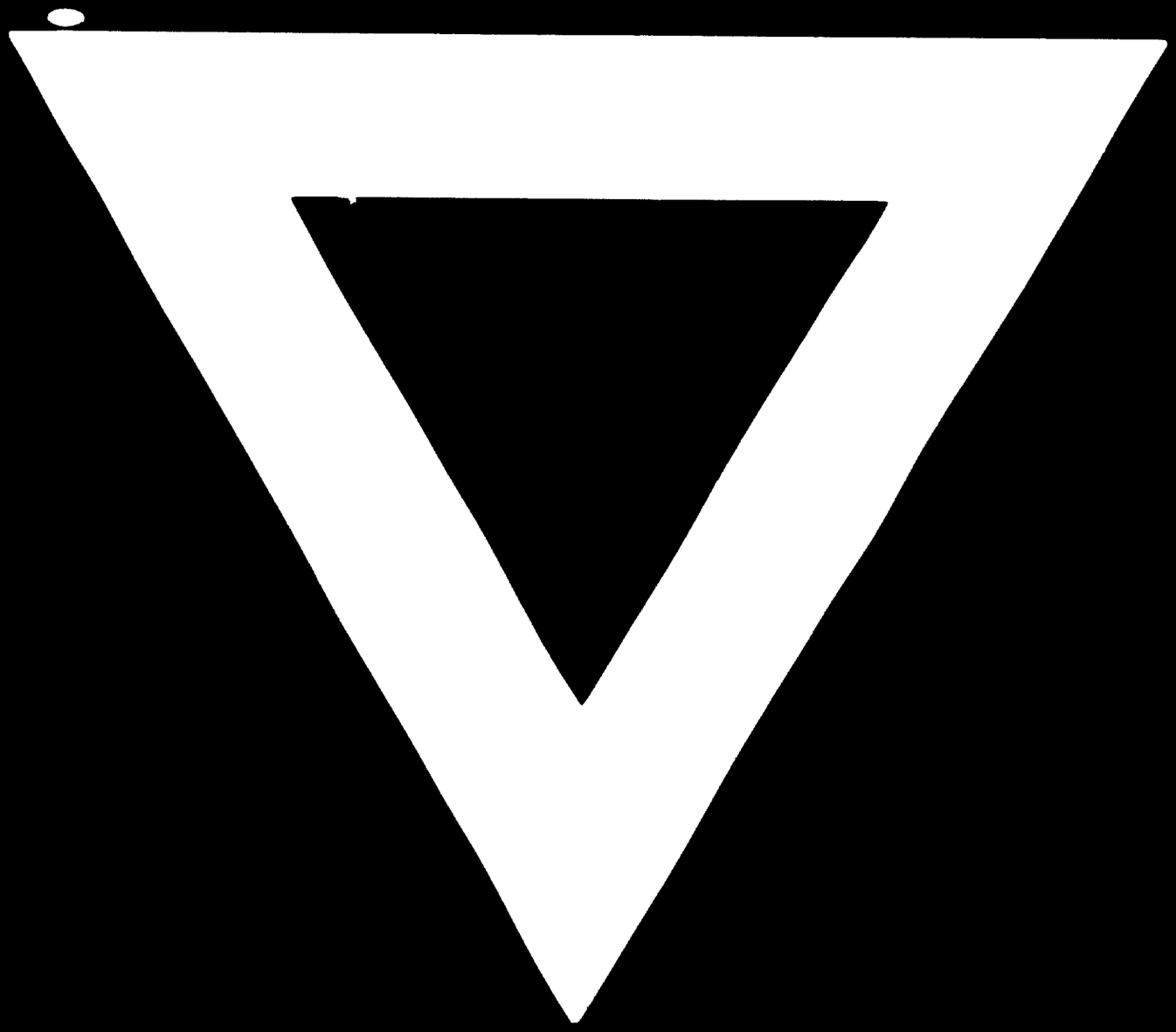

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