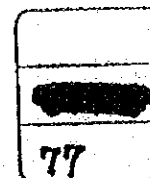
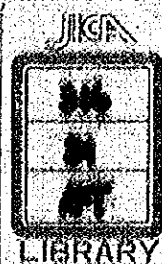


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PRELIMINARY REPORT
ON
AGRICULTURAL DEVELOPMENT
IN
THE YEMEN ARAB REPUBLIC

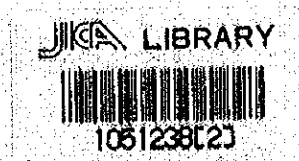
September, 1977

Japan International Cooperation Agency
JICA



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PRELIMINARY REPORT
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IN
THE YEMEN ARAB REPUBLIC



September, 1977

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Development in Hajjah area by
Dr. Hitoshi FUKUDA
Leder of the Japanese Preliminary Survey Team

Preface

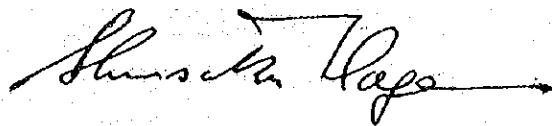
Japan International Cooperation Agency dispatched a study team to conduct a preliminary study on the agricultural development project of Hajja district from March 9 to April 4, 1977, at the request of the Government of the Yemen Arab Republic.

The study team surveyed the natural and socio-economic conditions around Hajja and studied the potentiality and techniques of agricultural development in the mountainous and plain areas.

I expect this report will prove to be useful as a basic material for formulating the master plan of the regional development of the country.

I wish to express my deep gratitude to the Government official concerned of the Yemen Arab Republic for their care and assistance extended to the study team.

September, 1977



Shinsaku Hogen

President

Japan International Cooperation
Agency

List of the team members

DR, Hitoshi FUKUDA	Leader	Professor Emeritus, University of Tokyo
Mr. Chuji MIYASAKA	Agronomist	Administrative Manager, Tochigi Agriculture & Forestry Statistic Association
Mr. Kenichi MAEDA	Soil Scientist	Senior Scientist, Environment Division, Central Agricultural Experiment Station, Ministry of Agriculture & Forestry
Mr. Toshihisa MURATA	Irrigation Engineer	Senior Engineer, Engineering Division, Planning Department, Agricultural Structural Improvement Bureau, Ministry of Agriculture & Forestry
Mr. Takao KUME	Drainage Engineer	Chief of Irrigation Section, Agricultural Planning Department, SANYU CONSULTANTS INC.
Mr. Nobuo KIMURA	Coordinator	Staff Member of Japan International Cooperation Agency

I. Introduction

1. Background and Purpose of the Study

Since the establishment of diplomatic relation between the Yemen Arab Republic and Japan in 1970, Yemen has been requesting Japan to cooperate in the economic development of the country. To comply therewith Japan has carried out in 1972 basic survey in three sectors — economic development, agriculture and mineral resource development, and in order to study on an approach to the development an investigation team has been dispatched. And in 1975 the Agricultural Cooperation Project Finding Mission visited Yemen to investigate the Tihama Plain of the Red Sea coast which is deemed highly potential for agricultural development. The investigation revealed the importance of water source development in agriculture of the country and a possibility of cooperation to institute the agricultural department in the university in Sanna, the capital, in the light of a fact that no agricultural curriculum is provided in the university of the country. Besides the above, Japan has dispatched several government-bass investigation teams heretofore including the Economic Cooperation Team headed by Zentaro Kosaka, former Minister of Foreign Affairs, and Water Source Development Investigation Team of the Overseas Economic Cooperation Fund.

All of those investigation teams have unanimously recommended to establish the self-sufficiency of food as a highly urgent sector in the development of the country, and because thereof the reports point out that the development of irrigation water, which is a bottleneck of agriculture in the country, is essentially required. Furthermore inadequacy in various agricultural and social infrastructures has been pointed out. However, up to now no concrete request has been made to Japan and due to the fact that natural and social conditions are so severe, no concrete cooperation method in agricultural development has been framed. Under the circumstances and in response to the request of the Government of the Yemen Arab Republic on April, 1976, Japan has dispatched the preliminary study team to carry out the survey on agricultural development of Hajja Governorate located north of Sanaa.

The purpose of this investigation was to confirm the objective area of agricultural development cooperation of Japan in Hajja Governorate and to clarify the objects of development plan. In order to ensure the same, the investigation team has been started their study with briefing the concept of agricultural development from the Yemen government agencies concerned by confirming the scope of cooperation request to Japan, and on-going similar development projects in the country have been inspected for reference to cope with the proposed cooperation. In the Hajja Governorate including the proposed project area, the ways and means of agricultural development have been studied on natural and socio-economic conditions and security of expected water sources.

Moreover, as for the topographic maps essentially required for plan formulation, the survey team went to London in the request of the Yemen authorities concerned in order to obtain the aerial photo-maps covering the proposed area, which were reported to have been already prepared in England.

2. Working Record

March, 1977

- 9 (Wed) Departed from Tokyo (PA 001)
- 10 (Thu) Arrived Karachi
- 11 (Fri) Left Karachi (PK 731)
Arrived at Jeddah. Consulted with Secretary Sudo of the Japanese Embassy on Itinerary. Stayed at Jeddah.
- 12 (Sat) Visited Japanese Embassy to make courtesy call on Ambassador Suzuki and Minister Yamamoto and consulted with Secretary Komizo on Itinerary.
Invited dinner party under the sponsorship of the Embassy. Stayed at Jeddah.

- 13 (Sun) Left Jeddah (IY 706)
 Arrived Sanaa. Met by Deputy Ambassador Shiotani and Mr. A. Alwazir of the Ministry of Agriculture (Counterpart).
 Invited dinner party from Deputy Ambassador Shiotani. Stayed at Sanaa.
- 14 (Mon) Held the first conference with the Ministry of Agriculture and consulted on development plan, investigation districts and itinerary.
 Attended by: Mr. H. Lulu, Vice-Minister of Agriculture,
 Mr. M. H. Jagman, Director of Planning Bureau of the same Ministry,
 The World Bank's experts: Mr. M. Saied
 Mr. N. Orabi
 Mr. R. Malik
 Deputy Ambassador Shiotani
 Stayed at Sanaa.
- 15 (Tue) Consulted with:
 Dr. M.A.W. Ariki, Deputy-Chairman, Central Planning Organization
 Mr. A.A. Alkhothir, Vice-Minister, Ministry of Public Works
 Mr. G.M. Abdu, Vice Minister, Ministry of Public Works
 Stayed at Sanaa.
- 16 (Wed) Sanaa to Taiz. Left for the on-the-spot investigation (2 land rovers) accompanied by Mr. A. Alwazir. Stayed at Taiz.
- 17 (Thu) Taiz. Visited UNDP/FAO Agricultural Experiment Station to receive briefing by Dr. R. Smith Zabid and the World Bank's Wadi Zabid Project and Dr. A. Shahata, Hodeidah. Stayed at Hodeidah.
- 18 (Fri) Hajjah. Made courtesy call on Mr. A.A. Almadani, Deputy Governor of Hajjah Governorate. Stayed at Hajjah.
- 19 (Sat) Consulted with Deputy Governor, and made on-the-spot investigation (Hajjah and Nabien villages). Stayed at Hajjah.
- 20 (Sun) Abiss. Consulted with Abiss Mayor, Mr. M.M. Altholey and made on-the-spot investigation. Stayed at Abiss.
- 21 (Mon) Hodeidah. Stayed at Hodeidah.
- 22 (Tue) Sanaa. Prepared the NOTE to be submitted to the Yemen Government. Stayed at Sanaa.

- 23 (Wed) Made report to Deputy Ambassador Shiotani and compilation of the NOTE. Stayed at Sanaa.
- 24 (Thu) Consulted with Mr. Shiotani and Officers-in-charge of the Ministry of Agriculture on the NOTE to be submitted. Stayed at Sanaa.
- 25 (Fri) Made inspection of vineyard of Bani Hoshaysh in the suburbs of Sanaa and on-the-spot inspection of digging artesian well for drinking water at Hizam by Japanese firm. Stayed at Sanaa.
- 26 (Sat) Sanaa. Held joint final meeting with the Ministry of Agriculture and the Central Planning Organization.
- 27 (Sun) Leader: Fukuda, members: Miyasaka, Maeda and Murata left Sanaa (IY 706). Arrived at Jeddah. Left Jeddah (PK 738). Arrived at Karachi. Stayed at Karachi.
Members: Kume and Kimura left Sanaa (IY 706). Arrived at Jeddah. Made report to Minister Yamamoto and Secretary Sudo. Stayed at Jeddah.
- 28 (Mon) The advance party left Karachi (PK 760) and the latter party left Jeddah and arrived at London. Stayed at London.
- 29 (Tue) The advance party arrived at Tokyo and the latter party met Secretary Hamano to obtain an aerial photograph. Stayed at London.
- 30 (Wed) Visited the Ministry of Overseas Developments and discussed the forwarding of aerial photgraph with Secretary Hamano. Stayed at London.
- 31 (Thu) Left London (SK 502, SK 971, SK 985) (Overnight on board)

April, 1977

- 1 (Fri) Arrived at Tokyo.

3. General Descriptions

Agricultural development projects, which are technically feasible and economically advantageous, have been materialized under the cooperation of financing agencies and the like. This survey team dispatched to the Yemen Arab Republic was the preliminary survey team in conducting

the so-called Project Finding. The investigation resulted to select two project area, Hajjah - Maben and Abiss in the Hajjah Governorate, almost the same size as Shikoku Island of Japan. The comparative study of the two revealed that Abiss would be more feasible. The details of the investigation process have been stated in the next Chapter, 'On-the-spot Investigation'.

On the other hand, during the discussion with the related agencies of the Yemen Government, the Team has come to realize the fact that northern part of the country (including the Hajjah Governorate) is inferior to the southern part in poor natural conditions and various socio-economic conditions for development, which have caused the development of the area to be delayed. In view of such situation it was understood that the Yemen Government had a firely seal toward the development of the northern part.

The Yemen Arab Republic expressed its keen desire to the Survey Team in the formulation of comprehensive development plan for the whole regions of Hajjah Governorate.

Nevertheless, it has been found that at present the Hajjah Governorate provided no proper topographic map indispensable in comprehensive development plan nor climatic and hydrological data available, and no survey had been made on geology and soil properties. In addition thereto, practically no data is available in socio-economic sectors which are the very keys to successful implementation of the project in future.

It is deemed reasonable that the Government of Yemen desires to establish an overall plan for the whole region prior to the establishment of independent favorable projects. Because accepted criterion is that each project is assessed and selected as a part of the integrated plan.

As comprehended from the above this report describes in stressing on each vafourable project with priority, including an intension of the

Yemen Government for comprehensive regional development. However, some of the projects stated above should not be construed as being valueless. When a comprehensive plan has been established for the whole region of Hajjah Governorate the above stated two projects can be expected to occupy a preferential position.

An orthodox method of development should begin with establishment of organic network of development for the whole region and in due consideration on priority of projects each other the network should be organized more and more closely. If such method be applied to this case in taking into account the present state of the Hajjah Governorate, rational development would be visualize by an approach toward the comprehensive regional development.

II. Field Investigation

1. Investigation Method

In the discussion with the Ministry of Agriculture (Mr. H. Lulu, Vice-Minister, Mr. M.H. Jagman, Director of Planning and Statistic Bureau and the World Bank advisor) on March 14 the Ministry side strongly desired to adopt the Hajjah Governorate as proposed project area. To comply therewith, it has been decided to find a prospective area for feasibility study to be carried out in future.

As for the itinerary of on-the-spot investigation, upon the result of consultation with the Ministry of Agriculture, Taiz and Zabid were to be inspected first in order to obtain basic knowledge of agricultural situations of Yemen and the conditions of advanced-projects; then to go to Hajjah Governorate to discuss with the Governorate's agencies concerned to start on-the-spot investigation. A survey in the Governorate was directed to the vicinity of Hajjah city, representing mountainous district, and northern Tihama Plain from which water potential can be expected.

In the Hajjah Governorate, a discussion was held with Deputy-Governor, Mr. AlMadani, on the districts proposed for survey and the

direction of future development. At that time the districts proposed by the Governorate's officials were Maben and Bani Qays along the Wadi Laah on the road from Hajjah to Dayr-Khashm besides Abiss, Harad and Maily of the northern Tihama Plain. However, as Mr. Wazir expressed an opinion that since Bani Qay's investigation had already been launched by China, it would be not desirable and it would be too tough itinerary to visit Hrod and Maily due to the fact that they were too far away therefrom, so eventually two districts, Maben and Abiss have been adopted for investigation.

Hajjah Governorate is composed of six Qadas, five of which are located in mountainous district and one in Tihama Plain. Out of the total population of 400,000, 320,000 live in mountainous district and 80,000 in Tihama Plain. Maben is a typical mountainous district and Abiss is a representing district of Tihama Plain.

2. Hajjah - Maben District

(1) General Situation of the District

The city of Hajjah populated by 5,800 is the capital of the Governorate, which is formed on the top of the 1,600 m elevation mountain, and Maben village is located 10 km northeast of Hajjah at the elevation of 1,900 m. The population of Hajjah - Maben as Nahyah (district corresponding to the middle of Qada and rural community) is 42,000.

The dwellings of this district are of stone masonry which is a typical method in mountainous and high lands. A group of 4-5 houses is scattered at the top or on the mid-slope of mountain which have been reclaimed into cultivated land in the vicinity of Hajjah city.

Cultivated land is distributed at the top or mid-slope of a mountain forming a beautiful terrace and main slope ranges from comparatively a gentle one to 30° + 40°. Ridge is built by dry masonry. Cultivated land surface is practically levelled with ridging. It is so built to

retain rain water. It is the same as terraced paddy field of Japan. Erosion by running water is unavoidable in steep sloping land, but cultivated land creation has appropriated to ensure good water management and contributes to the efficient use of water and soil conservation.

Annual rainfall in Hajjah city, according to the 1975 record, is 670 mm. The rainfall mostly takes place in April, May, June, July, August and September. The cultivation is dependent on rainwater.

The steep sloped road from Hajjah to Maben is very poor in sector and surface condition to the extent that landrovers can barely move, taking one hour and a half to travel only 10 km. The maintenance of road is carried out by inhabitants.

(2) Soil Condition

No data on the soil of Hajjah Governorate is available and future investigation should be required. Some observations have been made by taking the records of other districts as reference. The results thereof are as follows:

The vicinities of Hajjah city are made of complicated soil layers. The rocks along the road from Tihama Plain to Hajjah city are composed of sedimentary rocks of the Mesozoic era such as shale, sandstone, limestone, and rocks of the Pre-Cambrian era such as granite and crystalline schist. Those rocks in most cases are found in disorder under complicated and crooked formation.

In general, the soil of Yemen provided practically no properties of those parent materials. Because fine-grained soil (Loess-like soil, hereinafter referred tentatively as 'aeolian soil') which is considered to have been deposited mainly by aeolian, covers the whole country, the character of this soil is strongly manifested. In the vicinity of Hajjah city all arable lands in the mountaneous area have been terraced. Where the slope is steep the aeolian layer has been washed away or

buried; and in some places top soil is composed of colluvial soil containing many gravel. But in somewhat good terrace with slightly gentle slope, it seems that major portion is composed of aeolian soil or mixture of the both in most cases.

In the case of colluvial soil the gravel content is particularly large, but in general large gravel has been removed in terraced upland inflicting little difficulty in cultivation. It can be assumed that effective soil layer distributes shallow in uneven terrace, which accompanies a bottleneck in moisture retention.

The soil property is characterized by such high content of silt that can be generally classified as silty loam (SL). Perhaps continuous dosing of the organic matter (compost) around the Maben village would result in enrichment of the soil to some extent in water retention, and the organic matter contents seem to range 1-1.5 percent therein.

The results of spot investigation of terrace soil from Hajjah to Bani Qays revealed that all soils were considerably alkalic by approximately PH 9. However, electric conductivity (1 : 5 abstraction) was very low in the content of soluble salt all under 60 micromho. It can be concluded that the soil is calcareous, containing ammonium calcium. From the standpoint of physical aspect, there are many cases where the layers below the cultivating soil is considerably coagulated because of containing much silt contents but less organic matters.

(3) Condition of Farm Management

The rain-fed terraced upland cultivation depends on rainfall from mid-April and on, and the interview survey at Maben village found the major crops grown in the district as follow:

- Sorghum (*Sorghum nervosum* BESS et Sibult)
- Millet (*Panicum miliaceum* L)
- Wheat (*Triticum aestivum* L)
- Barley, two-rows (*Hordeum distichum* L. emend LAMARK)
- Maize (*Zea mays* L)

Cropping pattern assumed from interview with farmers is shown below.

Fig. 1. Cropping pattern for major crops in the Hajjah city's environs

Crops	J	F	M	A	M	J	J	A	S	O	N	D	Growth per (day) (*)
Sorghum (e.s.)			plowing	growth per									120 - 130 days
(l.s.)			sowing										
Millet (e.s.)													85 - 105
(l.s.)													90 - 110
Maize (e.s.)													120 - 130
(l.s.)													120 - 130
Wheat													105 - 115 (water available place only)
Barley (2 rows)													105 - 115 (water available place only)

Note: e.s. : early sowing
 l.s. : late sowing
 * : Germination - start of harvest

Besides the above, cultivation of perennial crops like Qat (*Catha edulis* (Porsk)) and coffee has been observed here and there.

Average cultivating acreage per farmer is said to be 2 ha with maximum around 5 ha.

Yield per unit acreage (1 libina = 44 m²) according to the interviewing of 7-8 farmers, converted to per-hectare average value is as follows. However, a difference by early and late sowing was not clarified.

Table 1. Yield/ha in the environs of Hajjah city
(1975 - 1976)

	<u>Yield/ha (kg)</u>	<u>Market Price (YR/50 kg)</u>	<u>Market Price/ha</u>
Sorghum	1,700*	70	2,380 ^{YR} = ¥151,000
Millet	680*	75	1,020 = 65,000
Wheat	680*	60	816 = 52,000
Barley (2-row)	630	0	630 = 40,000

Remarks: * ; single crop

1 YR = ¥63.5

No interviewing was available on maize

Furthermore, upon asking how much production increase can be anticipated if the irrigation water can be made available during the dry season (October - March), it was reported that it would be possible to increase the present two croppings in sorghum and millet growing to four croppings and the present unit yield would increase at least by three times. Some farmers said that things would not go smoothly always according to theory, but if the water be available at all time they would grow Oat and coffeee.

(4) Direction of Improving Farm Management

The vicinity of Hajjah city is of high elevation and certain amount of rainfall can be expected in summer season, but the adverse effect of drought on crop yield should be further studied. Although the drought damage can be assumed as a smaller when compared with Tihama district, according to the interviews with farmers drought year's yield is one fourth of that in the wet year. Since no complete compilation of data on this point has been carried out, clarification of soil moisture contents is highly desired in relation to the location of terrace and depth of soil layer.

Sporadic cultivation of wheat and barley was witnessed on March 19. Rather than drought damage during this period poor growth by the nutrient deficiency, particularly in nitrogen, was conspicuous. In the cultivation

over the years and decades a little nutrient, compost, has been supplied and as considerable leaching is deemed unavailable in rainy season it is assumed that nutrient including nitrogen is badly deficient. But just by increasing supply of nutrient it might accelerate drought damage and so the development of fertilization program for the year to conform to the periodical fluctuation of rainfall and soil moisture is highly desired.

It was explained that the compost applied was a natural compost but it was assumable that the same was crop residuals particularly stubbles or roots mixed and deposited with the excreta of man and domestic animal. Chemical fertilizer is said to be used, though in small quantity, but farmers seem to be prudent in its use, considering from its relation to drought.

After the replenishment of three elements, minor elements have been taken up as a problem²). Because of soil's pH is very high in Hajjah, when vegetable and fruit are to be introduced, application of minor elements made insoluble by alkali and the like: born, zink (Zn), copper (cu) and iron should be studied.

As a method of lowering soil's pH there is the application of a large volume of lime, but according to a research finding 1), to neutralize the soil of pH 9, it requires 10 tons lime per hectare which will be unpractical.

All the crops now being cultivated are sorghum and others that are adaptable to high pH and it is probable that crops to be introduced in future will be limited to those which have the same character. But for crops in which the deficiency of minor elements is a limiting factor for growing, production increase might be possible by their supplementary application. It was informed that many kinds of crops besides vegetables are being cultivated in the vicinity of Hajjah city, so if fertilization method stated above is established and extended to farmers, considerable production increase can be expected even under the present form of dependency on rainfall.

(5) Approach to Area Consolidation

As water source of this district Wadi flowing in the ravine can be conceived, but since no abundant water can be expected it might be appropriate to allocate the water to domestic use of inhabitants. With the exception of cultivated land along the Wadi, to pump up the water for irrigation to hillside land will be available only very limited areas because of the too large undulation of the land.

As a physical measure to ensure agricultural development of this district, the construction of road and ropeway networks is highly conceivable. The 77 km highway now under construction from Hajjah city to Amran by the aid of China is expected to be completed in 1980. The construction of trunk roads connecting with this highway and branch road and ropeway networks connecting with major producing districts will bring about a far reaching improvement in transporting agricultural input materials and harvests as well as in the living environment. With consolidation of these means of transportation, the objective arable lands will be comparatively in free selection ranging from 2,000 ha to 6,000 ha.

Consolidation of road networks will not ensure the direct improvement of agricultural production like the provision of irrigation. Production increase can be achieved by introducing agricultural extension service under which superior variety, advanced techniques in fertilization, plowing, and pest control will be applied as well as mechanization and input materials.

As for the improvement of rural infrastructure besides the consolidation of road networks, irrigation and drainage facilities and electricity supply can be considered essential. At present waterwork and electrification are consolidated only in Hajjah city.

3. Abiss District

(1) General Situation of the District

Abiss is located in the northern part of alluvial plain of Tihama stretching south to northing 50 km wide along the Red Sea. The site is from Bajil, the turnout point of a highway leading from Hodeidah to Sanaa, 118 km northward, is composed of 54 km of gravel paved road and 64 km of natural road.

The town of Abiss has a population of about 2,000. The dwellings of the Abiss's vicinity differ from the stone masonry of mountain and high lands, being built with log and roofed by leaves and stalds of sorghum. Some of the dwellings of Tihama Plain resemble to those of Kenya and Ethiopia.

Cultivating land of the district extends in parallel with the Wadi AL - Gaour and Wadi Bawhal flowing from the mountain region of east side in the range of 70 - 200 m elevation and cultivated land surface is level with ridges by which rainwater is stored and at the flooding of Wadi its surface water is induced and stored. The steepest inclination is estimated to be around 1/20 in general.

Although no recent observation data is available on annual rainfall of the area, the average rainfall of Zabid Camp, which is comparatively similar in geological condition to the Tihama Plain near the mountain side is 468 mm for the period of 1970 - 1973, then perhaps 300 - 400 mm can be expected. According to hearing from the inhabitants the wet season is in March, June and September. Cultivation depends on rainfall, flood irrigation of Wadi or partially on artesian-well irrigation.

Out of 118 km road from Bajil, 54 km gravel-paved road running near Bajil has not been repaired by grader. The road surface is rugged but road foundation is so firm as to stand for full use even in the wet season. Since the remaining part of the road leading to Abiss is natural road, the sandy road bed is passable, but in places where the silt distributes it probable becomes muddy in the wet season. It took 5 hours to travel this 118 km.

(2) Soil Condition

Abiss lies in the gorge of valley and the west tract of land extends comparatively flat. At two places in the vicinity of Abiss city the soil samples have been collected at the depth of 30 cm from surface and soil tests have been conducted on several items and the results are as follows:

(a) Point to the southwest of Abiss city

The upland was in the valley surrounded by hills composed of sandy gravel, forming the bare land after plowing. No development of horizon has been observed up to 30 cm from the soil surface.

Soil color Gray reddish brown, 5 YR 5/3

Moisture content: 0 - 10 cm, air-dry condition
 10 - 20 cm, moisture content (15%)
 20 - 30 cm, wet (25%)

Soil properties: SiCL (silty clay loam)
 Caly content is considerable large (15 - 20 %). Volume weight is small. Light alluvial soil and lower layer is slightly coagulated.

Content of organic matters:

 Estimated to be around 1 - 1.5 %

EC and pH (measured by portable instrument):

<u>Depth:</u>	<u>EC m, mho/cm:</u>	<u>pH:</u>
0-10 cm	0.06	9.2
10-20 cm	0.039	9.2
20-30 cm	0.038	9.3

(Measurement of soil on EC: under the percolation condition of water 1 : 5)

(b) Point to the west of Abiss city (by the side of the city's waterwork pump station)

Upland was flat in bare land condition after plowing. No horizon has been observed up to 30 cm from the surface.

Moisture content, a little less than (a).

Other factors were practically the same as (b)

EC and pH:	Depth:	EC m, mho/cm 25°C:	pH:
	0-10 cm	0.13	9.2
	10-20 cm	0.063	9.2
	20-30 cm	0.06	9.2

Upland fields in the vicinity of Abiss city have been assumed as being deposited by comparatively fine grains of alluvial soil forced out from BANI AL - Gaour. It appeared that aeolian soil in mountainous lands had been thrust by the action of water to produce the secondary accumulation in flat land near the mountain. However, as the age of its formation is young, no soil horizon has been developed at all. The soils of investigated points contained organic matters, though small amount. Taking into account the fact that dump layer lies deep, nutrient (particularly nitrogen) has been supplied considerably.

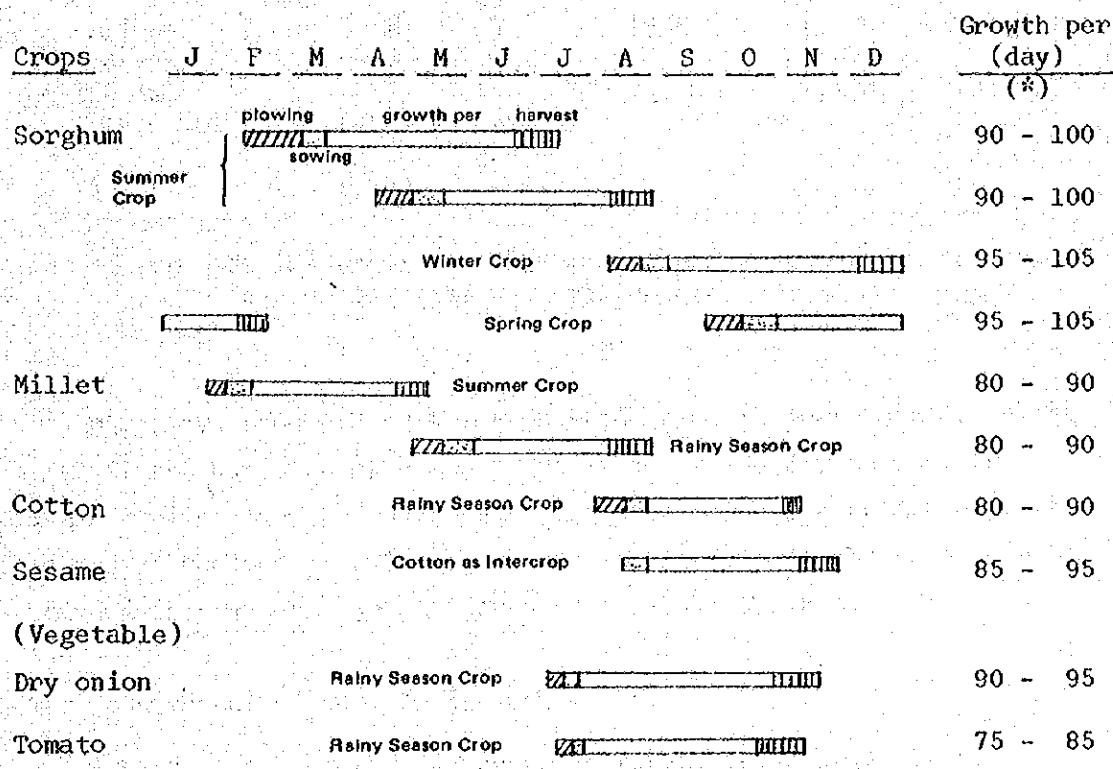
Hills, undulating a little, in this district are composed of gravel that the land can not be reclaimed for cultivation. Accordingly, in such a district small grain soil is distributed along the hollow land. In general, gravel layer exists as lower layer even in flat land. In Abiss district the depth of accumulated soil layers, including hollow land, is assumed to vary considerably with places.

(3) Conditions of Farm Management

Upland cultivation is dependent on rainfall after mid-April. The interviews with farmers revealed that growing crops are sorghum, millet, cotton, sesame and vegetables (dry onion and tomato).

By farmers' comments, the present cropping pattern can be prepared as shown in the following Figure.

Fig. 2. Cultivation pattern in the vicinity of Abiss city (1975 - 1976)



Note: *; germination - harvest

The yield per unit acreage obtained by interviewing with farmers have been converted to yield/ha and the present market price of crops are tabulated hereunder.

Table 2. Yield/ha and crops' price in the vicinity of Abiss city (1975 - 1976)

	<u>Yield/ha (kg)</u>	<u>Market Price (YR/50 kg)</u>	<u>Market Price/ha</u>
Sorghum	2,050 (single crop)	80	3,280 ^{YR} = ¥208,000
Millet	640 (")	100	1,280 = 81,000
Cotton	1,600		
Sesame	530	200	2,120 = 135,000
Dry Onion	1,140 (single crop)		
Tomato	1,800		

Remark: No information on the market price of cotton, dry onion, tomato and maize was available.

Moreover, upon asking how much production increase can be anticipated if the water is made fully available in the dry season, the farmer replied that he would like to increase the production of cotton and sesame besides more banana and vegetables and if the water can be obtained the revenue can be increased by 2.5 - 3 times.

(4) Improvement of Farm Management

According to the finding by EC measurement the soil can be characterized by very small accumulation of soluble salt and in the light of high pH it is a typical calcareous soil, the same as the soil of the vicinity of Hajjah city. The outbreak limit of salinity damage measured in plastic greenhouse bed of soil of Japan is set at 0.1 - 1.5 millimho. Even if the soil sampled near Abiss contains some salt, no outbreak of salt damage may be expected. (The result of measuring the water whose water source is artesian well reveals EC as slightly high at 1.2 millimho.) And in the light of a fact that in the wet season Wadi's water is introduced for ponding for which about 20 cm high border has been constructed around the upland fields, it can be assumed that a large volume of water can be stored temporarily. This has a function of removing the salt in the surface of soil by percolation.

A problem caused by pH can be summarized into two factors: kind of crop is limited because of high pH and impossibility to supplement minor elements.

Although it is not included in this Abiss district, the soil at one point on the road from Dayr Khasm to Abiss coagulation layer of silt has been observed 10 cm below the cultivating soil which not only inhibits the root growth but causes a very unfavorable condition for moisture supply from lower layer or in water retention capacity. Although this place was flat, too far away from Wadi and topographically slightly high, it is impossible to feed the water in the wet season. In such topographically high place either gravel covers the land or silt accumulates. Accordingly, the distribution of soil containing clay loam is found mostly along the Wadi. At the investigated point near Abiss dump layer seems to be considerably thick but, for the whole areas, the soil ranking should be made by taking into account of topography.

According to interviews, at present, farmers are using neither compost nor chemical fertilizer at all. And as the reasons to take such a practice can be assumed to be: (a) the water as a limiting factor may hardly result in nutrient's replenishment, (b) the formation of alluvial layer is comparatively a new; thus sufficient in nutrition and a new soil is readily supplemented from the water of Wadi during the wet season, carrying the nutrients continuously, (c) effective soil layer distributing deep allows to supply sufficient nutrient quantitatively and (d) the farmers have little knowledge on such techniques.

At any rate if water supply becomes available by irrigation, ways and means of supplying nutrient will become necessary (application of compost and chemical fertilizer). The fertilizer application and other related problems are the same as the vicinity of Hajjah; however, since Abiss district has a possibility to introduce irrigation system, considerable productivity increase can be expected by fertilization available. Soil is estimated to have higher fertility than the terrace fields of Hajjah district if the improvement in irrigation and

fertilization is ensured. It is assumed that yield per unit acreage would at least increase by 150 - 200 % of the present. Furthermore, if multi-cropping can be applicable it may be reasonable to anticipate even 300 % increase.

It is also recommended to introduce banana and mango plantation in the area.

(5) Possibility of Irrigation

As the water source for irrigation to this district surface water of Wadi AL - Gaour and Wadi Bawhal flowing from the mountain at the back of the districts and ground water supplied therefrom along the Wadis can be expected. Annual rainfall in the catchment areas of those Wadis are 989 mm for Al-Mhabsha (environs of drainage basin between the upstream of Wadi Al-Gaour and Wadi Maur), 1,102 mm for Al-Tour (ravine by the Tihama Plain, tributary of Wadi Mawr along Wadi Laah) and 670 mm for Hajjah (nearby mountainous areas), all recorded in 1975; they are practically in the same order as Wadi Mawr, the adjacent catchment area.

Due to absence of data, the potentiality of irrigation water should be estimated based on the records of runoff and groundwater in the advanced projects of Wadi Zabid and Wadi Mawr. The correlation between catchment areas of those Wadis and proposed irrigable acreage is as shown in Table 3. 3), 4). If a possible irrigation acreage is estimated by 5 % of catchment area, it is about 2,500 ha.

Table 3. Relation between catchment area and irrigation acreage by Wadi

	Catchment area (A)	Irrigation acreage (B)	B/A x 100 (%)
Wadi Zabid	560,000 ha	17,000 ha	3
Wadi Mawr	800,000	60,000	7.5
Wadi Al-Gaour	50,000	2,500	5

Remark: Wadi Al-Gaour includes Wadi Bawhal

The measurement of electricity conductivity of the water of artesian well as water source for waterwork, located in the center of the district was 1.2 m, mho/cm (27°C). When the same is compared with 0.34 - 0.74 m, mho/cm of Wadi Maur and 0.65 - 1.0 m, mho/cm (all measured at 25°C)⁴⁾, which are a little higher than those of others. However, since they were measured at only one point, so that water quality on the whole should not be based thereon. At any rate the water utilization in accordance with water quality should be necessitated.

Artesian well for waterwork from which the water is pumped now is 45 m in depth, and groundwater table is around 15 m from ground surface. It is hand-dug and the side is stone masonry. The outlet diameter of pump is 110 mm, and 20 HP engine is provided from which the pumping capacity is estimated to be around 15 l/sec. Pumping capacity per well of a government farm of Wadi Sorded is 55 l/sec (average). Anticipated value of pumping capacity per well of Wadi Mawr Project is 40 l/sec. The soil layer of Tihama Plain can be assumed as having not much difference by district in the light of its origin of formation. So the above value will serve as reference on well's pumping capacity.

(6) Approach to Regional Development

It is assumed that irrigation is effective more than anything else as a method of the agricultural development of the district. Since the construction of highway running southward from Tihama Plain connected to highway, which has been completed up to Jaizan under the aid of Saudi Arabia, is expected to be completed by 1980, it is desirable to keep in pace with the construction of road network connected to that highway.

Artesian wells should serve as the source of irrigation water and supplement surface water should be induced at flooding time. For that purpose well with 300 mm casing equipment with diesel engine pump should be provided. Only main canals should be built and the rest by continuous flowing irrigation.

For surface water simple headworks are constructed at 2-3 places

and shall link with main canals. Roads are of gravel pavement for the dual purpose of access roads for construction and operation and maintenance of water sources with sparse disposition.

Besides the above, as a development of rural community the enlargement and improvement of waterwork installation and electrification should be designed.

4. Summary of On the Spot Investigation

The results of the on-the spot investigation stated above have been comprehensively studied and it has been judged that Abiss is preferentially proposed as the suitable site for feasibility study. The Note on those investigations (attached to reference material) was submitted to a Joint Meeting with Yemen side. And after explaining the same, discussion has been made in details.

The reason for selecting Abiss as candidated site was that although the existing condition of groundwater along Wadi is unknown yet, availability of water is expected to some extent, and upon using this groundwater the establishment of a project with irrigation scheme, which will ensure a direct production increase as mainstay, can be materialized. Contrarily in the mountainous district of Hajjah - Maben, such immediately effective irrigation plan can not be conceived. As a physical measure for agricultural development the road will probably play vitally important role. Naturally, no direct production increase effect can not be expected by road construction, but it will bring benefit in a long run. It is highly recommended to expedite the improvement of agricultural extension service for production increase. And that might play an important role as nucleus in the development of the district.

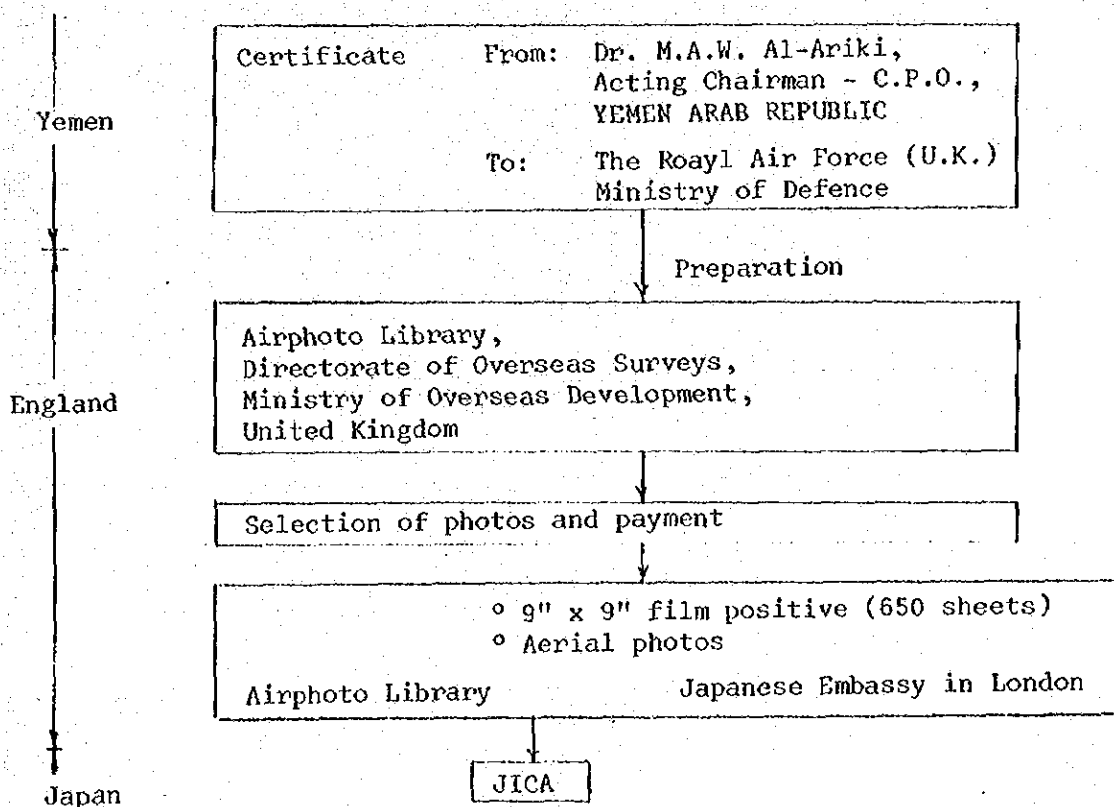
III. Preparation of Aerial Photographs

1. Necessity of Topographic Maps

No matter what kind or form of project is to be planned in Hajjah Governorate, the first requirement is topographic maps. It is desirable to prepare a reduced scale maps, 1/50,000, for general planning and for agriculture-related feasibility study, 1/10,000 scale maps. The best topographic maps now available in Yemen is a 1/250,000 scale

2. Procurement of Aerial Photographs

In 1973 the Royal British Air Force took aerial photographs from which 1/50,000 scale national land maps can be compiled and England is now developing maps therefrom. At present a portion of the vicinity of Sanaa is scheduled to be completed in 1978. An arrangement has been made to obtain those photographs from England upon the request of the Yemen Government and the Team received the photographs of Hajjah Governorate under the following procedure:



3. Preparation of Topographic Maps

Aerial photographing carried out by England did not establish an ground control point to make control point surveying on the proposed area. So with only those aerial photographs, no topographic maps of 1/50,000 scale can be developed. In order to prepare maps therefrom either surveyed data should be added or investigated reference material be used for. That is, such method as ground survey of standard point survey or survey satellite (N.N.S.S.) has to be used and in case of depending on existing materials it is possible to draw maps by 1/250,000 scale topographic maps or ERTS of the United States.

In the case of selecting a method for map preparation, the precision of topographic maps must be taken into consideration to meet the requirement in future as well.

REFERENCE MAT.

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- 2) Information Paper No.9
United Nation Development Program (1971)
Chapter V. The Soils of the Yemen Highlands - based on the work of R. Smith.
- 3) Appraisal of Tihama Development Project, March 27, 1973,
Document of International Development Association
- 4) Water Resources & Quality Survey of Wadi Siham & Hodeida Area (1975), Central Agriculture Research Organization Project, Taiz, UNDP/FAO/YEM/73/010

1. Briefing of the Consultation with Yemen Side

- (1) March 14, 9 A.M. Consultation with Mr. H. Lulu, Vice-Minister, Dr. Minister, Ministry of Agriculture.

Dr. Fukuda, a Team Leader introduced team members to the gathering of high-echelon officers of the Ministry and Government advisor from FAO, stating the Team's mission, particularly stating that present investigation is a frame works to feasibility study to follow. Mr. Lulu returned a cordial welcome and introduced all attended members of authorities concerned.

The consultation was initiated by a general descriptions on the state of development of the country: (1) Development plan for the flat land in the southern part of the country has already been established by the UN side. And in part of mountainous districts West Germany and

China have inaugurated the development, though in small scale; (2) As for other major roads West Germany and China have completed the construction and at present China is pouring its effort in the road construction in northern mountainous part (highway between Amran and Hajjah). (3) Future objective is to be directed to mountainous land to the north where the development is delayed. It has been expressed that it is desirable that Japan would investigate Hajjah Governorate.

Investigation's itinerary was discussed next. First, Taiz and Zabid Projects now being carried out by FAO are to be inspected in order to obtain fundamented knowledge of the state of agricultural development of Yemen, then to go to Hajjah Governorate for investigation.

Yemen Government offered two vehicles, a large land rover and station wagon and promised to provide Mr. Abdulla Al-Wazir, Director of Foreign Relation of the Ministry of Agriculture as interpreter and coordinator for the entire duration.

(2) March 15, 9 A.M. Courtesy call on Dr. Ariki, Dy. Chairman of the Central Planning Organization.

The Team has been briefed on the government structure of the Yemen Arab Republic. The Team has been honored by a praise of Japan's untiring effort for the reconstruction after the war and for the achievement of post-war prosperity. An administration has also been conferred on Japan's intensive farm management and agricultural cooperatives' development. Dr. Ariki mentioned Japanese fish culture in paddy field as an example of Japanese farmers' intensive farm management. The statement of Dr. Ariki gave an impression that Yeminites are interested in Japan.

He agreed to issue a certificate to obtain aerial photograph of Hajjah district from Great Britain.

- (3) March 15, 10 A.M. Courtesy call on Dr. Al-Khotir, Dy. Minister, Ministry of Health.

The team has been briefed on bloodsucking trematoda disease (*Schistosoma japonicum* Katsurada) and other disease of the country, particularly on peculiar relation of this trematoda disease to agriculture.

- (a) The highland of Hajjah district has a beautiful scenery but 97 % of farmers are supposed to be infected by this blood-sucking trematoda disease.
- (b) In the order of most numerous disease: tuberculosis, malaria, amoebic dysentery, smallpox, whooping cough hepatitis and thyroiditis.
- (c) Research finding has revealed that this trematoda invades man's body from skin. Symptoms are the swelling and hardening of liver. No treatment has been found so far. Infection is in wet season, manifesting symptom in summer season and gradually becomes chronic.

As a preventing measure against this disease: Avoid the drinking untreated water. Do not wash hand and face directly by untreated water, particularly, muddy water is badly dangerous. Upon leaving the water, within 24 hours larva of trematoda dies. Use the water after that or in case of using the water immediately, boil it.

- (d) Besides the above vaccination is enforced on children against diphtheria, lockjaw, mump and throiditis. For adult, vaccination is enforced on dysentery, typhoid fever and cholera.
- (e) One of the major objectives of this country's revolution was the eradication of disease. Prior to the revolution there were only three hospitals for the whole country. Now there are 49 including clinics. Doctors heretofore were only

foreigners but most doctors now are Yemenis. Because of no medical college in the country, doctors who have been trained abroad and now active in respective medical fields number about 600. At present 60 medical trainees are studying in Saudi Arabia, East and West Europe and the United States.

(f) Besides, as a vernacular disease of farmers in Hajjah district there are many liver lithiasis patients because the content of lime is large in the water of this district. And the water contains much fluorine, thus, there are many patients with thyroid gland hypertrophy. As a general trend, blood-sucking trematoda disease is numerous in highland and malaria in lowland. Reasons for a large number of dystrophy is because agricultural crop is limited to few kind. In highland where crops' kind is many few dystrophy is being witnessed.

(g) Qat so fancied by Yemenis contains Ephedrine and caffeine but no injury on man has been reported.

(4) March 15, 11:10 A.M. Courtesy call on Mr. Abdu, Dr. Minister of Public Works. Some members visited the Highway Authority Office for the briefing on road construction plan of the country.

(5) Final meeting with the Ministry of Agriculture to report and discuss the findings of the investigation. (March 26)

(a) Excerpt from Dr. Fukuda's speech

The development of Abiss area in Hajjah Governorate has been found feasible. The securing of water source in mountainous district of Hajjah and its vicinity and steep-terrace agriculture require, first of all, the development of road. When agricultural production has made some advance then consolidation of the road networks including ropeways would be most effective. On the other hand, Abiss city is in flat land,

alongside the river basin, the development should first be focussed on about 2,500 ha of 15,000 ha. The development should include the consolidation of road network. If priority is to be given, first, Abiss's vicinity, then followed by the road development in the vicinity of Hajjah city.

- (b) Excerpts from the replay of the Project leader, Mr. K. Monsour
- In the light of the present socio-economic situation of the country the development should be focussed on mountainous land. FAO's project under master plan for regional development centering on experiment and research is gradually being advanced. It is desired that Japan would establish a plan in congruity therewith.

Japanese side takes up agricultural development only. But for us we would like to have you consider integrated rural development program.

- (c) Question from Japanese side

What is represented by 'integration'?

- (d) Yemen side's answer

It means comprehensive development -- medicine, education, communication and road development, forestry and agriculture including animal husbandry.

- (e) Japanese side

As for such comprehensive development program we are not prepared to give an answer and we have no authority to answer. We shall report your desire to the Government of Japan upon our return.

- (f) Yemen side

Prior to commencement of Feasibility Study, in order to collect

data and to carry out basic survey to establish fundamental plan it is desired that Japan sends investigation team composed of several experts to this country for 3 - 6 months duration. Because our next 5-year development plan starts from coming July 1, we hope that Japan gives its answer on various points stated above not later than July 1, after due consultation with Japanese Government on our return.

2. Report submitted to the Final Consultation with the Ministry of Agriculture based upon the Investigation Results.

Sana'a, March 26, 1977

His Excellency Mohamad Al-Khadim Alwajih
Minister of Agriculture,
the Yemen Arab Republic

Note on Preliminary Survey of Agricultural
Development in Hajjah Area

Dear Sir,

I have a pleasure of submitting herewith a note of the results of the preliminary survey of Hajjah area, carried out by the team of the Japanese Government.

The results of the note, however, are tentative and subject to modification in the further study of the survey results, though basic concepts are not changed.

I believe that the feasibility study will be implemented by the Japanese Government as early as possible in 1977 based on this report.

I wish to express my hearty gratitude for your cooperation and hospitality extended to us during the course of the survey.

I remain,

Respectfully yours,

(DR. HITOSHI FUKUDA)
Leader of the Japanese
Preliminary Survey Team

cc: Embassy of Japan, Sana'a

3. Road Situation

(1) Road Condition

No hinderance is caused in vehicle's travel on paved road constructed by the aid of several countries, but there are many non-paved roads which are hazardous even by landrover. A map shows road sign but some road can not be used by vehicle. The length of roads and required hours to travel are:

For paved road:

Sanaa $\frac{160 \text{ km}}{4 \text{ hr}}$ Ibb $\frac{45 \text{ km}}{1 \text{ hr}}$ Taiz $\frac{160 \text{ km}}{3 \text{ hr}}$ Zabid
 $\frac{85 \text{ km}}{2 \text{ hr. } \& \text{ 30min.}}$ Hodeidah $\frac{50 \text{ km}}{50 \text{ min}}$ Bajil $\frac{160 \text{ km}}{3 \text{ hr. } \& \text{ 55min.}}$ Sanaa

For non-paved road:

Bajil $\frac{60 \text{ km}}{2 \text{ hr. } \& \text{ 20min}}$ Dayr Khashm $\frac{60 \text{ km}}{3 \text{ hr}}$ Hajjah
Dayr Khashm $\frac{50 \text{ km}}{2 \text{ hr. } \& \text{ 30min.}}$ Abiss

(2) Road Condition and Road Construction Plan in Hajjah Governorate

Road condition in the Governorate is very poor. There is not a single paved road, and there are two types of road -- sharp-curve mountain road with danger of falling-stone and desert road traversing the Tihama Plain. Hajjah Governorate contains so many mountainous lands and as major cities are located on the top of those mountains the roads end there. There is no road network to interconnect all those roads.

As for the road construction plan in the Governorate there are Amran - Hajjah highway under the aid of China, scheduled to be completed in 1980 and Maidy - Hodeidah highway by the aid of Saudi Arabia scheduled also for 1980 Completion.

4. Persons contacted in Yemen

Ministry of Agriculture

Mr. HUSSEIN LULU	Undersecretary
Mr. MOHAMED H JAGMAN	General Director, Planning & Statistics Dept.
Mr. ABDULLAH ALWAZIR	Director, Foreign Relation Dept. (=Div.) Planning & Statistics Dept.
Mr. HUSSEIN ALI EL-FAKIH	Acting General Director, Irrigation Dept.
Mr. KAMIL MONSOUR	IBRD Expert/Team Leader
Mr. MAHMOUD SAIED	IBRD Expert/Planning
Mr. MAFE ORABI	IBRD Expert/Agriculture
Mr. RAMIZ MALIK	IBRD Expert/Irrigation
Mr. ABDULLAH ALI ENASH	Acting Director, Agricultural Office in Hajjah

Central Planning Organization

Dr. MOHAMED ABDUL WAHAB ARIKI	Deputy Chairman
Mr. AGEEL AL-IRYANI	Head, Agriculture Sector

Ministry of Health

Dr. AHMED ALI AL KHOTHIR	Deputy Minister
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Ministry of Public Works

Mr. GAMAL MOHAMED ABDO	Deputy Minister
Mr. ABDULLAH AL-HAIFI	General Manager, Highway Authority

5. List of Collected Data and Information

The National Accounts of Yemen Arab Republic (1969 - 1973)

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- U.N. Economic Commission for Western Asia - (Beirut, Lebanon)

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- Dr. A.H. SHEHATA
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- UNDP/FAO of the UN
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Statistical Year Book (1976, Sixth year)

- CPO, Statistic Department, YAR -

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R.D. Sharma & Ahmad M Awad

(Soil Scientist) (Soil Scientist)

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Sorghum and Wheat Response to Applied Fertilizers Under Farmer's
Conditions in IBB Area

A.R.S. Qassim Director of Agriculture Research, Taiz Hari C

Dewan, Soil Scientist, FAO, Taiz

- TAIZ, September, 1975, -
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