OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

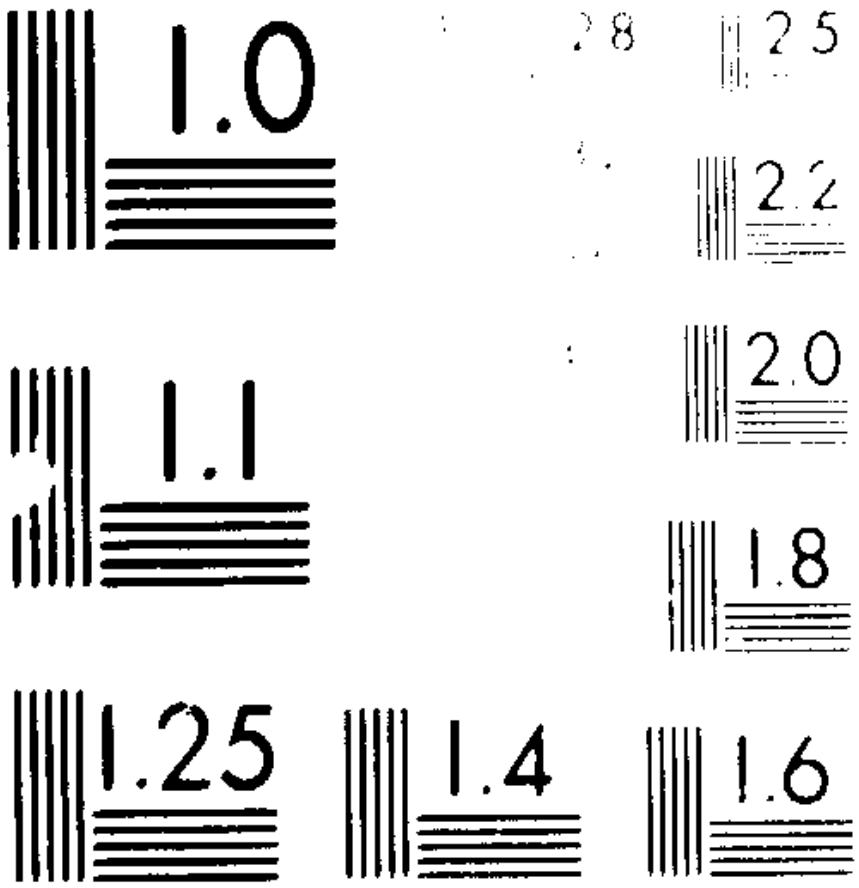
FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org


1.0
2.8
2.5
2.2
1.1
2.0
1.8
1.25
1.4
1.6

RESTRICTED

09676

DP/ID/SER.B/233
23 May 1980
ENGLISH

ESTABLISHMENT OF PULP AND PAPER INDUSTRY

SI/YEM/79/801

YEMEN ARAB REPUBLIC

Terminal report*

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

Based on the work of Erik J. Snellman, consultant

United Nations Industrial Development Organization
Vienna

* This document has been reproduced without formal editing.

The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The boundaries shown on maps do not imply official endorsement or acceptance by the United Nations.

TABLE OF CONTENTS

Table of Contents continued

1. SUMMARY:

A factfinding one person mission was made by Mr. Erik J. Snellman, UNIDO Expert, Helsinki, Finland, March 11 - April 7 1980 to the Yemen Arab Republic 'YAR) in order to evaluate the possibilities to establish an integrated pulp paper mill of small scale. Several different aspects related to the project are handled in this report. So far, until fiber resources based on agricultural residues have not been secured in competitive price, there is not enough basic conditions to support the project's economic viability. YAR's present per capita paper consumption is about 2.3 kg/a and the country already has a growing printing industry and some paper converting plants. The goals to increase the literacy rate from the present low 20% level calls for the establishment of a national pulp and paper industry which is possible in the Tihama Coastal regions water courses, and valleys (wadis) by using mainly agricultural residues of new imported vegetables like kenaf, sugar cane and sisal. On long range it has been suggested that changes be made in the objectives of the country's afforestation programmes. Altogether 16 different recommendations have been made.

2. INTRODUCTION

The Yemen Arab Republic (YAR) has for several years been in a continous economic and development boom. In the present Five-Year Plan ending in 1981, ambitious goals have been set for education and industrialization. Among others this has resulted in the continously growing need for paper products.

In order to save foreign currency and to establish domestic work places, the YAR Government has included in its Five-Year Plan a 30,000 TPA pulp mill using cotton and maize stalk as raw material, to be built in Zabid in the Tihama coastal area, on the road between Hodeidah, a major harbour city, and Taiz, the former capital,(10.10).

UNIDO was contacted by the Government, and the undersigned was selected to carry out a one-month mission study commencing 11 March 1980.

The major target of the mission was to find out the facts necessary to evaluate the possibilities to establish a viable pulp and paper mill in the YAR and also to review the possibilities to develop otner paper related industries (10.2 and 10.14).

Following are the findings, conclusions, and recommendations resulting from this mission.

During the mission a car trip was made, Sana'a - Taiz - Hodeidah - Sana'a, and an air trip, Sana'a - Hodeidah - Sana'a.

In this connection I want to present my appreciations to the staff members of UNIDO, UNDP, YAR Government different ministries and bodies as well as representatives of private YAR industries and trade. (10.14)

3. COUNTRY DESCRIPTION:

3.1. History, Geographic, Politics, Population:

YAR is located in the South western corner of the Arabian Peninsula. To the west the country is confined by the Red Sea, in the north, YAR adjoins the kingdom of Saudi Arabia.

In the South YAR borders in the territory of the former Western, Eastern and Aden protecterates, which now form the People's Democratic Republic of Yemen, (South Yemen). The boundaries in the south and east running in the desert area have not yet been officially recognized in the south and defined and demarcated in the east, between the neighbours. (10.5) This may cause problems in the future if oil will be explored in the border districts.

In antiquity, the area was called Arabia Felix. It has the famous history. One of the best-known kingdoms in the region was that of Sheba, which lasted from 950 - 115 B.C. Since then the country was ruled among others by Himyarite dynasty, the Ethiopians, the Sunnis, the Zaidis, the Othoman Turks, the Britons, and so on. (10.5)

From the recent history one can mention the following highlights:

- Before the revolution in 1962 the country was practically insulated from the outside world in a political and commercial sense. The Imaam ruled population suffered the poverty undernutrition and poor health. Especially the farmers had additionally heavy taxation burden.

- 1962, September 26th revolution started a new era . The republic was proclaimed. A civil war between the republicans and the royalists raged until 1969. In the war were involved also the Egyptians and Saudis.

  The agreement reached between these two parties was a compromize with representatives from both in the General Assembly. The previous ruling family was banned from the country.

- 1972, November 28th, in Tripoli, the two heads of YAR AND People Democratic Yemen signed an agreement of future fusion of the two countries. This was supposed to take place in the near future.

- South Yemen, after the British pulled out of Aden, has established a Government far to left. The greater part of the commercial and industrial enterprises have been nationalized, however not the land ownership. The relations with Saudi Arabia have been improving lately. High level discussions are being held.
- 1974 a military coup took place in YAR.
- 1977, October, YAR president was assassinated.
- 1978, June, YAR president was killed by a bomb transported in brief case from South Yemen.
- 1978, June, two days later, president of South Yemen was killed.
- 1978, October, an attempted coup against the president of YAR failed.
- Today YAR is ruled by a Military Government. No definite date for general election has been set. (10.3)

3.2. Area, climate, hydrology, population:

YAR has a total area of about 195000 sqkm, mostly mountaineous. The main watershed runs from north to south, almost parallel to the Red Sea, dividing the country into two parts, the western half, the water courses of which drain west-wards to the coastal plain of the Tihamah, and the eastern half, the "wadis" of which drain either southwards or eastwards.

The western half of YAR can be sub-divided into three major zones, which are also arranged parallel to the Red Sea:

a) Tihamah coastal plain or Western low lands (0 - appr. 500 m)

b) Western mid lands (500 - 1500 m)

c) Western high lands (over 1500 m)

.../

The climate of YAR is determined by the country's geographic location and by the articulated relief which rises from sea level to an elevation of 3700 m, within a distance of only 100 km.

From May to September the climate is mainly influenced by moist air massess of the monsoon circulation system which flow from the southwest against the Yemen high lands and cause heavy precipitation in the mountain slopes exposed to the west, mainly above 1500 m.

From October to February dry air masses originating from the central Asian Anticyclone are the main reason for the clear and rainless "winter" season.

The main precipitation occurs in the area of Ibb and on the rain exposed slopes of the western high lands which drop abruptly to the Tihamah coastal plain.

Mean monthly temperatures °C and average annual rainfalls are the following:

Table No. 1

Area	Altitude m	Climate type	Temp. °C	Rainfall mm
A. Tihamah	0 - 500	tropical	22 - 35	0 - 300
B. Western low and midlands	500-2100	sub-tropical	16 - 26	200-600
C. Highlands	1800-3700	temperate	10 - 18	200 - 1800
D. Eastern low and midlands	800-1800	sub-tropical	16 - 28	0 - 400

YAR main watershed runs parallel to the Red Sea at a distance 120 - 150 km from the coast thus dividing the country into two major hydrographic zones.

.../

The seven major water courses ("wadis") running westwards to Tihamah collect their water from the steep scarps and flow in deeply eroded gorges Before the wadis discharge their floods into Tihamah plain, they have to pass through steep narrows formed by the foothills.

There are distinguished three types of surface flows: the flood flow, (60 - 70 %), the past-flood flow (25%) and the base flow (10%) from the total run off.

Estimated hydrological flow paths are the following:

Table No. 2

Component	dry year mm	Average year mm	wet year mm
Rainfall	100	400	700
Evapotrans-piration	85	200	295
Run off	10	185	365
Ground water	5	15	40

The population de facto of YAR in 1980 is estimated to be 5.2 million, annual growth rate is 24000. Estimated number of long-term emigrants at the same time is 175.000 and of short-time emigrants 575.000, or totally 750.000. These are mostly in Saudi Arabia. The estimated population of South Yemen is about 1.5 million, de facto.

YAR population is quantitatively dominated by young people. 35% from inhabitants are under 10 years, 47% under 15 years and 67% under 30 years. Life expectancy at birth is below 40 years.

From the total YAR labour force of about 1.1 million is about 73% working in agriculture, forestry, etc., about 8% in industry and about 20% in services.

Rural population is estimated to be about 89% and urban population about 11%.

.../

At present time the growth of cities is however remarkable. The major cities are the following:

Sana'a , Capital, about 400 - 500,000	inhabitants
Hodeidah, major port, about 100 - 200,000	"
Taiz, former Capital, about 100 - 150,000	"

All the other cities, like Zabid, Ibb, Bajil, etc., have the population below 50,000.

The greatest population concentration is in the rural villages of Ibb - Taiz area. (10.5)

Access to electricity (1975) had from the total population 5% but in rural areas only 1%.

Adult literacy rate (1976) was only 10%, primary school enrollment however being 27%.

Access to piped water was in 1976 not high either. From the occupied dwellings was without piped water 91%.

3.3. Economics

GNP per capita in 1976/77 was $ 390.

Gross domestic product in 1975/76 in market prices was the following:

Table No.3

Item	$ mill.	%	Annual Growth 1969/70 - 1975/76 (%, constant prices)
GDP, total	1.157	100	8.5
Agriculture	572	45	8.0
Industry	118	10	9.0
Trade	271	23	11.0
Government	113	10	10.0
Others	137	12	11.0

Balance of payments has developed as follows:

Table No.4

Item	$ million			
	1973/74	1974/75	1975/76	1977/78
Export of goods,(Fob)	14	13	12	19
Import of goods,(CIF)	194	258	382	730
Trade Deficit	-180	-245	-370	-711
Non factor services, net	14	17	21	-3
Factor income, net	117	203	479	889
Workers remittances, net	112	191	457	842
Investment income, net	5	12	22	47
Balance or current income	-49	-25	130	175
Gross reserves	89	187	473	920

Merchandise Exports 1975/76 - 1976/77

Cotton and cotton products	57%
Coffee	18%
Hides and skins	14%
All other commodities	11%
TOTAL:	100%

Rate of Exchange

Since February, 1973
US $ 1.00 = YR 4.50
YR 1.00 = US$ 0.22

According to the Central Bank the inflation rate during the fiscal year ending June 1979 was 22%.

1 YR. = 100 Y Fils.

The welldoing of country can be said to be pre-dominantly being caused by emigrant workers remittances from oil producing countries. It has been said then to be exceeding 1.7 billion US$ 1979.(= 1.700,000,000)

YAR itself has no officially confirmed oil reserves. Neither any other remarkable natural resources. Some coal deposits exist.

Because of huge remittance there is a high and increasing purchase power in YAR. This has caused rising prices especially in real estate business/labour price, rents, services, qat (the favourate of Yemenies, a mild narcotic shrub or smal tree, whose top leaves are chewed in the afternoon qat sessions through all society classes) etc.

However because of under development of taxation systems, the Government bodies do not seem to have money enough to improve their low level premises(especially those occupied by foreign experts) and hire enough skilled workers requesting high salaries. The massive help in form of funds and favorable loans from friendly countries have assisted Government greatly into efforts to lift the country from under-developing stage to its present level. Taking into the account the number and political colour of these friendly countries one cannot avoid the conclusion that the Government and its foreign policy leaders have successfully been able to maintain the foreign policy. (10.4)

4. BASIC CONDITIONS FOR PULP AND PAPER INDUSTRY

4.1 Fiber Resources

The paper is made from pulp. chemicals. additives, by formating a continuous thin web usually with the assistance of water.

By far the most important elements from these is the pulp, which is the common nomination of accumulation of fibers. The fibers can originate from wood, agricultural residues or they can have artificial nature. In wood and agricultural residues, the fibers are bound together with lignin. In the pulping process, the fibers will be separated from lignin and each other by using heat-and mechanical energy and chemicals. If only energy is used, there is in a question mechanical pulping. If also chemicals are used. in the question is the chemical pulping. Numerous amount of combination exists.

The amount of fiber in paper depends upon the quality of paper, but normally it varies between 60 and 90%. The so-called yield of pulp in chemical pulping is usually 40-50% and in mechanical pulping 80-90% from the dry wood or agricultural residue dry weight.

4.2 Water Resources

The water is the second most important element in pulping and paper making. The whole process can be said to be water adding and water decreasing and the fiber-water slurry transportation. The requirements set to the water quality and its continuous transportation by pumping, screening, suctioning, evaporation, etc. is costly and therefore plenty of efforts have been made to reduce the amount of water in pulping and paper making. Circulating the so-called mill white water is one of the ways and means.

When planning pulp and papermill in YAR conditions, we can proliminarily assume the specific water consumption to be achieved would be

-in pulp mill	100 cum/ton of dry pulp
-in paper mill	50 cum/ton of paper

The above specific consumption figures mean the following absolute consumption in different sizes of mills.

/...

Table No. 5

Production		Water Consumption						
Annual tons	Daily tons	Pulp Mill cum/day	l/min	l/s	Paper Mill cum/day	l/min	l/s	Total l/s
10,000	30	3,000	2,000	33	1,500	1,000	17	50
20,000	60	6,000	4,000	67	3,000	2,000	33	100
30,000	90	9,000	6,000	100	4,500	3,000	50	150
40,000	120	12,000	8,000	133	6,000	4,000	67	200
50,000	150	15,000	10,000	167	7,500	5,000	93	250

It would not be impossible to pump this amount of water from underground. However, the water consumption is that high, that tempting to use surface water is great in order to leave groundwater for more important use.

Related with water usage is waste water effluent disposal. Paper mill waste water can be cleaned and used after that for example for irrigation. However, pulp mill effluent is usually more or less - depending upon the chosen pulping process- contaminant. Therefore the strict rules in industrial countries for environment protection have caused that the mills have been forced to build up very sophisticated waste water handling systems. These systems can consist of sedimentation tanks, aeration basins and finally biological treatment in order to reduce the biological oxygen consumption in the waterways down to the minimum.

Although there does not seem to be any such kind of rules prevailing in YAR so far, the ethics of consulting western engineer does not allow that the effluent of pulp mill will spill the small groundwater resources in the mill area. Therefore, the mill design calls for the latest technology of the field.

4.3 Market

One very important element in papermill design is the market of paper. A very good rule of thumb is that in developing countries, at least 2/3 from the planned papermill production should be covered by domestic consumption.

Usually any feasibility study should include the relevant market study consisting of desks study and field survey. The study should give the answers to the questions like:

-the amount of printing presses and the amount and grade of paper they are using;

/...

-the amount of paper converters and the amount and grade of paper they are using;

-the amount and grade of printed paper and converted paper products imported;

-the prices paid;

-the trends and forecasts, etc,.

Usually the paper consumption per capita in developing countries is very low compared to the figures of industrialized western countries. In the following table are some figures from the year 1977.

Table No. 6

Country	Consumption per Capita	
USA	273	Average 81 kg/a
Canada	191	
Sweden	195	
England	124	
Albania	5	
USSR	about 32	

Of 41 listed countries in Asia and Oceania, only three: Australia, Japan and New Zealand consume, per capita, over 100 kg/a and only three others exceeded 40 kg.

Excluding these, average consumption was only 6 kg/a. India and Indonesia consumption has only over 2 kg/a.

In Africa only, South Africa exceeds 40 kg/a. The rest had the average only of 4 kg/a. In Latin America, the average is 22 kg/a.

It is difficult to determine what is the minimum for reasonable development. The levels of 100 kg/a or above obtained in developed countries contain significant quantities of paper used for packaging and cosmetic purposes. A level per capita of 30 kg/a appears to be the minimum to achieve literacy, adequate communication and educational levels; 40% kg/a is a desirable objective, however, because it allows some element of packaging for industrial or export purposes. (10.6).

/...

In the country like YAR, this level would mean with the different population the following quantities and CIF values in millions of Rials anticipating the average CIF value for paper US$700.

Table No. 7

Population	Per Capita kg/a	Consumption ton/a	CIF value. mill. YR
5,200,000	20	104,000	325
6,000,000	30	180,000	565
10,000,000	40	400,000	1,270

One may compare these figures with the YAR's export value of 85 mill. rials.

4.4 Other Basic Facts

Additionally pulp paper industry establishment needs the following items

- land area
- chemicals and additives
- intrastructural developments, like housing, roads, health care, schooling, religious institutions, entertainment and sports facilities, energy service, transportation, etc.
- know-how and technology transfer
- management and marketing skills
- skilled and unskilled labour
- capital

From the capital needs one can say that pulp and paper industry is very capital intensive industry. The total investment of integrated pulp and paper mill varies at present time in developing countries from US$1,000 - 7,000/annual ton. Estimating in YAR conditions with proper design, the requirement to be US$2,000, one can assume that 10,000 ton pulp mill integrated with 15,000 ton paper will cost totally about 25-30 million US dollars.

5. FINDINGS DURING THE MISSION

5.1 Forests and afforestation. Fuel question

YAR has totally 1.6 mill. hectares classified as forest land. However, all forest has been depleted during the hundreds and thousands of years. At first on account of construction, later for fueling purposes. The only thing that is left, are some lonely Eucalyptus and Acacia trees, mostly in parks, and different types of shrubs scattered all over the country.

/...

The depletion continues for fueling purposes. The camels are widely used to carry fuelwood from deserts to the intermediate storages on the highway road-side, from where the camel caravans and the trucks carry the fuel to the market places in villages and towns. (10.4)

This fuel wood is extremely expensive. One small truckload, consisting of about 4 cum. costs in Sana'a, YR1,600. In intermediate storage areas, south from Taiz about 40 km., cost of lower quality thin wood about YR 150/cum. but high quality thicker wood about YR 300/cum. According to the salesman, local farmer, the price should double in Taiz because of high transportation costs.

These figures can let one estimate that fuel wood price "as delivered" would cost about YR 400-500 cum or YR 600-800/ton wood as dry corresponding US$ 150/ton dry wood. This figure can be compared with for example Scandinavian pulp mills wood cost of about US$50/ton dry wood. In other words the difference is triple.

The depletion continues also that way that rural farmers' females seem to cut and uproot the shrubs on the highway sides.

When one adds here 10 mill. sheeps and goats of the country, which will be cut to a common grass of villages, there is no wonder, that in most places the humus layer of soil has disappeared and finally even mineral-layers are suffering because of erosion caused by heavy rains and wind.

Ministry of Agriculture has a small Forest Department, totally four persons, taking care of afforestation programmes, which are 4 under development and starting 1980.

1. World Bank Aid No. 1, Taiz-Ibb Area, totally 500 ha/4 years, mixed specie
2. World Bank Aid No. 2, Hodeida area, totally 800 ha/4 years, mixed specie
3. German Aid, South from Sana'a, totally 440 ha/4 years, mixed specie
4. British Aid, East from Sana'a, totaly 430 ha/4 years, mixed specie

There are in the country totally 4 nurseries, where 40 different species are under testing. The aforestation is expensive in YAR. Programme costs 200 man/days x 80 rials or YR 16,000/ha excluding the land price. One may compare this figure of about US$3500/ha with scandinavian planted forest land including the price of land, of about US$ 500/ha.

The objectives of afforestationprogrammes are fueling, soil improvement, sand during prevention, cattle feeding - but not any forest based industry. (10.14)

/...

The FAO forester is assisting in afforestation programme the Ministry of Agriculture Forest Department.

Assuming that suitable Eucalyptus or other specie can be planted and reserved for forest industry, one may calculate the yield/ha to be about 6 tons as dry wood " rotation time being 15 years.

Assuming that 50% from yield would go for lumber and plywood industry, 50% for pulp industry, one may calculate that about 40,000 ha forest is needed to satisfy the 50,000 ton/a pulpmill, when pulping yield is 45%. Each annual harvesting would require new plantations of about the same amount of hectares.

Although afforestation would reach the above huge dimensions, it is self clear that the household fueling problem in the country has to be solved first before one can expect any supplies from forests to the pulp industry.

One solution for this could be domestic oil, or coal, government subsidized, imported liquid gas or kerosene or charcoal or rural electrification.

Anyway, forest fiber supplies cannot be expected to take place until after 30-40 years.

From the existing forests, a potential fiber resource is only palm tree leaves. Palm trees seem to grow in Wadi areas, South of Taiz and North of Hodeida and obviously also in other wadis. At the present time the farmers seem to use these leaves as roofing materials in their huts, and also for fuel as well.

There was no possibility during the mission to estimate the amount of the excess leaves in tons, but with good reason, it can be assumed that these leaves could form only a marginal portion of the possible pulp mill's fiber raw materials.

5.2. Agricultural residues. new plants:

YAR is the agricultural land. It has applied labor-intensive and sophisticated agricutural techniques for centuries on the slopes of steep and rugged mountains. YAR farmer spares no effort to gain maximum profit from the scanty rainfall for the cultivation of his crops even on the most difficult terrain.

New opportunities for work in the neighbouring oil-rich countries already present dangerous competition for traditional agriculture with its labour - intensive methods.

For the irrigation the farmers have used several methods, like spate irrigation, spring irrigation, traditional lift irrigation and modern pump irrigation.

During last years several feasibility studies have been made by Government for wide irrigation systems construction in different wadies, especially in Tihamah area. Some of these plans are in the implementation phase.

The total area of the cultivated land was estimated in 1976/77 to cover 1.515.000 ha. From this the rainfed land comprises by far the largest portion, appr. 1.277.000 ha (= 84%). The spate and perenially spring-irrigated areas are estimated to cover 120.000 ha (= 8%) and 73.000 ha (=5%) respectively.

The pump irrigated land covered only 45.000 ha (=3%) but this part increases from year to year.

Out of a total land area of appr. 20 mill.ha only 7.5% (=1.5 mill.ha) are thus regularly cultivated. Sometimes, during high rainfall seasons, an additional 2 mill.ha of marginal agricultural land is cultivated. When woody vegetation or shrub covers 1.6 mill.ha, there are left about 15 mill. ha (=75%) rocky, mountaineous and semi-arid range lands with very sparse vegetation.

From the crop production about 90% is covered by food grains, i.e. sorghum, millet, wheat and barley. The rest is covered by potatoes, grapes, fruits, coffee, cotton, qat, etc.

.../

The most profitable crop to the farmers is said to be nowadays the qat, labor intensive cotton cultivation has decreased. Qat has taken land from coffee. (10.4., 10.5). One ha of qat land produces 300,000 - 400.000 YR/a!

Crops account for about 75% of the agricultural sector's output value, some 20% is from live-stock, 4% from forestry and 1% from fisheries. Livestock estimates for 1977/78 were:

Table No.3

Species	Amount, heads
Cattle	840,000
Sheep and goats(70%/30%)	10,400,000
Camels	105,000
Horses	3,000
Donkeys	700,000

Area and production of cereals for 1977/78

Table No.9

Specie	Prod. 1000 ton	Yield ton/ha	Area 1000 ha
Maize	54	0.8	64
Millet & Sorghum	564	0.6	922
Wheat	46	0.8	60
Barley	38	0.7	56
TOTAL	702	0.64	1.102

There is no official statistical figures for stalk (straw) production from the above cereal fields. However the matter has been handled in some irrigation studies made for maintain plains and wadi Rima in Tihamah.

.../

According to them, Fodder (straw) dry matter yields of crops grown on the Montane Plains, is the following in kg/ha. (10.12)

Table No. 10

Crop	Yield level kg/ha, fodder					
	Irrigated			Rainfed		
	Area 1	Area 2	Area 3	Area 4	Area 5	Area 66
Barley straw x/	1,650	1,125	.900	600	450	225
Wheat straw x/	1,800	1,250	1,125	.675	.450	225
Yellow sorghum stalks	4,500	3,500	3,000	2,500	2,000	-
Yellow sorghum leaves	450	350	.300	.250	.200	-
Red sorghum stalks	-	. -	3,000	2,000	1,500	800
Maize tops	1,200	1,000	-	-	-	-
Alfalfa	16,000	13,000	6,500	5,000	3,500	1,500

x/ Estimated on basis of 75% of stated grain weight

The grain yields from the same areas were the following, kg/ha

Table No. 11

Crop	Yield level kg/ha, grain					
	Irrigated			Rainfed		
	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
Barley	2,200	1,500	1,200	800	600	300
Wheat	2,400	1,700	1,500	900	600	300
Yellow sorghum	1,800	1,200	1,000	700	500	-
Red sorghum	-	-	-	700	500	200
Maize	1,600	1,000	-	-	-	-
Alfalfa	-	-	-	-	-	-

Alfalfa is cultivated merely for animal fodder.

Barley and yellow sorghum were in the studied areas by far the two most important grain groups in terms of total yield producing approximately 60% of the total cereal output in the area. Wheat and red sorghum each contribute approximately 20%.

Yellow sorghum has by far the most important fodder crop and accounted for 43% of the total dry matter produced.

/...

From the figures one can conclude the importance of irrigation to the grain and fodder production.

In the same study (10.12) also has been listed commodity prices at farm gate and in average 1975/76

Table No. 12

Crop	Aver. 1975/76, YR/ton		Farm gate, YR/ton	
	grain	fodder	grain	fodder
Barley	950	940	807	750
Wheat	1,375	940	1,169	750
Yellow sorghum	1,362	-	1,158	-
- stalks	-	900	-	720
- leaves	-	1,000	-	800
Red Sorghum	662		563	
Maize	1,125	-	956	-
- tops	-	1,210	-	970
Alfalfa	-	2,000	-	1,600

Farm gate prices are 15% lower than average prices for grain and 20% for fodder respectively.

Because of high transportation costs the sorghum stalks in Sana'a cost even 7 rials per bundle and in Taiz 5 rials per bundle. This gives per dry ton approximately YR 2,000 in Sana'a and YR 1,500 in Taiz, in March 1980.

Using as the average straw price of YR 1,500/dry ton, delivered to the pulp mill and estimating pulping yield to be 45%, one will get for the raw material price

YR 3,300/ton pulp = US$ 730/ton pulp

This is extremely high figure compared for example with Scandinavian, internationally high, pulp wood price of about US$ 20/cum, corresponding approximately

YR 540/ton pulp = US $ 120/ton pulp

The high price of fodder straw in YAR is not caused only by high production costs but also because of the market situation. There is too little fodder for animal feeding. According to Ministry of Agriculture and FAO's local representative, the cattle is starving and nil-producing in many places in the country.

/...

Therefore no excess amounts in competitive price from the country's estimated total straw production of abou' 4-7 million tons for pulping purposes is available. And if there would be, these amounts most probably would go for household fueling!

New ways and means are needed to satisfy the raw material need of pulping industry.

New Plants (Specie)

As the suitable land areas are scarce in the country, water resources have to be saved and fodder -and fuel- usages compete heavily with pulp-mill fiber usage, the pulping fiber production should be based on such plants, which

- are most productive per ha
- are not needing best cultivated land
- are not needing too much irrigation
- are preferably not usable for animal feeding and can be prevented to be used for fueling.

In the following are described some of most promising new plants. (10.7)

Kenaf

Kenaf has traditionally been grown as a crop fibre for the manufacture of twine and rope. For those purposeses, only the bast fibre, or about 20% of the total weight of the dry stalk has been used. (In fact, after setting, washing and processing, the bast fibre, the total yield of dry fibre has been as low as 10%). This has been then the raw materials of (jute) gunny bags. The remaining portions of the stalk have been discarded, consisting of very short-fibred, woody material and some pithy material.

Since the bast fibres are relatively long, the use of fibres or fibre ribbons, as the material comes from the decorticating machine has been considered in a number of countries as a source of long-fibred pulp to be mixed with short-fibred pulp such as bagasse. However the high cost of producing the kenaf fibre alone has rendered it uneconomic for pulp and paper production. The best fibres of kenaf vary from 1 to 10 mm in length with an average of about 2.5 mm, which is considerably longer than hardwoods and is comparable to the fibre length of softwoods. Kenaf fibres are also more narrow than wood fibres and are excellent from the quality standpoint for practically any grade of paper. Unfortunately however the woody fibres from the kenaf stem average only about 0.5 - 0.6 mm in length and the chemical pulp produced from this fraction has extremely slow drainage characteristics and is of poor quality for any purpose.

/...

In the research work of U.S. Department of Agriculture, in Northern Regional Research Laboratory at Peoria, Illinois, it has been found necessary to first separate the two components, which are vastly different in physical characteristics, before pulping. When each can be treated separately under appropriate conditions for the type of pulp for which each might be specifically suitable. In this connection the possible use of the woody portions of the kenaf stem for production of mechanical pulp is particularly appealing because it may very well be used as part of newsprint furnish.

The future use of kenaf for production of newsprint has some exciting possibilities. In fact, by separating the two components before pulping, the entire furnish for a newsprint mill might even be obtained from kenaf. The bast fibre, constituting 20 - 25% of the dry weight of the kenaf could be used for the chemical pulp component and the woody material, 75 - 80%, could be used for the mechanical pulp component. This possibility should be particularly attractive for the small newsprint mill in developing country like YAR.

In extensive planting tests in various parts of USA, the yields of from 4-20 tonnes per acre, dry material, have been achieved.
The agronomists working in the field say that 20 tonnes per hectare of dry material is a reasonable annual yield. (10.7)

Bagasse

More than forty bagasse pulp mills of substantial size - most of them integrated with paper mills - have been built during the last 25 years. Production vary from 100 - 300 tons/day. In addition, there are at least fifty small bagasse pulp mills, production 10-25 tons/day.

Bagasse pulp is produced in all 20 countries.

Bagasse has a distinct advantage over the other non-wood fibres in that it involves no great problem of collection. The costs of collection, crushing and cleaning the material are borne by the sugar extracting process.

There is a wide range of types of bagasse pulp produced. These vary from the very high yield mechanical type pulp used for insulation board to the highest quality, high brightness bleached bagasse pulp used for high quality tissue, printing and writing and newsprint papers, and bleached paperboard. When it is considered that in some areas the annual yield of

/...

dry bagasse per hectare is in excess of 10 tonnes, with as much as 9 tonnes of sugar per hectare taken from the same land, it is not difficult to understand why sugarcane growing, in any land, which is suitable for it, gives one of the highest returns of any agricultural crop. (10.7)

Sugar industry again produces as subproduct, molasses, which could be particularly interesting for YAR as it can be used as raw material for protein (TORULA and PEKILO) production. Protein again mixed with soyabeans and fishmeal is an excellent cattle fodder.

Sisal

From the other new plants which could have potential in YAR, especially in Tihama coastal area, one may mention also sisal, whose leafs are used for pulping raw materials for example in Brazil.

In the following table are listed some non-woody and woody fibres and their estimated annual yield in dry tonnes per hectare.

Table No. 13

Specie	Non-woody	Woody	Yield in dry tonnes/ha
Alfalfa	x		1.5 - 16.0
Barley	x		0.8 - 1.0
Sorghum	x		2.2 - 5.0
Wheat	x		1.2 - 1.5
Kenaf	x		6.0 - 20.0
Bagasse	x		4.0 - 10.0
Sisal	x		?
Eucalyptus		x	6 - 8
Gmelina Arborea		x	10 - 12
Caribbean Pine		x	5 - 7
Southern Pine		x	6 - 8
Scandin. Pine		x	1 - 3

The yield is greatly depending upon the irrigation, fertilizing and soil conditions, etc.

/...

Alfalfa, which already is planted in YAR for animal fodder has in some conditions high yield and it also could be used for pulping.

However kenaf and bagasse, which are not fodder and which have very high yield, look the most promising raw materials for YAR pulping industry. They are not cultivated in YAR. Sugarcane has been under minor testing according to the verbal information.

The following table gives the indication how big areas of each plant is needed to satisfy 10,000 tons annual pulping need.

The pulping yield has been estimated to be same, 45% (chemical pulping). One may note, that in mechanical pulping the yield might be 80 - 90%.

Table 14

Nonwoody fibre specie	Yield, aver. dry ton/ha	Cultivated area need for 10,000 tons/a pulp mill
Alfalfa	8	2,800
Wheat	1	22,000
Sorghum	3.5	6,300
Kenaf	13	1,700
Bagasse	7	3,100

Wide test plantations are needed in similar conditions in order to evaluate the exact figures and the order of superiority.

5.3 Market

There was no possibility during the short mission time to make any detailed market study. However the major points and rough estimates as well about quantities and grades as prices could be made.

5.3.1 Printing Industry

For this subject one earlier study (Requirements of Modernization and Expansion of Printing Industry) of UNIDO expert, issued in May 1976, was available. (10,11). However the study did not mention with one single word about the paper used in printing presses. Also it came up, that lot of changes in presses had happened since 1976. During the visits to Taiz and Hodeida, it was possible to visit some of the presses for gathering the information of paper usage. This was also done in Sana'a.

/...

Table 15 Private presses in YAR.

No.	Name of the Press	City	Type of Work	Labour amount	Paper usage est. grade, amount
1	Dar El-Ahly Press	Sana'a	Commercial	5	
2	Dar Al-Hadid Press	Sana'a	Commercial	5	
3	Dar El-Kodssi Press	Sana'a	Commercial	8	
4	El-Haditha Press	Sana'a	Commercial	1	
5	El-Shiah Press	Taiz	Commercial	5	
6	Saba Press + Branches	Taiz	Commercial	5	
7	Thabet Abd El-Gelil	Taiz	Commercial Exercise books Ledgers, calendars	16	70x100 cm, 50-70 g/sqm 70x100 cm, 220 g/sqm 100+40 tons/a + 20 tons/a
8	People's Printing Press	Taiz	Commercial	15	70x100 cm, 50 g/sqm 70x100 cm, 235 g/sqm appr. 20 + 6 tons/a
9	Eastern Trading Press	Hodeida	Commercial		
10	Al-Fateh National Press	Hodeida	Commercial	12	70x100 cm, 5--60 g/sqm appr. 10 tons/a + 3 tons/a
11	Al-Nahdah Printing Press	Hodeida	Commercial		
12	Assalam National Printing Press	Hodeida	Commercial		
13	Mouin Printing Press	Hodeida	Commercial	7	70x100cm, 70 g/sqm, wood free 300 g/sqm board
14	Almahdah Printing Press	Hodeida	Commercial		appr. 10 tons/a + 3 tons/a

From the above table, one can conclude that all commercial private presses are using 100% sheets in dimensions 70x100 cm, surface weight from 50 up to 70 g/sqm.

Additionally the visited presses informed that the relation white/coloured is approximately 50/50.

Besides wood free printing grades, the presses are using different type of boards, also in sheets 70x100 cm, surface weight from 200 up to 350 g/sqm. Grades: bristol board, vanguard board, grey board, etc.

Except press no. 7 in Taiz, which used about 100 tons/a printings and 60 tons/a board, all the other presses are in the class 10 - 30 tons/a paper and 3 - 5 tons board /a.

Totally this gives the following summary.

Press No. 7	100 ton paper	60 tons board
Presses No. 1-6, 8-14,	260 " "	50 " "
Total	360 " "	110 " "
Contingencies 10%	40 " "	10 " "
Estimated total -	400 " "	120 " "

The CIF price, what the presses informed being paid varies from US$ 600 - 1150/ton paper and US$ 500 - 1200/ton board depending upon the grade.

The biggest importer-distributor in the country. Printers Trade Center, Sana'a, informed during the visit that their sales per annum is the following:

-printing paper	45 - 80 g/sqm	190 tons/a
-bristol board	200-250 "	80 "
-eurcart paper	70-80 "	25 "
-miscellaneous		5
	Total	300 tons/a

CIF prices vary from 600 - 900 US$/ton. This amount does not include any tenders, which can be 150 tons/tender. It looks, that with ± 20% accuracy we can assume, that small commercial printing presses do not use more than 500 tons/a paper and 200 tons/a board per annum.

/...

Table 16. Government presses in YAR

No.	Name of Press	City	Type of Work	Labour Amount	Paper usage est. grade, amount
1	Yemen Printing & Publishing Co. (Saba). (Belongs to the Ministry of Information & Yemen Nat'l. Bank	Sana'a	Newspapers, magazines, books, visit cards, commercial work	40	300 tons/a, 52 g/sqm newsprint, also sc-grades Some 70 g/sqm, newsprint
2	Military Printing Press	Sana'a	Newspapers and military own printing requirements	-	400 ton/a, 52 g/sqm, newsprint
3	National Institute of Public Administration Press	Sana'a	-	-	-
4.	Ministry of Education Press	Sana'a	Newspaper, school books, exercise books	60	2000 ton/a wood free 70 g/sqm, 70x100cm 260 ton/a newsprint 230 ton/a 220 g/sqm
5	Branch of Yemen Printing & Publishing Co	Sana'a	-	20	-
6	New Ministry of Information Press	Sana'a	Newsprint web-offset	30	Estimated 1980/300 ton/a 52 g/sqm, newsprint

As from the Table No. 16 , one can see the government operated presses are by far the most important writing and printing paper consumers in YAR.

Estimated total amount is for wood free printing about 2500 ton/a, 70 g/sqm. 70x100 cm, for newsprint about 500 ton/a, 52 g/sqm, in rolls, 60 cm wide, and about 300 ton/a, board, 220 g/sqm in sheets, 70x100 cm.

This makes total consumption in YAR presses in 1980.

Table 17

Grade	Specification	tons/annum
1. wood-free printing 50–80 g/sqm	70x100 cm sheets	2,500
2. Newsprint 52 g/sqm	rolls	3,300
3. Board 200–350 g/sqm	70x100 cm sheets	500
Totally		6,300

However, Ministry of Education Press (NO.4) is at present time making only about 40% from all books and exercise booklets needed. The rest is imported. The press has expansion plans and its estimated paper usage will be 8000 tons /a in the year 1985.

The Ministry of Information is just installing new web-offset newsprint rotator press and its paper consumption will be increasing also in near years. (10.14).
Some newsprint is made in USSR, some is a gift of UNICEF, made in Finland.

5.3.2. Paper Converting Industry

There are some paper converting plants in YAR. (10.14).

1. National Company for Sponge & Plastic Industry Ltd., Taiz, has a corrugated box manufacturing line to make boxes mainly(90%)for the biscuit and sweet plant, which belongs to the same Hail Saeed Corporation, with Headquarters in Taiz. The plant was established 1975 and it uses, working in one shift,

1000 tons/a kraftliner , 120–150 g/sqm
750 " fluting, 127 g/sqm

Width of rolls is 150 cm.
The demand of boxes has grown 5–10% per annum in 1975–78, but 1978, so as much as 40% when new biscuit production line was assembled.
Kraftlines and fluting is imported from Norway and Sweden.

/...

2. Same company as above has a plant also in Sana'a where it is also toilet roll and facial tissue manufacturing line.

Jumborolls, width, 160 cm. are imported from Sweden and West Germany. Estimated paper consumption is

25	tons/a	for toilet rolls
15	"	for facial tissue
40	"	total

Also this plant is working in only one shift and during the visit, the plant was shut down because of big storages. The plant makes its own cores from imported kraftpaper. The plant representative could not say, how much from the market their production covers, as the statistics are not very reliable because of smugling.

3. National Factory for Paper and Plastic. Sana'a, Amran, way to Dharan (near factory No. 2) is a small 3-men operated bag plant, which has two bag machines. It uses kraftpaper imported from France and Finland. Estimated consumption is 100 tons/a, 50 g/sqm.

Another bag plant in Taiz had been shut down (temporarily ?) because of plastic bag competition.

Totally paper converting industry is using in YAR approximately 2000 tons/a different grades of paper and board.

There is in YAR no manufacturing of such paper commodities, as

- paper sacks
- gummed paper
- bitumenous paper
- polyethylen laminated paper
- waxed paper
- envelopes (they are imported and printed in YAR.
- twisted paper
- paper drums
- napkins
- towels , etc.

As this industry is labor-intensive and suitable for females, very little water and energy consuming, it is very suitable for industrial estates for example.

5.3.3. Imported paper production:

There are three big users for these products in YAR.

1. Cement plant in Bajil belonging to Yemen Cement Industry Corp. is making now 65.000 tons/a Portland Cement but is under expansion to 350.000 tons/a 1982.
Plant uses now 1.5 mill. sacks 50kg/4-ply, 70 /sqm., 49.5 x 64 x 9 cm, imported as printed from Austria.

The price per sack is 45 fils/CIF Hodeidah.
In tonnes the above amounts mean:
1.5 mill. sacks, appr. 300 tons/a/1980
8 " , " 1.600 tons/a/1982.
as one sack is weighing about 0.2 kg.
As new cement plant of 500.000 tons/a is under construction north from Sana'a and third one, perhaps 1.000.000 tons/a, is under pre-planning south from Taiz, the sack consumption will be in the end of 1980's about 20 mill. sacks, appr. 4000 tons/a.

2. Juice plant in Hodeidah is using appr. 500 tons /a imported boxes and milk cartoon, imported in sheets and printed, in their TETRA - pack - packing process. Taiz box plant cannot supply boxes for them because of specifications.

3. Biscuit and sweet plant in Taiz uses about 1.760 tons/a printed and imported sulfite wrapping paper, value of this is about 6 mill. YR. CIF.

5.3.4. Foreign Trade Statistics

Foreign Trade Statistics book 1976, published by Central Planning Office's (CPO's) Data Center, Sana'a, gives the following paper and paper products import figures. (10.9)

Table No. 18

Item	Commodity	Amount	Value 1000 YR	
			1976	1979
1.	Printed matters		7	6.658
2.	Paper sensitized, not developed		224	439
3.	Other paper and paperboard, calinders		44	1.057
4.	Handkerchiefs, cleaning tissues		1	1.445

Table No. 18 cont.

Item	Commodity	Amount	Value 1000YR	
			1976	1979
5.	Cigarette paper		65	
6.	Carbon, copying paper		70	794
7.	Toilet paper		305	365
8.	Boxes, bags		822	10.607
9.	writing, envelopes, etc.		144	742
10.	Note books etc.		907	6.646
11.	Other paper		272	910
12.	Newspaper, journals			785
	Total		2.911	30.448
13.	Kraft paper and board 1976/	4.000 t.	303	3.623
14.	Sulfite wrapping paper		2.241	
15.	Parchment, greaseproof		1.968	
16.	Coated, hand-made paper		624	
17.	Sack kraft paper		2.867	8.831
18.	News print		62	3.555
19.	Printing and writing		626	4.158
20.	Wall paper			866
21.	Gummed or adhesive paper stripes			2.285
	Total		8.691	23.318
	Grand Total		11.602	53.766

The growth has increased by 4.6 fold, or over 100% per year.

The latest figures from the 1979 foreign trade statistics above specify, that grand total value of imported paper and paper products was about YR. 54 mill.

Summary:

Based on the above collected information one may estimate that YAR paper production for capita 1980 is about 3 kg/a or 15,000 tons/a absolutely.

.../

This has been claculated as follows :

Table No. 19

End user	Paper grade	Tonnes/a
1. Printing presses	1. woodfree printing	2500
	2. newsprint	3300
	3. board grades	500
2. Imported books etc.	-	3500
3. Paper converting	1. kraftliner	1000
	2. corrugating medium	750
	3. tissue	40
	4. bag paper	100
4. Imported paper prod.	1. cement sacks	300
	2. juice cartoon and boxes	500
	3. sulfite wrapping	1760
5. Miscellaneous		750
	Total	15000

The average CIF value/ton of imported paper, printed products and paper converted products is according to above YR 3600/ton or about US$ 800/ton.

The figure above does not include the packaging materials, like corrugated boxes, flowing into YAR with almost all imported miscellaneous goods.

5.4. Waste paper:

Waste paper can be and should be used for paper production. The best circulating degree has been achieved in Japan, about 40-45% and in W.Germany about 35-40% from domestic paper production. In most countries circulation degree is however only 20-25%. The biggest obstacle in circulation is the organization of collection. Special laws and Government steps are needed in this respect. Some developing countries request, that printing presses are not allocated new "fresh" paper unless they do not return from their consumption 20%.

One would not expect that in YAR conditions can be gotten better return than perhaps 10-20%.

The waste paper percentage of Box Plant in Taiz was about 4.5%. Waste was burnt as the price of buyers from Greece did not cover even the transportation costs to Hodeidah.

Also the Ministry of Education' press burnt its waste paper. Tissue plants used it too

5.5 IMPORTED PULP

As in many connections during the mission has been presented the idea to import pulp from e.g. Scandinavia and manufacture it into paper in Y A R, some words for that subject might be needed.

As above and later on has been described, all costs in Y A R are very high, even compared with high European standard. The construction costs here are maybe on a 30% higher level than in Europe. Power costs more, labor is expensive, also chemicals, water, transportation, etc.

Already Middle European single paper mills are suffering at least 10% loss compared with integrated pulp-paper mill. Hence the paper manufacturing here from imported pulp would be no solution to Y A R and it would mean the paper manufacturing company an economic disaster. Only so much pulp should be imported what is needed for specific properties of each paper grade. But the basic pulp material has to be produced in Y A R itself. The average imported pulp price might be around US$ 500/ ton and imported printing paper would cost perhaps US$ 800 / ton CIF.

There is of course institutional ways and means, like custom regulations and import restrictions, to protect the national paper industry. At present time paper raw materials for industrial purposes have the duty of only 1-10 percent. As the country's present paper consumption consists of so many different grades, the total amount being so little as about 15000 tons/a., the above ways and means would be difficult to implement in the practice.

The duty of converted paper products runs in 20-30%.

5.6 WATER

There would be no greater difficulties to satisfy the mill water need of small size paper mill by ground water pumping in almost any part of Y A R. Besides this, water would not be wasted as an uncontaminant it could be used - after sedimentation and perhaps aeration - for irrigation purposes. The cement plant in Bajil, north from Hodeidah, in rather arid area, has no difficulties to pump its water need, 800 cum/day or 550 l/min or about 9 l^3/s from 4 wells, 30 in deep, 5 km from mill site. And they do not expect any difficulties although increasing the capacity over 5 times, adding the water requirement respectively up to 3000 l/min or 50l/s

Their price for water delivered to the mill site has been in 1979 0.9 Fils/l water and after expansion they expect it to be, even with higher diesel oil price, not more than 1 Fils/l or 10 Rials/cum.

The quality of water through the Y A R is good. The only problem in coastal area is its high salinity.

The following ground water analyses data were received from WHO-representative in Ministry of Public Water, Sana'a. The samples had been taken from the area near Zabid, south from Hodeidah.

TABLE NO. 20

ITEM	DESCRIPTION	SAMPLE NO. 1	2	3
1	R. Programme no	2B	2B	2B
2	Sample no	020019	02011	02010
3	Village / Town	Biit - Faqi	Khahwkha	Sukhna
4	Governorate	Hodeidah	Hodeidah	Hodeidah
5	Water source	Drilled well	Dug well	Spring
6	Sampling place	Tank	Tank	
7	Date of sample	19/1/79	3/5/78	28/3/78
8	Purpose	Water qual.	Water qual.	Drinking water survey
9	Date of analyses	22/1/79	4/5/78	26/3/78
10	P H	8.5	8.7	

/...

Table No. 2 (cont'd)

ITEM	DESCRIPTION	SAMPLE NO. 1	SAMPLE NO. 2	SAMPLE NO. 3
11	Hardness			
	-Calcium	800	170	
	-Total	1500	300	
12	Chlorides	700	475	16000
13	Nitrate	125	6	
14	Sulfates	80	650	120
15	Iron		NIL	
16	Manganese		NIL	

There would be no greater difficulties to desalinate this kind of water for pulp paper mill process and steam boiler feed water purposes.

The remarkable difficulties will be confronted when one has to solve the question of pulp mill contaminant effluents. This has to be made by proper process selection and sophisticated waste water handling design.

Anyway, as ground water is never too much and there is a possible access to surface water use, one should consider it as a first priority although it may require more expensive investment in treatment also in fresh water end.

There is namely also at least theoretical possibility to generate water power if enough water is available, soil is suitable, and dam can be built for bigger water reservoir, which can serve not only for irrigation but also water power station and pulp paper mill process needs.

If this water reservoir + water power station idea would turn to be unpractical for one reason or another, there is also an alternative to use for mill purposes both surface and ground water. Surface water could be taken from diversion weir through paper pulp mill's own channel, for the processing purposes. When there is no water in channel, then the ground water could be used. Silting may be one problem in the reservoir.

According to Tihama Development Authority, Hodeidah (10.14) the drilling of one well costs about 2000-2500 YRial/m and the average depth of wells is about 50 m. The equipments, like pump, diesel motor, tank, etc. incl. erection costs additionally YRial 50,000. Hence one

/...

well would cost about YR 15,000 producing in average about 30 l/s water.

Boxplant in Taiz informed, that their 15 m deep well cost YR300,000, and it supplies water about 8 m^3/s, when it is necessary to use pump only 2-4 hrs/day.

If all 10000 ton/a pulp mill integrated with 15,000 tons/a paper mill water need would be satisfied with groundwater, this would mean about 60 l/s. Only 2 wells, 3rd one perhaps as spare, would be then needed in Tihama coastal area.

No water analyses for surface water exists. The irrigation project's design flood for the Mishraf diversion veir is established 2000 m^3/s. Wadi Rama discharges an average annual volume of about 80 mill cu. A theoretical 100% efficient structure at Mishrafeh with an intake capacity of 15 m^3/s would divert 89% of the average annual flow volume. The Wadi Rima total catchment area is about 2500 sq km. The highest flood recorded were August 1975 (525 cum/s); April 1976 (950 cum/s) and August 1977 (710 cum/s).

5.7 ENERGY

Until these days each industrial plant has taken care of its own energy service. 100 - 1000 KW diesel engines are widely used. For example cement plant in Bagil had 6 units each of these 540 kw, 2-3 standby. As this plant had been delivered by USSR, it also had Russian machinery, incl. diesel engines. The plant paid for diesel oil only 63 fils/l, delivered and its power cost was 31 fils/kwh. As the plant is owned by Government controlled company, its diesel oil obviously was subsidized.

The private box plant in Taiz paid for diesel oil 95 fils/l and its power cost was 75 fils/kwh/1975 and about 1 rial/kwh/1980.

Government-owned Yemen General Electricity Corporation, whose chairman is also Deputy Secretary in Ministry of Economy, has three major network in Sana'a, Taiz and Hodeida, plus 32 smaller networks in smaller towns. Sana'a will generate 40 MW in 2 plants, totally 12 engines; Taiz will generate 30 MW in one plant, totally 7 engines; Hodeida 22.5 MW in 2 plants, totally 6 units.

Now this same company is constructing the national grid. Within two years new 150 MW heavy oil fueled, condensing powerplant near Hodeida will feed 132 KV system, which will be built in different phases between Hodeida and Taiz, Hodeida and Sana'a, Sana'a and Taiz, and for some other bigger towns or industrial plants.

Second power plant, at least 150 MW will be built 1983 in Mocca, and third one about the same size. on the coast between Hodeida and Mocca. Investment in 1st phase is 250 million US$ and totally about 4 times that much (10.16.)

This compeny is also paying today only 63 fils/l for diesel oil. For heavy fuel oil has not been predicted any price for the year 1983. It will be world market price unless the own oil refinery of YAR will not start before that date. Company has been charging all its customers, small and big, 85 fils/kwh flat. However new tariff is under development. The verbally predicted forecast for future cheapest power price is 50 fils/kwh. Sana'a Industrial Estate is charging from its occupants 75 fils/kwh.

The next supply voltage from 132 KV is 33 KV The company is prepared to build this kind of transmission line including transformator station to any

/...

industrial client in Tihama region after 1982 but charges for it 40000 YR. /km. Low voltage distribution is based on 400 and 220 v, 50 s/s.

Power factor as planned is 0.9.

The present high voltage system in Taiz and Hodeida is based on 11 KV, in Sana'a 33 KV. Taiz and Hodeida will be changed up to 33 KV 1980.

Yemen General Electricity Corp. is all the time improving its capability to supply power without blackouts. It has 5 engineers, from which 4 are expatriates, financed by aids of different countries.

Power price in YAR, 31-85 fils/kwh is high compared with Scandinavian industrial tariff, appr. 20 fils/kwh.

YGEC is also exploring coal in YAR and has found some deposits. YGEC has calculated the following specific investment needs YR/KW for different types of power stations:

-solar energy power station: 600,000 YR/kw
-heavy fuel oil condensing : 2,300 "
-diesel oil power station : 1,900 "

5.8 TRANSPORTATION AND LOGISTICS

YAR has now two rebuilt ports, Hodeidah and Mocca. From these Hodeida is the major port of country, handling with modern equipments also containers. Congestion does not exist and awaiting time is highest one week.

YAR highway system is in satisfactory condition between the main cities; Sana'a-Hodeidah-Taiz, these roads are paved. However, the roads are rather narrow and are suffering from the lack of maintenance. Especially, the road Sana'a-Hodeida, built by Chinese aid 20 years ago. is curvy and dangerous. The speed of trucks is low and driving requires patience. The road from Sana'a to Taiz, financed by USA, is in best condition (10.14 and 10.4).

Total road network consists of 4000 km from which 1000 km are paved.

Approved axel load national limit is 13-tons. It is understood that highway system is in continuous improvement planning.

There are three major airports in Sana'a, Taiz and Hodeida. There are no railways in YAR. Taking into account the samll trucks, high gasoline

/...

price (20% below European average level), high salary level of skilled labor, like drivers, difficult mountainous roads and lack of service, one can conclude that transportation costs are high in YAR.

Therefore in possible site location, the logistic study is necessary in order to minimize the total costs.

Preliminarily, one can estimate that from logistics point of view, the plain area between Hodeida and Taiz could be one of the most economical.

If the mill needs access road, the cost of it can be estimated to be YR1,000,000-2,000,000/km based on the experience of cement plant project north from Sana'a.

It has also to be taken into account, that employer has to provide usually transportation services to its labor in YAR.

Concerning the storages, the mill has to make reservations for bigger than normal storage amounts what concerns raw materials, supplies, additives, spare parts. Boxplant in Taiz informed that the transportation costs by 7 ton truck/110 km from Mocca to Taiz is 250 YR/ton. This gives about YR 2.30/tonx km. Bigger 20 tons trucks are cheaper. The distances from Hodeida to Taiz, 275 km; from Hodeida to Sana'a, 150 km; from Sana'a to Taiz, 250 km.

It is obvious that in order to minimize costs, the possible future pulp and paper mill has to rely on its own fleet of trucks.

5.9 CHEMICALS AND CHEMICAL RECOVERY

There are about 40 different straw pulping processes in use or developed. And continuously research laboratories worldwide work for new developments. The process applied in YAR conditions has to be obviously suitable for several agricultural or annual crop residues pulping. It has also to be such that minimum amount of contaminant waste water will be released from the mill to pollute the environment and ground water. This matter has to be taken into account already in the process, so that waste water system investment can be minimized.

It is quite obvious that first, when the fiber raw material supply has been confirmed, necessary laboratory tests and pilot plant trials, possibly even mill scale trials in some existing facilities are necessary.

/...

Hence, it would be too premature in this phase to handle in detail the necessary chemicals, supply and price.

However in YAR are represented all the big chemical companies like JCJ Hoechst, BASF, etc., so that quite obviously no special obstacles in supply will exist.

YAR itself has no chemical industry but there are some mineral deposits like limestone, kaolin, salt suitable for caustic soda and chlorine. There are also signs of sulfur on the road from Sana'a to Hodeida. So far none of the deposits have been proven to be economic; basic aerial geographical and ground survey work is being carried out. (10.4.)

From the recovery point of view, pulping process is by far more important than paper making. In papermaking, main chemicals are fillers like kaolin, colours, alum, resin, foam preventitives, etc.

5.10. LABOUR AND MAINTENANCE

The biggest comparative advantage, which most developing countries have enjoyed in the early stages of industrialization is that low wages and associated wage costs more than offset initially poor productivity resulting mainly from low skill levels. In YAR not only is productivity low, due essentially to low skill levels, but wage rates are far above those typical in developing countries (10.4). Below are some workers' wages paid by companies visited during the mission:

- -Cement plant in Bajil, 3-shift work, average salary 2000 YR/month;
- -Box plant in Taiz, 1-shift work, average salary 950 YR/month, ordinary workers 2000-2500 YR/month, skilled workers;
- -Bisquit plant in Taiz, 2-shift work, 900-1500 YR/month depending upon the age and skill;
- -Ministry of Education Press in Sana'a, 1-shift work, 1500YR/month for ordinary workers, and 2500YR/month for skilled printer

Annual bonuses, leave entitlement, medical facilities, free transport, clothing, low-rent housing and subsidized food are the most common non-wage elements in wage costs. They made approximately 40% addition in wage costs in Taiz biscuit and boxplants.

Generally construction work is particularly well paid (10.4.) Builder's Price Book (10.15) specified following basic rates in April/1979;

	daily, YR
-Foreman	400
-Surveyor	300
-Mechanic	200
-Fitter	200
-Plumber	200

/...

-Mason	200
-Carpenter	200
-Painter	200
-Electrician	250
-Helper	90
-Unskilled	60
-Excavator rock	200
-Rock breaker	150
-Driller	75

Inflation rate per year is 20-30%, as estimated in 1980.

Though comparisons of wage costs in different countries are difficult, it is clear that typical rates in YAR are closer to those of Southern Europe than to other developing countries, most of which are much further advanced industrially than YAR. The average hourly wage rate paid by the Government owned spinning and Weaving Corp. was $1.20 in 1977, compared according to ILO data with $0.17 in Egypt (1976) and in India (1973), $0.33 in the Republic of Korea (1975), $0.44 in Syria (1975) and $1.36 in Spain (1975). (10.4.)

It is quite obvious, that future YAR pulp papermill, has to rely during its first 5-year operation time, heavily on expatriate work force.

Maintenance services rely traditionally on technical skills and willingness to offer services. As there are practically no vocational education in YAR and there is a lack of skilled labour, which additionally have high salary level, it is quite obvious that future pulp paper mill has greatly to rely on its own service facilities. In other words it has to be self sufficient in that respect.

Maintenance is greatly dependent upon the availability of spare parts; this has been noticed especially in diesel motor operations.

5.11. LAND AND SITE

The land area needed for 10000 ton/a pulpmill +15000ton/a papermill is about 20-30 ha, but usually at least doubling of that area for future expansion is needed.

Additionally needed are land for housing, roads, etc.

/...

Totally we are speaking any way about the land area need not exceeding 100 ha.

Much more land is needed to produce the necessary fibre material. Kenaf would need about 1000 ha and sugar cane (bagasse) about 2000 ha.

Land is very expensive in YAR. The major part of it belongs to the private farmers, which usually own 5-10 ha, some of them 50 ha. In Tihama area, 10% of farmers own 30% of land. (10.14.). Quite remarkable landowners are religious associations. In Tihama, Wadi Rima area, they (partly feminine) own about 1/3 of the land. Government owns land usually only in remote areas, but in Tihama region, it owns:

1. In Wadi Rima, about 2500 ha near Hodeida -Taiz Road, in Zabid.
2. In Wadi Surdud, about 2300 ha.
3. In Wadi Siham, about 500 ha.

Estimated private land price in Wadi Rima area (10.14) is about 10000 YR/ha near Zabid (less irrigation) and 20000 YR/ha near the foothill (more irrigation).

For the comparison, please note below some other land prices as informed:

1. Cement plant plot in Bajil in 1968, 6-7 sq km. total cost, 5 million YR corresponding about YR 8000/ha.
2. Boxplant in Taiz, land in hilly district. 1974 was brought 4 ha costing YR 25000/ha. When the additional plot of 9 ha was bought in 1980, it cost YR 1,000.000/ha!
3. Cement plant north of Sana'a, 24 ha, the farmers are asking 270mill for it. YR corresponding to YR 11,250,000/ha! (This deal is still unclosed).
4. Industrial Estate in Sana'a is leasing land to small and medium size industries in the rent of YR 100,000-150,000/ha per annum.

The manufacturing building floor area they will lease in the rent of YR 1,200,000-1,800,000/ha x a.

5. According to box plant in Taiz, the industrial building including the ground levelling costs:

5.1. Class I, concrete type, 1450 YR/sqm

5.2. Class I. Imported pre-fabricated type, 600 YR/sqm

5.3. Class III, Stoneblock type, 1250 YR/sqm.

In Sana'a. all prices are 50-60% higher. (10.14).

According to Cement Plant Project Supervisor (CPC) industrial building indexes are as follows:

/...

-YAR 100

-France 70

-Japan 65.

According to that, one may conclude that pulp paper mill construction will cost about 2000-2500 YR/sqm.

As the land and construction costs so much in YAR, one has to be very careful when selecting and occupying site for future pulp papermills.

When in Tihama area:

a) government owned land

b) suitable fertile soil exists

c) both surface and groundwater is available in wadi areas

d) from transportation and other logistic points of view area is suitable

e) Tihama Development Authority is in feasibility study phase in two wadis / and in implementation phase in 4 wadis / investing in each wadi's area irrigation system from 180 up to 315 mill. YR depending upon the catchment area and size of wadi

f) Transmission line of 132 KV is under construction along the Hodeida-Taiz road

g) Town Zabid is giving reasonable infrastructural background.

This area certainly is one of the most suitable alternative sites for future pulp-paper mill.

As a hypothetical place may be considered government owned 2000 ha land plot in Wadi Rima, near Zabid.

This plot can however receive in average only 3000 m^3/ha of surface water when again:

-sorghum requires about 8000 m^3/ha x crop
(90 days/crop; 2 crops/a)

-cotton requires about 9-10000 m^3/ha x crop
(150 days/crop. 1 crop/a

-Millet requires about 6000 m^3/ha x crop
(85 days/crop, 2 crops/a)

-Maize requires about 10-12000 m^3/ha x crop
(100 days/crop, 2 crops/a)

-Sugarcane requires about 15-25000 cum/a x crop
(? days/crop, 2 crops/a)

-Kenaf requires about ? cum/a x crop
(? days/crop, ? crops/a)

The rest of water need has thus to be satisfied by groundwater.

Sugarcane has been tested in one ha testing area on government 910 ha farm

/...

in Wadi Surdud, in 1971 during two years. The results were good, but termite danger has to be taken into account.

In fact, all the following Tihama wadis:

1. Wadi Rasyan
2. Wadi Zabid
3. Wadi Rima
4. Wadi Siham
5. Wadi Surdud
6. Wadi Maur

would be suitable small pulp paper mill sites.

By having one 10 - 30,000 ton/a agricultural residue pulp paper mill in 4-6 wadis, the need of YAR for pulp and paper could be satisfied for 20 - 30 years until afforestation programme begins to produce woody fibers.

The major part of fiber raw material of these mills can thus come from their own (or government-owned) land but also partly from contract farmers, who can be minority shareholders in pulp-papermaking company or who can proceed on the cooperative basis.

Minor amounts of good quality printing presses waste paper and imported pulp will complete the paper mill furnish.

6. CONCLUSIONS

6.1. At present time in prevailing conditions, there is no possibility to establish pulpmill in YAR until the fiber raw material availability in reasonable price has been confirmed.

6.2 On the short and medium time range YAR has to rely on agricultural residues use for pulping

6.3 On the longtime range, say 25 years, there are reasonable possibilities to receive woody fiber from afforestation programme forests

6.4 Domestic household fuel question has to be solved on different basis as nowadays.

6.5 In order to achieve full literary rate and for saving of foreign currency, YAR should prepare long range plan to produce in national pulp paper industry about 150,000 ton/a printing and newsprint paper grades and about 50000 ton/a wrapping and board paper grades.

There exists at least theoretical

/...

possibilities for this. The paper consumption per capita in YAR is strongly increasing.

6.5. Ministry of Agriculture has a challenging task to take responsibility for the development of fiber resources in YAR for short, -medium and long time range.

6.6. There are different possibilities to develop paper converting and printing industry.

6.7. Different kind of studies and tests have to be implemented in rather quick tempo which requests the technology transfer in different forms.

6.8. Such organization has to be formed which can take responsibility of the development of national pulp and paper industry in YAR.

6.9. The institutional and organizational obstacles in waste paper collection and use have to be identified and removed.

6.10. The objectives of the present afforestation programmes have to be re-evaluated and the size and depth of present test programmes, if only possible, to be increased, as the new national forests would have great influence on not only for future industry but also tourism, weather conditions and the recreation possibilities of Yemenites themselves.

7. RECOMMENDATIONS

7.1. Fiber Resources Studies

7.1.1. The Ministry of Agriculture has to implement the countrywide fiber (fodder) inventory for each specie (cereals, alfalfa, reed, palm trees) including the amounts, specific weights per volume unit, prices at producing farms and market places, transportation costs. This is an urgent task. The careful balance calculation between the fiber (fodder) production and animal production has to be made too.

7.1.2. Tihama Development Authority has to test new plants like kenaf, sugar-cane, sisal in potential pulp mill candidate sites or nearby in different wadi areas. The tests have to show the production per ha, irrigation needed, quality of crop and cultivation costs compared with usual YAR crops. Before testing desk research and literature survey has to be made.

7.1.3. The objectives and scope of work of the afforestation programme to be re-evaluated by Ministry of Agriculture, FAO and financing bodies. Costs can be reduced in plain areas by using mechanized planting (PAPERPOT).

/...

7.1.4. Ministry of Economy has to make an organization plan for waste paper collection and use.

The boxplant in Taiz should be encouraged to study the possibilities to establish in Taiz a small liner and other board grades producing mill using mainly waste paper as raw material. Board machine width 1.5 m-1.6 m. Pre-feasibility study recommended to be financed possibly by CPO.

7.1.5. CPO Data Processing Center to be re-evaluated -the content and objectives of Foreign Trade Statistics figures on paper and board, paper and board products and printed matters. The amount and values and country of origin to be mentioned for each checked and renominated items.

7.2 SITE RESERVATION STUDIES

7.2.1. CPO and TDA together has to pre-select and reserve the potential pulp paper mill estates sites.

7.3 (Pre)Feasibility Studies

7.3.1. CPO has to prepare prefeasibility study for sackplant in Bajil. Study should include countrywide market for cementsacks (compared with bulk - transportation), solid waste sacks (hospitals, communities, etc.), sacks for packing of agricultural products, etc. Estimated costs about 0.2 - 0.4% from total investment (class 30 - 50 mill. YR).

7.3.2. CPO has to prepare pre-feasibility study including laboratory trials for pulp-paper mill making lowgrade printing and newsprint in hypothetical site, in Wadi Rima area, near Zabid, as soon as enough information is available for fiber raw-material availability, quality and price, so that the size of mill-production can be preliminarily defined. Paper machine width 3.2 m.

If sugarcane alternative looks promising, then also a sugarmill plus molasses based PEKILO and TORULA protein plant to be included in study. Estimated costs about 0.2 - 0.3% from total investment.

7.3.3. Countrywide study for different paper converting production lines needs to be made, at least for envelopes, towels, napkins, etc. The private industries to be encouraged to start production in these fields. Ministry of Economy might be most suitable for this task.

/...

7.3.4. Feasibility study to be executed by CPO for integrated pulp paper mill during next 5-year plan, when the wide field tests have secured the raw material availability and pre-feasibility study shows reasonable techno-economic viability. (Estimated costs about 1% from investment, incl. pilot-plant trials). Paper machine trim width 3.2 m.

7.3.5. TDA has to ask some of the consultants working on Wadi's feasibility studies, to study the possibility to generate water power.

Samples to be taken for testing different analyses for surface water through the year.

Analyses recommended to be made, are the following:

suspended solids	mg/l (turpidity)
Evaporation residue	"
PH	
Color	mg Pt/liter
Conductivity	mS/m
COD	mg/l
BOD	"
Total hardness	mg $CaCO_3$/l
Total alkalinity	mg $CaCo_3$/o
Iron as Fe	mg/l
Manganese as Mn	mg/l
Silica as SiO_2	"
Calcium as Ca	"
Magnesium as Mg	"
Chlorides as Cl	"
Free Carbon dioxide as CO_2	"

Samples taken through the year during dry and rainy and flood seasons. Some comparative analyses to be made simultaneously for groundwater.

7.4. Project Organization

Project team to be established to take responsibility to develop national pulp and paper industry of YAR. It has to include members at least from following bodies:

1. Ministry of Economy
2. Ministry of Agriculture

/...

3. CPO
4. Tihama Development Authority
5. Ministry of Education Printing Press

The chairman has to be from high level, meetings has to be held at least 6/year, it may set ad hoc task groups for different studies and works, etc. Budget to be made for each year. Private converting and printing industries representatives to be heard as experts.

7.5. Technology Transfer

7.5.1. US Government Ministry of Agriculture has to be asked to give aid in kenaf, sugarcane and sisal matters, etc.

7.5.2. UNIDO assistance may be used for short time expert works to advice paper converting and paper printing industry, pulp-paper mill development projects, etc.

7.5.3. Consultants to be used to make (pre)feasibility and market studies etc.

7.5.4. Pulp and Paper International Magazine to be subscribed and circulated to committee (7.4) members.

8. APPENDICES

8.1. Map for Physical Regions & Hydrography (from World Bank Country Study, Ja. 1979).

8.2. Map for Wadi Rima and Montane Plains location and different wadis in YAR. (From Project Report 18 of Land Resources Div., Tolworth Tower, Surbiton, Surrey, UK , for Ministry of Overseas Development, 1978)

8.3. Job description No.
ST/YEM/79/801/11-02/32.1.E.

9. LIST OF TABLES

/...

10. REFERENCES

10.1. The Middle East and North Africa
1977-78, 24th Edition
Europa Publications Ltd., London

10.2. Job Description
SJ/YEM/79/801/11-02/32.1.E

10.3. Industrial Development in YAR
Summary
O. Milne Grieg/UNIDO/Febr. 5th, 1980

10.4. A World Bank Country Study /YAR
Jan. 1979

10.5. Final Report
on the airphoto interpretation project
of the Swiss Technical Co-operation Service, Berne
Zurich, April 1978

10.6. Appropriate Industrial Technology for
paper products and small pulp mills
UNIDO, UN, New York 1979

10.7. Present status and future potential for
utilization of nonwood plant fibres - Worldwide Review
Joseph E. Atchison
Indian Pulp and Paper, Febr. 1974

10.8 Statistical Year Book, 1977-78 /YAR
CPO, Statistics Dept.

10.9 Foreign Trade Statistical Book 1976/YAR
CPO, Data Center

10.10. Five-Year Plan/YAR
1976-1981

10.11. Requirements of modernization and expansion of
printing industry (TS/YEM/75/005/11-01/06)
Final Report prepared by UNIDO expert Ibrahim F. Abouelela
May 30th 1976

10.12. Wadi Rima Irrigation Development Feasibility Study
Made by DHV Consulting Engineers Sept. 1978 for
Tihama Development Authority in
YAR Ministry of Agriculture sponsored by
Ministry of Foreign Affairs and
Kingdom of Netherlands

10.13. Project Summary for Animal Fodder Improvement through
increase in the digestibility of straw
Ministry of Agriculture/YAR
FAO/UNDP/Sana'a

/...

10.14. Verbal interviews with different authorities, UNIDO and UNDP staff and private industry and trade representatives in YAR, March 1980

10.14.1. H.E. Minister of Economy
Mr. Mouhmad Hizam Ashowati

10.14.2. Director of Dept. of Industry
Ministry of Economy
Mr. Omar Al Kuniem

10.14.3. Director of Public Corporations
Ministry of Economy
Mr. Salak Aziz

10.14.4. Project Coordinator, UNIDO
Industrial Advisory Services,
Ministry of Economy
Mr. Ahmad Rashad Moussa

10.14.5. Assistant Deputy Secretary
Central Planning Organization (CPO)
Prime Minister's Office
Mr. Anwar Al-Harazi (tel. 3506)

10.14.6. Programmer/Analyst
Data Center/CPO
National Institute of Public Administration
Mr. Abubaker S. Kassim (P.O. Box 175)
(Tel 8314 or 7237)

10.14.7. Director General of Irrigation
Ministry of Agriculture
Mr. Abdul Karim

10.4. 7 Chief Engineer
Dept. of Irrigation
Ministry of Agriculture
Mr. Fawzi Elsaid

10.4.8. Director, Surface and Groundwater
Dept. of Irrigation
Ministry of Agriculture
Mr. Faizan-ul Haq

10.14.9. World Bank Forestry Advice in
Dept. of Forestry
Ministry of Agriculture
Mr. Mahmoud Juneidi (P.O.Box 115)

10.14.10. Forester in Dept. of Forestry
Ministry of Agriculture
Mr. Hisam Al-Ashwal

10.14.11. Livestock Adviser/UNDP/IBRD Project
Ministry of Agriculture
Dr. Mustafa Mohamed El Mudasher

/...

10.14.12 WHO Sanitary Engineer in
Ministry of Public Works
Mr. M. Afzal Mullick

10.14.13 UN Expert in Statistics Dept/CPO
Dr. Mohammed G. El-Rouby

10.14.14. Project Manager/Swiss Group in Survey (Map)Dept.
Ministry of Public Works
Mr. Werner Dubach (P.O. Box 2576)

10.14.15. Project Manager, UNDP Construction Costs
Ministry of Public Works
Mr. B.V. Kulkarni (Tel. 2226/264)
P.O. Box 551

10.14.16. Chairman and Director General
Tihama Development Authority (TDA)
Mr. Ahmed Alu Hummed
P.O. Box 3792, Hodeida, Tel.4096

10.14.17. Asst. Director of
Tihama Development Authority (TDA).
Mr. Ghazi Nasser Mohammed

10.14.18. Chief Engineer in
Yemen General Electricity Corp.
Head Office, Sana'a
Mr. S.W. Dundas, tel. 3842

10.14.19. Print Press Manager
Ministry of Education
Mr. Hassan Eid, P.O. Box 2585

10.14.20. Public Relations Officer
Ministry of Information Newsprint Press
Mr. Budreldin Babinker

10.14.21. Acting General Manager
Industrial Estate Development Authority (IEDA)
Mr. Abdulkarim Ismail Alarhabi (tel.804[illegible])

10.14.22. UNIDO Expert in YEDA
Mr. Odd Milne Grieg

10.14.23. Director of
Taiz Chamber of Commerce
Mr. Abdul-Hadi. A. Hameed
P.O. Box 4029, Taiz

10.14.24. Director of
Hodeida Chamber of Commerce
Mr. Abdul Qawi Saleh Salem
(P.O. Box 3370, Hodeida)

/...

10.14.25. General Manager
National Company for Sponge & Plastic
Industry Ltd. (Box plant), Taiz
Mr. Abdulla A. Rahman Alkirshi
(P.O. Box 4302, tel. 2980)

10.14.26. Dep. Gen. Manager
Yemen Co. for Industry and Commerce Ltd.
(Biscuit and Sweet Plant), Taiz
Mr. Derham A. Saeed
(Tel.4307, P.O. Box 4302)

10.14.27. Plant Manager of
National Company for Sponge and Plastic Industry Ltd.
Sana'a Branch
Mr. Omar Kutbi Omar
(Te. 2543; P.O. Box 4302, Sana'a)
(Toilet and facial tissue roll plant)
(10.14.15–27 belong to Hayel Saeed Corporation)

10.14.28. General Manager
Yemen Cement Industry Corp., Bajil
Mr. Ali Kaid Hadeshi
(P.O. Box 3393 - Hodeida)

10.14.29. Chief Engineer of
Yemen Dairy and Juice Industries Ltd., Hodeida
Mr. Grant Rooney
(P.O. Box 3337, tel. 2489)
(Belongs to Thabet Brothers Group)

10.14.30 Manager of
National Factory for Paper and Plastic (Bagplant in Sana'a)
P.O. Box 1736, Amran, way to Dehran

10.14.31. Managing Director of
Printers Trade Center, Sana'a
Mr. Ali Hassan Ali, Tel. 2307

10.14.32. FAO Resident Representative, Sana'a
Mr. Mohammed Jama

10.14.33. UNDP Programme Officer
Mr. Tim Howick-Smith, Sana'a

10.14.34 Dr. Manfred Judt
UNIDO, Vienna

10.15 Builders Price Book, Sana'a
Volume I
Ministry of Public Works

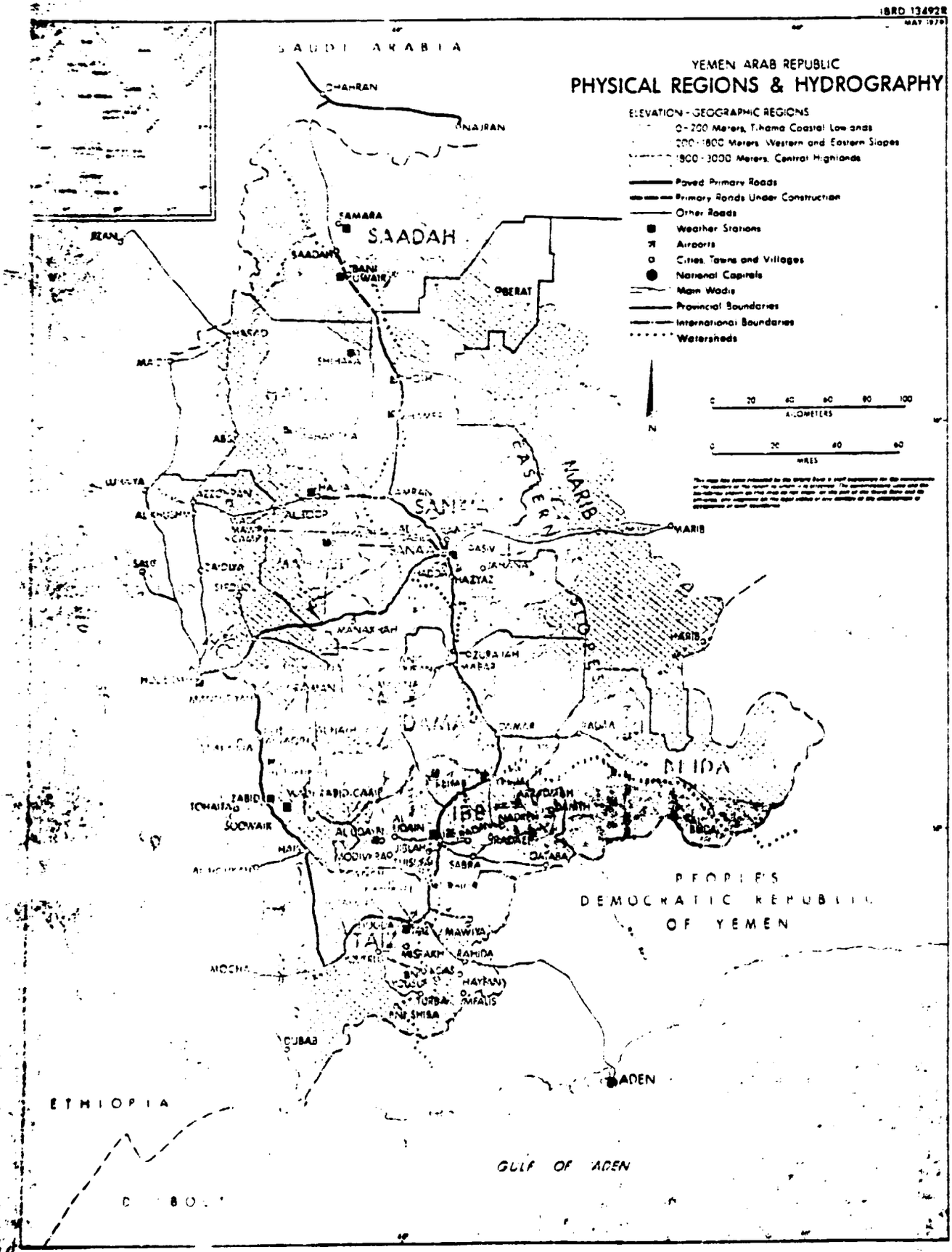
10.16. Yemen General Electricity Corp.
Stage III Electrification
Development of Interconnected System 1982-85
Report 6802/1
Kennedy & Donkin, Consulting Eng.

11. ABBREVIATIONS

a	= annum = year
bill.	= billion = 1,000,000,000 (USA)
^{o}C	= degree Centigrade
cm	= centimeter
CPC	= Central Planning Organization
cum	= cubic meter = 100 l = m^3
day	= 24 hours
GNP	= Gross National Product
g/sqm	= grams/square meter (surface weight)
ha	= hectare = 10,000 sqm
IEDA	= Industrial Estates Development Authority
kg	= kilogram
KV	= kilovolt = 1000 volts
KW	= kilowatt
KWH	= kilowatt hour
l/s	= liter/second = 60 liter/minute
m	= meter
mg/l	= milligram/liter
mill	= million
mm	= millimeter
MW	= Megawatt = 100 kilowatt
South Yemen	= People's Democratic Republic of Yemen
sqkm	= square kilometer
TDA	= Tihana Development Authority
ton	= 1000 kg
UNDP	= United Nations Development Programme
UNIDO	= United Nations Industrial Development Organization
wadi	= major water course
YAR	= Yemen Arab Republic
YGEC	= Yemen General Electricity Corporation

Rate of Exchange

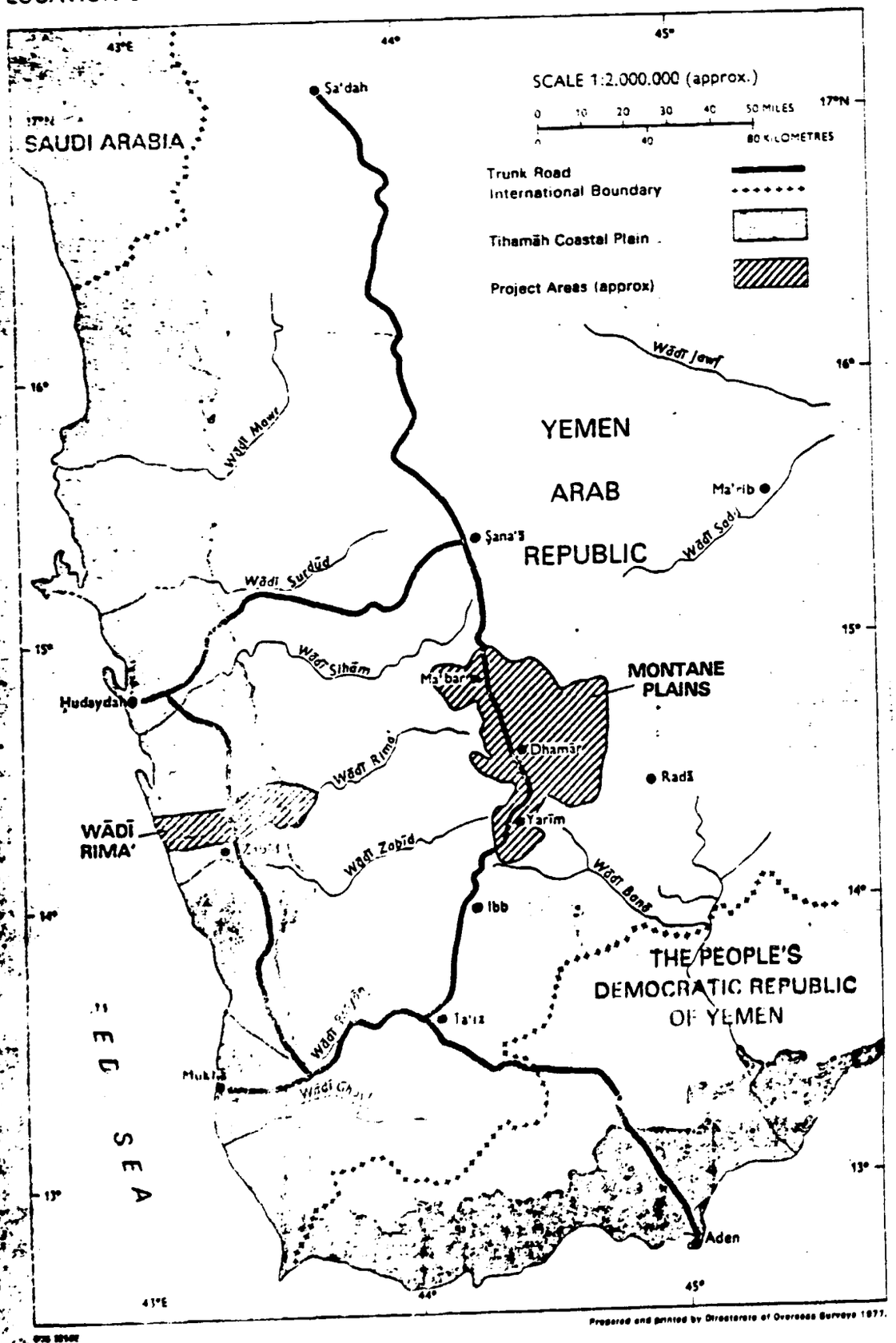
YR	= Yemen Rial (US$ 1 = YR 4.5)
1 YR	= 100 Fils = US$ 0.22


IBRD 13492R
MAY 1979
YEMEN ARAB REPUBLIC
PHYSICAL REGIONS & HYDROGRAPHY
ELEVATION - GEOGRAPHIC REGIONS
0 - 200 Meters, Tihama Coastal Low ands
200 - 1800 Meters, Western and Eastern Slopes
1800 - 3000 Meters, Central Highlands
Paved Primary Roads
Primary Roads Under Construction
Other Roads
Weather Stations
Airports
Cities, Towns and Villages
National Capitals
Main Wadis
Provincial Boundaries
International Boundaries
Watersheds
KILOMETERS
MILES
N
SAUDI ARABIA
DHAHRAN
NAJRAN
SAADAH
SANA'A
MARIB
HODEIDAH
TAIZ
ADEN
PEOPLE'S
DEMOCRATIC REPUBLIC
OF YEMEN
ETHIOPIA
GULF OF ADEN

8.2.

LOCATION OF THE PROJECT AREAS

TEXT MAP 1



Prepared and printed by Directorate of Overseas Surveys 1977.

8.3.

UNITED NATIONS

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO 14 December 1979

Request from the Yemen Arab Republic for
Special Industrial Services

INTERNAL

JOB DESCRIPTION

SI/YEM/79/801/11-02/32.1.E

POST TITLE	**Paper Production Specialist**
DURATION	**One month, with possibility of extension**
DATE REQUIRED	**As soon as possible**
DUTY STATION	**Sana'a, with travel within the country**
PURPOSE OF PROJECT	**To assist the Government, through the Department of Industry, Ministry of Economy, in the establishment of a national paper production unit.**
DUTIES	**The expert will be attached to the Department of Industry of the Ministry of Economy. In close co-operation with the authorities concerned the Director General of Industries and the Project Manager of the Industrial Promotion and Advisory Unit, the expert will specifically be expected to:** **1. In close co-operation with the paper production economist, study the extent of the country's potential demand for different types of paper.** **2. In close co-operation with the paper production economist, study the availability of local raw materials, ways and means for the replenishment of requirements for raw materials from other sources, and availability of infrastructure for the project.** **3. Identify and prepare a design for the ideal size of such a project, defining clearly the size of the different production and service facilities.** **4. Establish the capital requirements of the project in terms of foreign and local currency.**

..../..

5. Define the sources for machines and equipment needed for the project.

6. Recommend an organizational scheme and a training programme.

7. Recommend follow-up activities for further UNDP/UNIDO assistance.

The expert will also be expected to prepare a final report, setting out the findings of his mission and his recommendations to the Government on further action which might be taken.

QUALIFICATIONS: University degree or equivalent knowledge in pulp and paper technology, with experience in paper and paper processing and technology.

LANGUAGE: English; Arabic an asset.

BACKGROUND INFORMATION: The country is one of the least developed countries of the world. It has very recently started modernization and development. With the opening of new schools, universities, institutes and multiple Government and private offices as a result of the country's industrialization process gathering momentum, the use of different types of paper products has increased manifold. The expenditures on imports of paper and paper products has increased tremendously. In order to save the much needed foreign exchange and create job opportunities, the Government has decided to explore the possibility of having its own paper production facility, in which respect UNIDO's assistance is being sought.

NO CANDIDATES REQUIRED AT THIS TIME