report 4

water sector cooperation programme

Yemen Arab Republic
Kingdom of the Netherlands

review and recommendations Netherlands supported water sector activities in the Yemen Arab Republic

CONFIDENTIAL

WATER SECTOR COOPERATION PROGRAMME
YEMEN ARAB REPUBLIC - KINGDOM OF THE NETHERLANDS

Report 4

REVIEW AND RECOMMENDATIONS NETHERLANDS SUPPORTED WATER SECTOR ACTIVITIES IN THE YEMEN ARAB REPUBLIC

The Hague, January 1985

From September 8-25, 1984 a joint evaluation mission of the Governments of the Yemen Arab Republic and the Kingdom of the Netherlands evaluated the water sector activities of the Yemeni-Dutch development cooperation programme with the aim to advise on future water sector activities together with an assessment of priorities. To this end the following activities were evaluated:

Water Resources
a. Water Resources Assessment Yemen Arab Republic
b. Tihama Water Resources and Water Use Study
c. Al Bayda Water Resources Study

Domestic Water Supply and Sanitation
a. Support Rural Water Supply Department
b. Water and Sewerage Dhamar/Ibb
c. Water Supply and Sanitation Component "Rada Integrated Rural Development"

Irrigation
a. Wadi Rima Supervision
b. Irrigation component "Rada Integrated Rural Development"
c. Irrigation component "Tihama Agricultural Extension"

The main findings, conclusions and recommendations of the mission are presented in a four-volume report:

Report 1: Main report water sector cooperation programme Yemen Arab Republic - Kingdom of the Netherlands

Report 2: Evaluation report Water Resources Assessment Yemen Arab Republic

Report 3: Evaluation report Support Rural Water Supply Department

Report 4: Review and recommendations Netherlands supported water sector activities in the Yemen Arab Republic

The rapporteurs have the pleasure to submit the draft reports for comments to the counterparts within the joint mission through the Central Planning Organization of the Yemen Arab Republic. After their reaction c.q. clearance these reports will officially be submitted to the Governments of the Yemen Arab Republic and the Kingdom of the Netherlands and through them to all projects concerned.

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ABBREVIATIONS

CPO	Central Planning Organization
DGIS	Directorate General of International Cooperation
EEC	European Economic Commission
FAO	Food and Agricultural Organisation
LDA	Local Development Authority
MOA	Ministry of Agriculture and Fisheries
NWSA	National Water and Sewerage Authority
RIRDP	Rada Integrated Rural Development Project
RUDP	Rada Urban Development Project
TDA	Tihama Development Authority
UNDP	United Nations Development Programme
YAR	Yemen Arab Republic

INTRODUCTION

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The project evaluations of "Water Resources Assessment YAR" and "Support Rural Water Supply Department" are presented in Report 2 respectively Report 3 of the mission.

This report (Report 4) includes a review and recommendations of the other Netherlands supported water sector activities in the YAR. Although not explicitely mentioned in the Terms of Reference, the evaluation mission also briefly studied the current water supply and sanitation problems of Rada Town and included its review and recommendations in this report as well. On the basis of the Reports 2, 3 and 4 the mission submits its recommendations on activities and priorities for future Yemeni-Dutch development cooperation in the water sector of the YAR in the main report, Report 1.

The Terms of Reference of the mission are attached as annex 1. Annex 2 presents the list of organisations and people met by the various members of the mission.

1. TIHAMA WATER RESOURCES AND WATER USE STUDY (PHASE II)

1.1. Introduction

In 1980 the Governments of the Yemen Arab Republic and the Netherlands agreed to undertake a water resources study in the Tihama coastal plain (figure 1). The study has been divided into two phases. Phase I consisted of the collection and interpretation of available data. Based on the results of phase I DHV consulting engineers prepared a draft project document including Terms of Reference for phase II.

The draft project document for Phase II formed the basis for the discussions between the members of the mission and the representatives of the Tihama Development Authority (TDA) and DHV. Several field trips were made to get an impression of the Tihama coastal area.

1.2. Project description

Activity:	Tihama Water Resources and Water Use Studies, Phase II
Place:	Tihama region with headquarters in Hodeidah and branch offices in Wadi Zabid and Wadi Mawr areas
Executing authority:	Tihama Development Authority (TDA)/DHV Consulting Engineers
Duration:	Three years
Starting date:	1 November 1984
Sector:	022000 (water)
YAR Contribution:	YR 10,500,000.-
Neth. contribution:	Dfl 6,000,000.-

(World Bank contribution through the Netherlands: US $ 400,000)

Summary of activity:

- strengthening of TDA's Hydrological Section;
- assessment of available water resources in the Tihama area;
- assessment of the optimum distribution of water in areas where irrigation systems have been constructed.

Justification of the Project:

At present there is no reliable overall view of the water balance and the water availability in the Tihama coastal plain. For policy decisions concerning future development of agriculture and domestic and industrial water supplies a comprehensive insight into all water related aspects will be required.

Long term objectives:

- preparation for long-term and uninterrupted collection of hydrogeological data in the catchment area of the major wadi's debouching into the Tihama plains, in wadis where development is already taking place, in wadis where future development is feasible, in areas between the major wadis where surface water or ground water potential is being or will be developed;
- processing and storing of all data;
- an overall assessment of the water resources potential;
- provision of data on the actual use of surface water and ground water for crop cultivation;
- provision of guidelines for efficient water management on the basis of the data collected before and during the project;
- equitable distribution of water and agricultural income on the basis of socio-economic studies;
- training of counterpart staff.

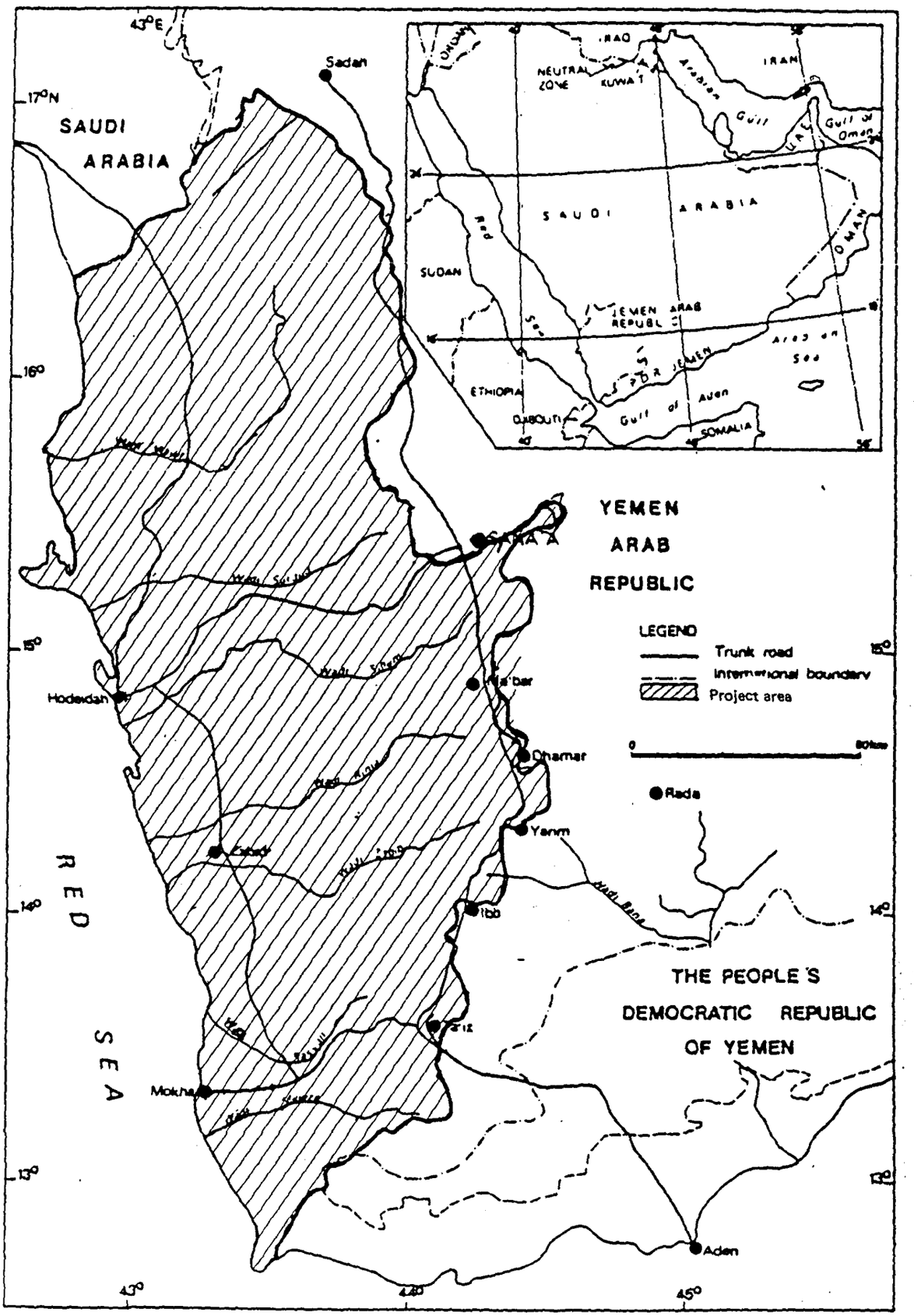
Immediate objectives:

- the provision of a data base and an assessment of potentials for efficient management of the existing water resources in the Tihama plains, to maximize economic output from a national point of view;
- provision of a reliable data base for furture development or extension of irrigated agriculture in the Tihama plains, with good quality water as the limiting factor;
- provision of a data base for effective and just distribution of surface water in all irrigated areas to individual water users;
- provision of a data base for effective management of the ground water potential in order to prevent mining of ground water and salinization of agricultural land;
- training of staff in the Hydrological Section in the collection and processing of data, so that data collection can be continued after the completion of the project;
- efficient monitoring of the surface water and ground water with computer models and prediction of the water potentials on the basis of these models;
- efficient use of the data base on the basis of guidelines in regard to the required administrative measures that have to be taken and to the institutional system to execute these measures;
- efficient management and monitoring of the new irrigation schemes;
- equitable distribution of the scarce water resources;
- equitable distribution of income from spate irrigated agriculture;
- training of staff in water management and operation and maintenance of the new irrigation systems.

Plan of activities:

a. Water resources study
   - review and updating of basic data on surface and groundwater hydrology (with the help of a microcomputer);
   - rehabilitation and extension of the existing networks for data collection on surface water hydrology (rain gauges, water level recorders);

Figure 1: The project area (DHV, 1984)



- extension of the existing networks for data collection on groundwater hydrology (monitoring of wells);
- processing of all data collected at the various stations and gauging sites;
- geophysical investigations through geo-electrical and - possible - seismic refraction surveys as well as through geophysical well logging;
- geohydrological investigations through well inventories;
- exploratory drilling programme;
- phased assessment of the water resources potential and water uses in the Tihama (by means of a mathematical groundwater model computer programme).

b. Monitoring of water allocation and irrigated crops Wadi Rima and Wadi Zabid
- monitor the functioning of all water structures;
- measure wadi and canal flows at significant locations;
- measure application rates of irrigation water on sample plots;
- establish a base map scale 1:5,000 of the whole project area;
- execute a complete crop inventory of the irrigated areas, once for each growing season;
- perform inspection and sample surveys to analyze the fuctioning of the canals and structures and to monitor crop growth;
- determine crop areas and cropping intensities in each growing season;
- establish reliable estimates of crop yields of the major crops, of the distribution of agricultural production and income (with special attention to sample plots on which irrigation rates are measured);
- estimate changes in the cropping pattern in relation to changes in the regularity of water supply;
- compare irrigation practices in Wadi Rima and Wadi Zabid in relation to the differences in cropping patterns and other significant factors.

c. Socio-economic studies:
- selection of research areas;
- pilot study to estimate the degree of variation in water distribution, farm operations and consequences at the macro-level;
- number of case studies to establish a socio-economic picture of the area (including changes in water distribution rights and practices and farming operations);
- study of macro-level aspects.

d. Training of counterpart staff:
- survey to assess training requirements within the organization;
- tailor-made training programmes for the individual staff members;
- preparation of training materials and manuals;
- on the job training;
- training abroad.

Inputs:

a. Inputs Yemen Arab Republic:
   - salaries staff hydrological section TDA
   - running costs
b. Inputs Netherlands:
   - a team of experts
   - equipement
c. Input World Bank:
   - equipement (e.g. ultra light aircraft)

Workplan

A tentative workplan for phase II has been prepared by DHV. (see page 10).

1.3. Conclusions and recommendations

General

The mission is of the opinion that phase II of the Tihama study will only be beneficial if the project aims at:
- training and institution building to strenghten TDA's capability to independently executing its hydrological research and water management tasks;
- a complete insight in the technical, economic and social aspects of water distribution and its effects in terms of increased yields.

Hydrology

The draft project document is proposing a lot of advanced hydrological equipment. Bearing in mind that training of counterpart staff is a primary goal, the instruments that will be installed or used should meet the following requirements:
- it should be possible to measure the hydrological conditions directly on the spot;
- as it is difficult to observe on the spot whether the proposed equipment is functioning, intensive testing has to be carried out also to ensure that TDA staff get used to its sophisticated equipment;
- data processing, data storage and data retrievel should be organized in such a way that the Yemeni counterparts will be able to operate the whole process without any problems;
- an organization and (small) workshop has to be set up in such a way that the Yemeni counterparts can easily repair and maintain the hydrological and meteorological equipment.

In the hydrological system of the Tihama coastal plain the ground water movement in the unsaturated zone plays a very important role. For an insight in this movement the important parameters have to be determined and the unsaturated ground water flow has to be modelled for different soils and irrigation conditions. It is advised to do this for the Wadi Rima area.

In the draft project document it is proposed to monitor both Wadi Rima and Wadi Zabid area. For the purpose of the Tihama study, this is not required. Monitoring the Wadi Rima area at relevant places from the dam down to the fields will provide

full insight in one wadi system. This insight will probably cover the major part of the conditions that can be exspected in the other wadis. It is understood that TDA attaches importance to including the Wadi Zabid in the monitoring activities in order to obtain also insight in the economic effects of the new works in this area.

Institutional aspects

It is recommended to pay more attention to institution building in Phase II of the study as TDA should be able to execute its service in the fields of hydrology, hydrogeology, operation and maintenance of irrigation works and monitoring and evaluation of socio-economic development in a smooth and independent manner by the end of phase II. The mission is of the opinion that a mere monitoring of the institution building process by the consultant, followed by some recommendations in annual reports, may not be sufficient to guarantee a proper strengthening of TDA.

Therefore, the mission recommends a more explicit advisory role for the consultant, in which the various experts of the project team act as advisers to the Yemeni and expatriate staff in the different sections of TDA and institution building takes place in an active way.

Socio-economic Studies

The Yemeni-Netherlands mission evaluating Phase I of the study (November December 1982) recommended the incorporation of socio-economic studies in phase II, especially in order to examine the impact of new irrigation techniques, improved agricultural systems and changing water regulations on the socio economic structures in the Tihama plain, expecially the traditional water distribution systems. This recommendation is underlined by the present mission.

In the draft project document it is indeed proposed to carry out a series of socio-economic studies. Still, in the opinion of the mission, not all aspects receive due attention. Consequent to the outcomes of the Water Resources Study, appropriate farming systems and related irrigation systems as well as on-farm irrigation techniques have to be developed. This requires a thorough study of possible cropping patterns, farm irrigation techniques and farm budgets. To this an agronomist and an (agro)economist should be involved in phase II of the study. Both specialities are not foreseen in the consultant's personnel. The rather short input of a qualified socio-economist (6.5 manmonths) and an assistant agriculturist is definitely not sufficient to cover the need of studying agronomic and (agro)economic problems and developments.

On the other hand, the study of the impact of the new irrigation and farming techniques and related changes in legislative rules (i.e. re-allocation of lands, share cropping agreements, distribution of water etc.) on traditional socio economic structures seems to be covered by a team of sociologists (an adviser sociologist, a senior sociologist, a rural sociologist, two assistant sociologists and a water rights adviser). Moreover, the experience of the proposed

socio economist in the field of rural sociology should not be neglected and although for short periods added to the "sociological manpower" of the consultant's personnel.

Given the obvious need for more agronomic and (agro)economic inputs in phase II, the mission recommends a re examiniation of the manpower requirements. It may be that one Arab speaking senior sociologist and one assistant sociologist, (seconded by a Yemeni assistant sociologist) - one of them preferable being a women - who will stay in the YAR during the total project period of phase II, will be sufficient. As a result budget-indifferent positions could be created for an agronomist and an (agro)economist in the consultant's team of experts.

Staffing

Based on the draft project document and the comments given above, the mission likes to recommend that the proposed project manager will be responsible for the hydrological part of the study.

Given the importance of training, institution building and socio-economic aspects of the study, it is strongly recommended to nominate a project manager with extensive management experience in developing countries and a intimate knowledge of socio-economic aspects of rural development projects.

1.4. References

Water Resorces Study Tihama Coastal Plain
Wadi Rima Irrigation Scheme
Evaluation Report
Utrecht, February 1983

Yemen Arab Republic
Yemen Oil and Mineral Corporation
Water Resources Study in the Tihama Coastal Plain
Consultancy Services Agreement
DHV Consulting Engineers
The Netherlands, 1977

Yemen Arab Republic
Ministry of Agriculture and Fisheries
Tihama Development Authority
Tihama Basin Water Resources Study
Project Document (draft)
DHV Consulting Engineers
Amersfoort, September 1984

Water Resources Study Tihama Coastal Plain Phase I
Volume I: Main Report, Annexes, Maps
September 1983
Volume II: Annexes,
September 1983
Volume III: Climate, rainfall, discharges
Monthly data, 1932-1982,
April 1983

Volume IV: Rainfall, discharges
daily data, 1969-1982.
July 1983
Volume V: Wells,
Wadi Mawr, Wadi Surdud, Wadi Siham
Monthly data, 1974-1982
Wadi Rima, Wadi Zabid, Wadi Rasyam
Monthly data, 1969-1982,
July 1983
DHV Consulting Engineers
Amersfoort, 1983

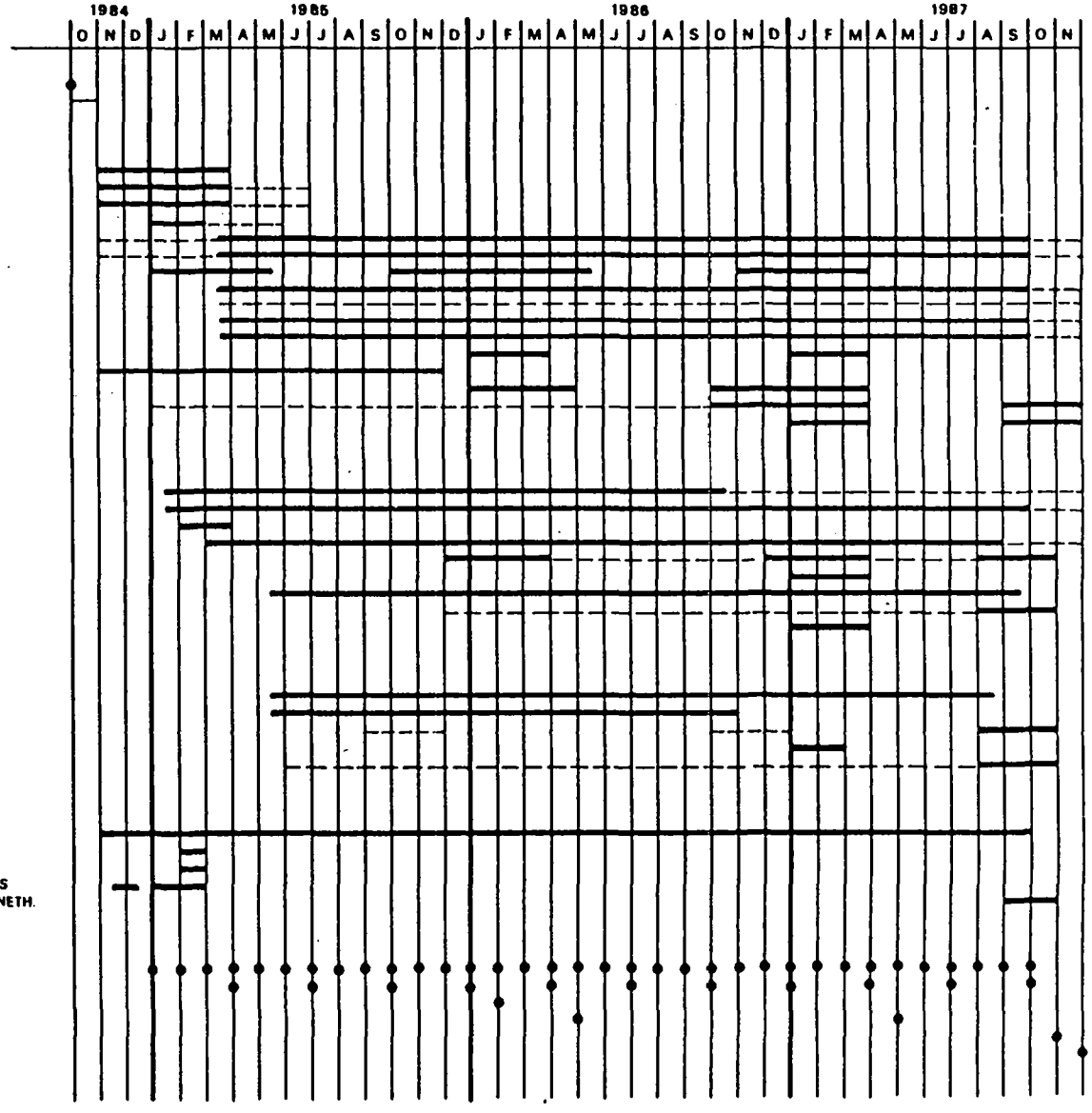


Figure 2: Tentative Workplan Phase II

Source: Draft Project Document, September 1984

2. AL BAYDA WATER RESOURCES STUDY
RADA INTEGRATED RURAL DEVELOPMENT PROJECT

2.1. Introduction

Since 1977 the Ministry of Agriculture and Fisheries (MOA) of the Yemen Arab Republic and the Directorate General of International Cooperation (DGIS) of the Netherlands Ministry of Foreign Affairs cooperate in the Rada Integrated Rural Development Project (RIRDP). This project comprises of a number of closely related activities, all contributing to an integrated development in the Rada district (see annex 4). Up till 1983 a Netherlands consultancy firm (ILACO) has been in charge of project management and staffing; over the years a number of Netherlands volunteers and associate experts (DGIS) has been assigned to RIRDP as well.

Since 1983 a Yemeni staff leads the project, whereas the Netherlands concultants, associate experts and volunteers remain to be involved in an advisory role, the Netherlands Technical Assistance Unit. At the same time MOA seeks to expand RIRDP's activities across the borders of the Rada district, in order to cover the entire Al Bayda Province. The underlying study is one of the first results of this expansion.

2.2. Project description

Activity:	Al Bayda Water Resources Study
Place:	Entire Al Bayda Province (see map on page 12)
Executing authority:	Rada Integrated Rural Development Project (RIRDP)/Ministry of Agriculture and Fisheries (MOA)
Duration:	Less than one year
Starting date:	Early 1983
Sector:	Integrated area development
Neth. contribution:	Dfl. 500,000.-

Summary of activity:

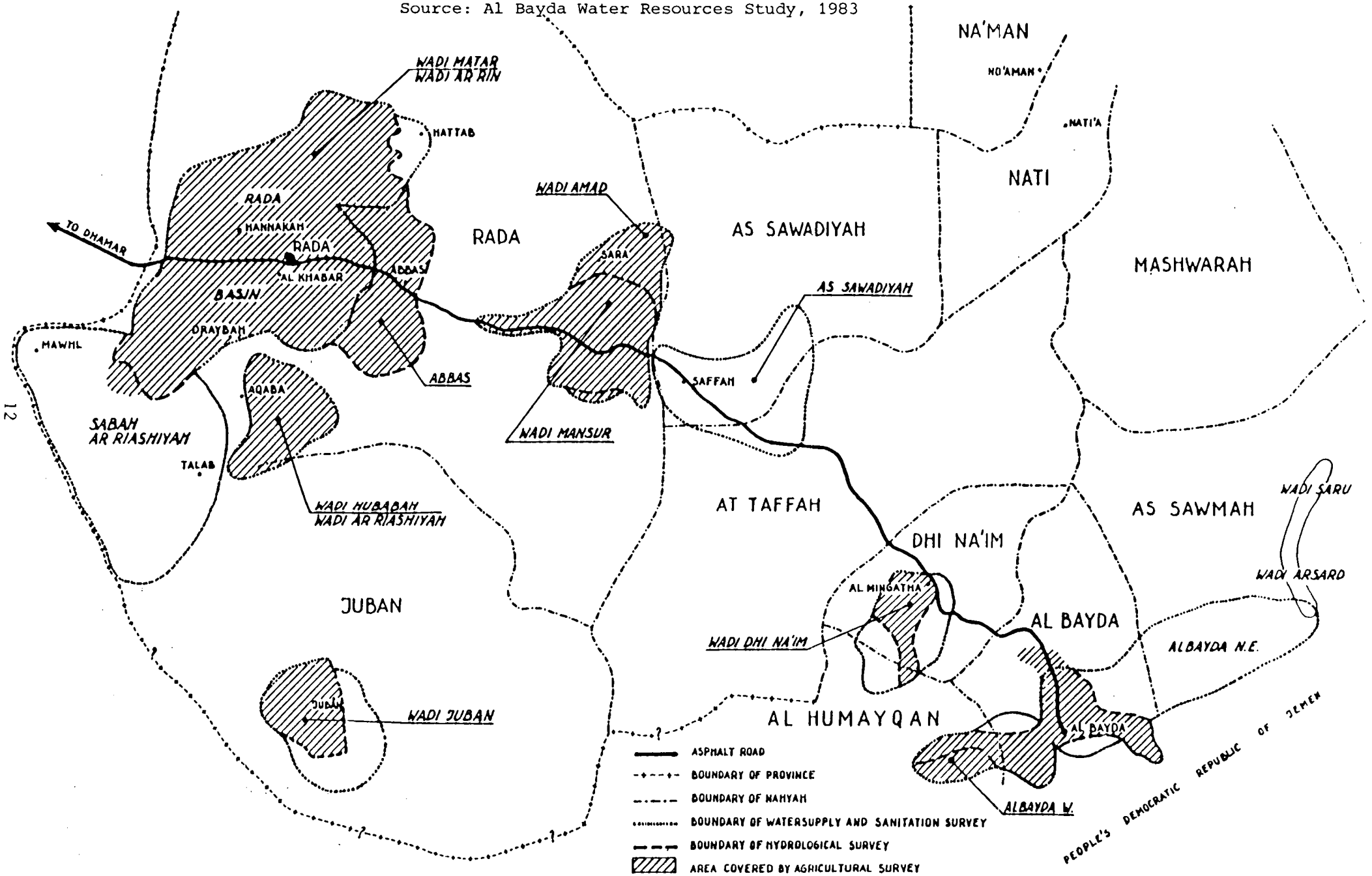
- study of the availability of land and water resources in the Al Bayda Province;
- study of the main uses of water: water supply for man and livestock, sanitation and agriculture;
- identification of priority areas for development based on these studies.

Justification of the study:

To identify priority areas for rural development at the one hand and to prevent over exploitation of the limited water resources at the other hand, a general framework is needed for water resources assessment, water management and water control. The present project is intended to be a first step in this process.

AREAS COVERED BY THE SURVEYS, AL BAYDA PROVINCE

Source: Al Bayda Water Resources Study, 1983



Long term objectives of RIRDP:

- improvement of the life of the rural population;
- assessment and monitoring of water resources with the ultimate aim to contribute to:
  - the preservation of this natural resource;
  - the development of safe and reliable water supplies and sanitation;
  - an increase of agriculture and livestock production.

Immediate objectives of the study:

The overall objectives of the study are:

- to provide information on available water resources to enable present and future water use to be assessed;
- to prepare a first framework for future development of water resources and water management.

More specifically, the objectives are the following:

- to identify geohydrological structures and their groundwater potentials related to present population distribution and land resources to be developed for irrigated agriculture;
- to select areas with ground water potentials to be studied in more detail;
- to formulate recommendations for:
  - areas where because of limited availability of resources only recommendations will be formulated on the contruction of new, or the improvement of existing domestic water supply systems;
  - areas where, in view of the available land and water resources, irrigated agriculture might be feasible;
  - additional investigations such as monitoring or geo-electrical and electromagnetic research for site selection of new deep and shallow wells.

Plan of activities:

a. First phase
   - a preliminary study of water resources aiming at the delineation of catchments;
   - a rough identification of land resources and potentials for irrigation in various parts of the province;
   - a review of the population and its distribution, and a preliminary study of the present water supply and sanitation situation in the province;
   - the assessment of the need for and type and detail of subsequent field studies, selection of areas for further study, preparation of questionnaires.

b. Second phase
   - detailed studies in the selected areas in the fields of hydrogeology, domestic water supply and sanitation and irrigated agriculture;
   - study of the costs and returns of irrigated agriculture;
   - analysis and presentation of findings;
   - formulation of recommendations;

Workplan:

- late 1982: preparation of research outline;
- March-April 1983: reconnaissance study;
- May 1983: preparation of an inception report;

- April-October 1983: detailed field surveys;
- October 1983 - February 1984: data analysis and report writing.

2.3. History of the study

From 1-13 March 1981 a Yemeni-Netherlans mission evaluated the RIRDP. From the mission report it was learned that at the time there appeared to be five major deficiencies from the water resources activity:

1. poor coverage of the data collection activity networks (shallow wells, rainfall, water quality)
2. lack of coordination between the different sub-activities (i.e. water level/rainfall, water level/water quality);
3. absence of deep aquifers monitoring;
4. absence of a comprehensive and integrated programme of data collection;
5. lack of continuity in the collected data and in the collecting activity.

One of the reasons for these deficiencies probably was that, although the need for a general study programme of water resources was already stated in 1977, no practical recommendations were formulated in terms of the number of networks, where to locate them and how to organize their operations. The water resources activity was not regarded as a full activity needing staff and equipment independent from the water supply activity.

The evaluation mission came up with a series of recommendations, of which the undertaking of a further study of the hydrogeological characteristics of the catchment areas and of the social and economic impacts of a project (coupled with a careful study on the origins of salinity in the soil and in the water) finally led to the underlying study (see also Report of Evaluation of RIRDP, 1-13 March 1981).

2.4. Implementation

The Al Bayda water resources study was finalized late 1983 and the results were presented in February 1984. The main conclusions can be summarized as follows:

1. There is considerable potenial for further development of ground water resources.
2. Expansion of irrigated agriculture is, in economic terms, justified.
3. There is a great need for the construction or improvement of water supply systems.
4. In some areas, water management to preserve ground water for domestic water supply is required.
5. All villages surveyed need improved sanitation facilities.

In view of these findings and conclusions, ILACO proposed a series of development activities, partly to be implemented within the framework of the 1984/85 Plan of Operations of RIRDP. These proposed activities, as far as the water resources study is concerned, refer to:

- a study into water resources in the Al Bayda Province, phase 2;
- expansion of the monitoring network (for the measurement of rainfall, water levels, well abstraction, well drilling, water quality);
- preparation of a ground water model for the Rada Basin;
- site selection of boreholes for domestic water supply for selected villages;
- preparation and implementation of a programme for reducing the bacteriological pollution of drinking water from shallow wells;
- implementation of a semi-detailed soil survey for the preparation of land suitability maps in areas with a high irrigation potential.

Within the framework of RIRDP the follow-up of the Al Bayda water resources study started in January 1984 with a well inventory. This activity will be finalized before the end of the year. For the full execution of the follow-up study it is proposed to use the same approach, methodology and questionnaires as applied before. Areas that will be covered are Sabah/Ar Riashiyah, Al Bayda North-West, Wadi Arsard/Wadi Saru, Sha-Aban, Wadi Hubabah/Wadi Ar Riashiyah and As Sawadiyah.

2.5. Major findings of the mission

Whereas the mission fully adheres to the last three main conclusions of the study, it is hesitant in underlining the first two findings without comment. The calculation of the potential for further groundwater development (some 21.3 cubic metres per year) is confined to eight investigated areas and may deviate up to 25 % (because of local and hydrogeological conditions, present abstractions and water use). Therefore, figures of potentials should be considered with care and expansion of monitoring network as well as finalizing the study in areas not yet covered is required.

As to the expansion of irrigated agriculture it was stated that some 1,500 ha could be added to the present irrigated area. It has to be borne in mind however, that the economic justification of such an expansion is based on current crop yields and prices, which may be affected by a series of external and internal factors, such as changes in the prices for various cereals (see also Main Report) in the out migration patterns, in diet patterns etc.

The Al Bayda Water Resources Study does hardly refer to surface water development: traditional and new techniques for water harvesting are not being discussed on the assumption that all surface water is already being used. Still, in the light of a nation-wide debate on the relation between surface water and ground water development, the ongoing project should also pay attention to this issue. Although the scope for storage dams in the Al Bayda Province seems to be limited (low annual rainfall, high degree of infiltration, high sediment load) the mission is of the opinion that a consultant on surface water management (with ample experience in arid zones) should investigate the possibility of improving existing surface water management

practices in the Yemen Arab Republic including the Al Bayda Province (see also Main Report).

Monitoring of the water resources in the Al Bayda Province appears to be of great importance. This task is carried out by the geohydrological sub-section of RIRDP and has to be further improved and extended, according to a monitoring scheme that should not be too sophisticated and will include a training programme for counterpart staff.
At present eleven rain gauges are operational in and around Rada Basin. For the moment it is not possible to extend this network to other areas due to lack of time and manpower (low salaries compared to salaries for other activities seems to be a major constraint in this respect). Electronic rainfall recorders could be an answer to this problem.
As to the monitoring of water levels, approximately twenty places (deep boreholes, shallow wells and especially drilled monitoring holes) are used as measure points. Once a month, these wells are measured manually. Since the geology of the Rada Basin is very complex, monitoring should be extended in this area. Also the other areas of the Al Bayda Province should be covered.

Three alternatives have been discussed:

1. Drilling of nine monitoring holes in the Rada Plain. This seemed to be a good idea, but was met with strong resistance from the farmers, who thought that these boreholes would be competitive to their own holes. Moreover, extension of this method into the other parts of the Al Bayda Province is not feasible (because of time constraints), whereas this system is also only applicable to shallow aquifers.
2. Manual measuring of water levels in existing shallow wells and deep boreholes, e.g. by Yemeni observers or Netherlands BSc students, to whom a car should be made available. In this alternative, results in the Rada Basin could be obtained twice a month; a total covering of other areas in the Al Bayda Province would still be very difficult because of time constraints.
3. Installation of electronic water level recorders in shallow wells all over the Al Bayda Province (30 to 50 measurement points). In this way, the whole province could be covered fairly easy. A separate network in the Rada Basin could be set up for deep boreholes, to be controlled manually by the hydrogeologist of RIRDP. In this system more data can be obtained, whereas the water level recorders will provide detailed insight in the abstraction of the selected wells.

A detailed cost estimation could be prepared for the three alternatives.

In view of the variability in the geohydrological structure of the study area as well as the expected ground water flows due to excessive overpumping, the application of ground water models is being considered. Because of the danger of saline water intrusion in the Rada Basin, this sub-region should be the first to be endowed with such a model.

As to well siting techniques and site selections it appears that this activity of RIRDP runs very smoothly. The local

population is very interested in the services the section can offer. A well logger, which can be used on the site selection equipment, is very useful for checking already existing wells: people often ask for such an advice. Furthermore, it has been discussed to use computer equipment (together with a good plotter, printer, monitor and - most important of all - good software), aerial photographic interpretation (mainly to trace faults and other geological features), electro-magnetic and geo-electric measurements.

2.6. Conclusion

The conslusion of the mission is that the first phase of the Al Bayda Water Resources Study can be considered as a good starting point for a next phase, in which the water resources studies have to be intensified and a monitoring network put into operation.

2.7. Recommendations

As such the mission:

1. supports the use of computer equipment, electro-magnetic and geo-electric measurements for well siting;
2. does not recommend the application of groundwater models as yet. Results of monitoring will enable first indications regarding riskful developments (salinity increase, excessive lowering of ground water table). At a later stage, it may be necessary to carry out ground water model studies; at the moment these models are considered inopportunle, partly because of the costs involved, partly as for some time to come, the data will be insufficient;
3. recommends some trials with electronic rainfall recorders before applying them on a large scale. Contacts with the Department of Hydrology and their TNO advisers could prove to be useful with respect to this matter;
4. recommends a combination of monitoring alternatives. A number of ten electronic water level recorders, to be installed at vital points, together with a great number of manual measurements, should offer a good start for monitoring activities. This combination of monitoring alternatives will require some backstopping from a senior expert;
5. prefers Yemeni observers to Netherlands BSc graduates for the measuring of water levels, especially in view of the training aspect of this RIRDP activity;
6. recommends an investigation of possible improvements of existing surface water management practices by a short term consultant with ample experience in arid zones (see also Main Report).

2.8. References

Rada Integrated Rural Development Project: Project Plan 1984-1985
YAR-Neth., June 1983, (code 4.08.038)
Ilaco, Arnhem, The Netherlands

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Study into water resources in Al Bayda Province
Volume I - Main Report
Volume II - Annexes
Volume III - Maps
Volume IV - Appendices

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February 1984 (Code 4.08.038)
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Ilaco, Arnhem, The Netherlands

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March 1-13, 1981
May 6, 1981

3. IBB AND DHAMAR WATER SUPPLY AND SEWERAGE PROJECT

3.1. Introduction

In 1976 The Government of the Yemen Arab Republic and the International Development Association (IDA) agreed to implement water supply and sewerage projects for the towns Ibb and Dhamar. The Government of the Netherlands is one of the co-financiers.
The works, that were planned to start in 1979 were serious delayed due to various reasons. This year it was decided to review the project design before retendering the construction works.

3.2. Project description

Activity:	Ibb and Dhamar Water Supply and Sewerage Project	
Place:	Ibb and Dhamar	
Executing authority:	National Water and Sewerage Authority (NWSA)	
Duration:	4 years	
Starting date:	1979	
Sector:	Environmental Sanitation	
YAR contribution:		
Dhamar:	Dfl. 96,400,000.-	(YR 168,700,000.-)
Ibb:	Dfl. 33,700,000.-	(YR 59,000,000.-)
	Dfl. 130,100,000.-	(YR 227,700,000.-)
Donor contribution:		
Dhamar:		
Arab Fund:	Dfl. 61,700,000.-	(YR 108,000,000.-)
Netherlands:	Dfl. 26,000,000.-	(YR 45,500,000.-)
IDA:	Dfl. 23,000,000.-	(YR 41,700,000.-)
Ibb:		
KfW*:	Dfl. 80,000,000.-	(YR 140,000,000.-)
IDA:	Dfl. 53,000,000.-	(YR 92,000,000.-)
	Dfl. 243,700,000.-	(YR 427,200,000.-)

Summary of activity:

Provision of a safe and reliable supply of water as well as piped sewerage to the cities of Ibb and Dhamar.

Justification of the study:

The provision of water supply and sewerage facilities to practically the entire population of the cities Ibb and Dhamar will:

* KfW = Kreditanstalt für Wiederaufbau

- eliminate dependance on unsafe and insufficient supplies of water;
- eliminate unsanitary conditions which already exist and which would be further aggravated if additional quantities of water were introduced into the cities without making provision for their adequate disposal;
- lessen the danger of aquifer contamination;
- reduce the risk of outbreaks of water and sanitation related diseases.

Long term objectives:

- a well functioning water supply and sewerage system in the cities of Ibb and Dhamar and through this an improved public health situation;
- strengthening of NWSA at central level and at branch level (Ibb and Dhamar).

Immediate objectives

To continue the development of NWSA's institutional and operational capabilities by:
- assisting NWSA in its programme of improving water supply and sewer service in Ibb and Dhamar;
- provinding on-line operational, technical and financial assistance for several branches of NWSA;
- upgrading the technical and professional skills of NWSA staff by assisting in the implementation of a training programme;
- assisting NWSA during project supervision with particular emphasis of NWSA's own staff assuming additional responsibility for project supervision.

Plan of activities:

The project works include:

a. Ibb Water Supply

- drilling and equipment of eight wells (90 lps total capacity;
- a collection tank (60 m^3) and pumping facilities (3 pumps, 127.5 lps total capacity);
- 2 electric power stations (one with 2 x 300 KW and the other 2 x 25 KW generators);
- a 400 mm transmission line (2.1 km length);
- headworks (2 reservoirs, 1,500 m^3 each, pumps and pressure tanks);
- distribution network (12.7 km of 400 mm, and 12.0 km varying in diameter from 80-250 mm);
- 3,000 house connections;
- consulting engineering services for final design and supervision (approximately 74 man months).

b. Ibb Sewerage:

- collection system (60.5 km varying from 200-600 mm diameter and 1,200 manholes);
- a treatment plant (aerated lagoons and stabilization ponds with design flow rate of about 90 lps);
- land for the treatment plant;

- a power plant;
- 4,000 house connections;
- consulting engineering services for final design and supervision (approximately 100 man months).

c. Dhamar Water Supply:

- drilling and equipment of nine wells (102.4 lps total capacity);
- a collection tank (150 m^3) and pumping facilities (5 pumps, 237.5 lps total capacity);
- two electric power stations, one with 2 x 300 KW and the other 2x 20 KW generators;
- a 400 mm transmission line (16.5 km length);
- headworks (2 reservoirs, 3,400 m^3 each and pumping station, 216 lps);
- distribution network (11.5 km of 400 mm and 11.2 km varying in diameter from 80-200 mm);
- 3,000 house connections
- consulting engineering services for final design and supervision (approximately 96 man months).

d. Dhamar Sewerage:

- Collection system (64.3 km varying from 200-600 mm diameter and 1,300 manholes);
- a treatment plant (aerated lagoons and stabilization ponds with design flow rate of about 90 lps);
- land for the treatment plant;
- a power plant;
- 4,000 house connections;
- consulting engineering services for final design and supervision (approximately 100 man months)

e. Assistance in the Institutional Development of NWSA:

- construction of two office buildings (Ibb and Dhamar);
- 430 man months of on-line assistance providing operational, technical and financial staff for several branches of NWSA;
- training of staff from NWSA.

Inputs

The original total estimated cost of the project amounted to US $ 91.94 million or YR 413.72 million.
The project was to be financed as follows:

		Millions	
	YR's	US $	%
IDA credit	54	12	13
Co-financing	198	44	48
Total borrowing	252	56	61
Government equity	162	36	39
	414	92	100

In 1983 the co-financiers increased their respective contributions to bridge a financial gap of about YR 268 million (YR 142 million for Ibb and YR 126 million for Dhamar).

Workplan:

The original project implementation was scheduled from 1979 to 1984. Due to serious delays a new project implementation timetable was prepared mid 1983.

3.3. History and progress of the project

Late 1976, the Government of YAR and the IDA agreed to implement water supply and sewerage projects for the towns of Dhamar and Ibb. Feasibility studies were conducted by Italconsults (1977 - 1978) and financed by the World Bank. In August 1979, NWSA signed an agreement with Dorsh Consult to prepare the final designs and perform complementary hydrological investigations. In 1981, the necessary wells (8 in Dhamar and 7 in Ibb) were drilled by Preussag/Saudi Arabia, under supervision of Dorsch Consultant.

Tendering for the construction of the water supply and sewerage facilities started in October 1980. Mid 1983 the Government of the YAR decided to retender, because:

- existing bids dated back for more than one and a half years;
- negotiations with the lowest bidder resulted in substantial changes in the condtions of the contract and the nature of works;
- greater response and increased competition due to reduced economic activity;
- limitation of local funds.

To identify areas of possible savings it was agreed by the parties involved to carry out a design review before retendering. Furthermore it was agreed to consider whether bidding according to performance specifications for the sewage treatment plant could result in cost and time savings.

Donor contributions

During the first co-financiers meeting of November 1979 it was decided that the World Bank would contribute Dfl. 31,4 million, BRD Dfl. 50,0 million and the Arab Fund Dfl. 31,4 million. As agreed during the bilateral consultations of May 1980, the Government of the Netherlands committed Dfl. 12,0 million to the project.

During the second co-financiers meeting of January 1983, the Government of the YAR requested the co-financiers to increase their respective contributions to bridge the financial gap, caused by delays and a too optimistic original cost estimate. The Netherlands committed another Dfl. 14,0 million.

3.4. Conclusions and recommendations

1. The design review of the original plans brought an important reduction in costs.

The original tender of October 1980 was: YR 563,530,000.-
The actual estimates re: YR 330,380,000.-
However, estimates are not confirmed by bits. Reality could be less favourable.

2. Still insecurity exists concerning the financial plan. The financial situation should be clear before the next step (re-design) should be taken.

3. Experience of contractors shows that contractor risks in YAR are high resulting in lack of interest for bidding or excessive bids. Constraints should be indentified and measures taken to reduce to a maximum price increases due to inefficient adminstration by the government. CPO sent in 1982 a questionaire to all embassies concerning this matter.

4. It seems advisable to have the existing water supply systems in Dhamar and Ibb be tested to study possibilities of integration of these systems in the new plans.

5. Stock of 80,000 meter of PVC in Taiz should be tested before they are considered to be used in the new schemes.

6. If the supervising consultant will be changed it must be made clear who is responsible for the design.

3.5. References

Ibb and Dhamar Water Supply and Sewerage Project
Minutes of Co-Financiers Meeting held on January 26 and 27, 1983,
Kredikanstalt für Wiederaufbau, Frankfurt am Main.

Sana'a second water supply and sewerage project (credit 670-YAR) Water supply and sewerage project for Ibb and Dhamar (credit 950-YAR) List of attachements,
mission report August 30 to September 4, 1983 World Bank

Yemen Arab Republic Staff Appraisal Report on the Water Supply and Sewerage Project for Ibb and Dhamar
World Bank, Report No. 2392a-Yar, for official use only, August 14, 1979, (Water Supply and Sewerage Division Europe, Middle East and North Africa Regional Office)

Dhamar and Ibb, Water and sewerage projects design review, Dorsch Consult, 1984.

4. WATER SUPPLY AND SANITATION
RADA INTEGRATED RURAL DEVELOPMENT PROJECT

4.1. INTRODUCTION

Since 1977 the Ministry of Agriculture and Fisheries (MOA) of the Yemen Arab Republic and the Directorate General of International Cooperation (DGIS) of the Netherlands Ministry of Foreign Affairs cooperate in the Rada Integrated Rural Development Project (RIRDP). This project comprises of a number of closely related activities, all contributing to an integrated development in the Rada district (see annex 4). Up till 1983 a Netherlands consultancy firm (ILACO) has been in charge of project management and staffing; over the years a number of Netherlands volunteers and associate experts (DGIS) has been assigned to RIRDP as well.

Since 1983 a Yemeni staff leads the project, whereas the Netherlands consultants, associate experts and volunteers remain to be involved in an advisory role, the Netherlands Technical Assistance Unit. At the same time MOA seeks to expand RIRDP's activities across the borders of the Rada district, in order to cover the entire Al Bayda Province.

Water supply construction activities started during the second half of 1978. Up till December 1983 a total number of 26 water supply schemes were completed. Sanitation projects are a rather new phenomenon within the project and, at present, still in the stage of preparation and implementation of pilot projects.

4.2. Project description

Activity:	Domestic water supply and sanitation
Place:	Entire Al Bayda Province
Executing authority:	RIRDP/Ministry of Agriculture and Fisheries (MOA)
Duration:	From 1977 onwards
Sector:	Integrated area development
Contribution YAR:	For present phase 1984-1985: YR 5,440,900.--
Contribution Netherlands: (including contribution EEC)	For present phase 1984-1985: Dfl. 6.044,00.--

Summary of activity:
- development and improvement of water supply systems;
- sanitation activities as follow-up to the implementation of the water supply schemes;
- pilot projects to improve village sanitation.

Justification of the project:
- An increase and/or improvement of the rural water supply and sanitation facilities will have a positive influence on the

general health situation by reducing water and sanitation related diseases;
- The new water supply facilities will release women from the heavy burden of water collection over long distances.

Long term objectives:
- provision of sufficient quantities of safe water to the rural population;
- improved sanitation facilities in the rural areas;
- reduction of water related diseases and improvement of community health.

Plan of activities for 1984-1985:
- site selection of bore holes;
- implementation of 18 water supply schemes;
- evaluation and monitoring of completed schemes;
- advice and assistance on sanitary aspects as follow-up of the implementation of water supply schemes.

4.3. Water supply

4.3.1. History of the project

As drinking water is a primary human need, its provision in sufficient quantities and of good quality is a major objective of the RIRDP programme. Between November 1978 and December 1983 26 villages in the project area have been provided with a water supply system by the engineering section of RIRDP. (It is estimated that another eleven villages in the region do have piped water supplies either auto-financed or installed with aid from the Rural Water Supply Department and the Local Development Association).

From 1-13 March 1981 a Yemeni-Netherlands mission evaluated the RIRDP and observed the following achievements:
- implementation of 18 schemes (not all completed);
- set up of a system of cooperation with the villages where a large part of the implementation of the scheme was taken over by the villagers;
- use of the local market (Rada's) for procurement and local contractors for implementation.

At the same time the mission came to the conclusion that:
- Livestock water consumption is not included in the daily total requirement;
- No water quality check is carried out on the water resource, before or after the installation; no special protection is given to the area surrounding the water source; covers for the shallow wells are not included in the design;
- No public taps were included for people who cannot afford a house connection;
- no follow-up was given after implementation of the scheme in terms of:
  + training of village caretakers for operation and maintenance;
  + creation of repair unit for pumps;
  + integrated rural development;
- no real integration with other project activities (women's section, sociology section, agriculture);

- unclear selection criteria. Poverty of the villagers and lack of sufficient safe water do not seem to score high.

4.3.2. Implementation and major findings

At present the procedure for the construction of a water supply system is as follows. Villagers request the aid of RIRDP - sometimes through the local LDA - for the construction of a system. After approval of the request by RIRDP and a 30% contribution to the construction costs by the village and/or LDA (at present total costs of a water supply system amount to YR 500,000.-), a system will be constructed. Currently the rythm of construction is about ten systems per year. In 1984 six schemes have been completed so far; another two or three will be finalized before the end of the year.

The criteria for approving of a request are not well defined. RIRDP staff together with the LDA have a brief look into the general socio-economic conditions of the village concerned (village cohesion, willingness and ability to pay the contribution) whereas the engineering section considers the technical aspects of the water supply construction. Nearly all requests are approved of: disapproval relates especially to financial problems. Also after the works have been started, construction may be delayed or stopped because villagers fail to pay their contribution.

The 30% contribution of the villagers is shared between the village concerned and the LDA. Since the LDA often runs into financial problems (according to its chairman, mainly because of limited contributions from the area, related to poor harvests), its share tends to be rather small. In 1983 the LDA of Rada only spent YR 100,000. on water supply facilities. As a result, integration of the rural water supply component of RIRDP into the local institutional framework has as yet to be considered rather weak. LDA is involved in the priority-listing of the requests, but it is not clear whether priorities are set according to formulated preconditions.

At the moment 53 villages have requested the construction of a water supply system (about 5% of all villages in the project area). No clear information is available about the question which type of villages do not request a water supply system as yet. The LDA supposed that these villages are either satisfied with their current water provision, or have weak representatives. In some villages, the women seem to be very eager to get a piped water supply, whereas the men are not (yet). As it is generally not possible for women to present a formal request to RIRDP it may be very difficult to make their need for an improved water supply known to the project.

In view of the available manpower and a great interest for new water supply schemes, it appears to be possible to accelerate the rythm of construction up to an annual average of fifteen schemes. In this respect it could be possible and it will also be advisable, to increase the contribution of the villages. According to RIRDP staff and LDA, a substantial increase (in the range of 10 to 20%) - necessary because of a budget

indifferent increase of the annual total number of new systems - will probably be acceptable to the villagers.

An increase of the number of new water supply systems up to fifteen per year can be handled by RIRDP and local contractors. Still, such an increase will require a accelaration of the necessary bureaucratic formalities.

As to the existing water supply systems, the mission noted that nearly all main and secondary distibution pipes are exposed and that many breakages or leakages occur where pipes that are not or only parly buried cross roads or tracks. No thorough study of the durability of the systems has been made as yet, although of the systems are planned to last for at least a 20 years period.

House connections are constructed at an average of YR 200.- to YR 300.- (sometimes up to YR 1,000.-) per connection. These costs are borne by the users. It appears that in case a household cannot afford a private connection, the other villagers take care of these additional costs. More information is needed, however, to know for certain whether the whole village population is able to benefit from the new water supply.

Operation and maintenance of the water supply systems is the formal responsibility of the LDA and the village itself. It is left to the village to appoint an operator, to organize the maintenance of the system and to collect the water charges. Water charges may vary from place to place, according to the needs and preferences of the villages, and can even be provided in kind. In general, it seems that water operators have some knowledge and experience to operate pumps, but that skills to repair leakages in the piped system are generally lacking. A training programme for these key persons seems to be imperative; such a programme should be adapted to the specific training needs and include also a discussion on related health aspects.

No direct working relationship between the engineering section and the women section of RIRDP could be established so far. With the present limited staff, the latter section is more occupied with economic activities and literacy programmes, leaving not much time for regular involvement in water, sanitation and related health programmes. The appointment of a new staff member (a qualified nurse) in the women section, to be expected in the fall of 1984, will hopefully strengthen the cooperation between the two sections.

4.4. Sanitation

4.4.1. History of the pilot projects

Health hazards, expecially due to poor disposal of waste water, solid waste and human and animal excreta, are widespread in the Al Bayda Province. These problems are being aggravated, not only because of population increases, but also because of new trends like the use of plastics, tins etc. and the introduction

of water and toilet facilities. Hence, sanitation programmes have become more important to be integrated in the water supply activities of RIRDP.

4.4.2. Implementation and major findings

In general sanitation improvements are given low priority by the rural population, the only exeption being an interest in impoved washing/purification facilities at the mosques. Hardly any request has been made for assistance to improve the sanitation situation in the village and the LDA of Rada has up till now not yet developed any approach to the problems.

In 1983 the RIRDP made an inquiry into the sanitation situation in the Al Bayda Province as a part of the "Al Bayda Water Resources Study" (see page 15). As a result three types of sanitation pilot projects have been suggested:

- modified baladiya toilets with safe disposal of liquid and solid excreta together with suitable disposal facilities for domestic waste water;
- treatment facilities for sewage and waste water for a large village, together with agricultural re-use of effluent;
- wahsing and excreata disposal facilities near a mosque.

These pilot projects are to take place in villages already covered by the RIRDP programme to emphasize and make full use of the integrated nature of the project. Up till now only a village for a pilot project on modified baladiya toilets has been selected, viz. Al Khilaw, where activities will have to start on 26 September 1984. In this village houses will be provided with improved or new facilities (modified baladiyas). The liquid excreta together with domestic waste water will be piped into evelated garden plots (vegetable plots) near the houses. The gardens will be tended to by the households, probably the women.
A survey to obtain more background information on the village and its anticipated participation as well as extension needs will be conducted soon.

The mission has studied this first proposal and visited Al Khilaw. As to the proposed activities the mission would like to express its doubts and reservations about certain points, viz:

1. a pilot project should not concentrate on only one type of disposal system/toilet, but different possibilities should be taken into account and tested;
2. the incorporation of elevated gardens should be studied very closely, preferably by a trained horticulturist of the agricultural section; the effects of leading waste water into these plots by underground pipes (about 50 cm under the soil surface) as well as the location of the plots near the houses need a closer examination (possible clogging of drains, salinization etc.);
3. participation of the local population is indispensable for a succesful programme; a brief survey of the present sanitary conditions and possibilities is not sufficient, if the survey itself, the results and possible alternatives are not discussed with the men and the women and the children of the village. Discussions should also include health aspects

(e.g. safe disposal of children's faeces), gardening (and nutrician) and financial aspects.
4. it is not clear what the financial contribution of the population will (should) be and in what way the population will participate in maintenance and operational costs;
5. it is not clear whether Al Khilaw is more or less representative for the 1,300 plus villages in the Al Bayda Province.

As to the proposed pilot projects on the water/sanitation facilities near mosques and on safe waste water disposal, the mission did not obtain full information as yet. It is of the opinion, however, that improvement of sanitation around the mosques may be of great importance for public health, provided needs and practices of women and little children are also taken into account and suitable, safe alternatives are being included.

This mission questions the need for a full-time technical associate expert for the proposed pilot schemes, unless these schemes are carefully planned and implemented in close cooperation with the local population. If time permits the associate expert could give an input in the water supply activities.

4.5. Recommendations

4.5.1. Water Supply

As to further developments in the water supply sector of RIRDP, the mission recommends:

1. to keep a record of the villages that requested the construction of a water supply system, indicating scarcity and quality of water; women's workload and other socio-economic characteristics; also to investigate the reasons for not applying of other villages;

2. to formulate and use clear priority criteria (see above) in order to serve the most needed villages first;

3. to increase the contribution of the villages in the construction costs up to 50%, but gradually. An increase to 40% per 1 January 1985 seems to be feasible, another increase up to 50% could be considered by 1 January 1986;

4. to strengthen the ties between RIRDP and local contractors with two or three construction assignments per contractor per year and to look regularly for new contractors;

5. to strengthen the ties between RIRDP and the Rada Vocational Training Centre. The latter could be invited to set up training courses for:
   - plumbers, to assist in the construction works, expecially piping, and to repair leakages;
   - water operators, to upgrade (where necessary) the operation and maintenance of of the water supply systems of the villages.

6. a review of the present lay-out and planning of the water distibution systems. Possibilities of burying the pipes adequately at vital places should be studied.

7. a short evaluation of the completed schemes as indicated in the workplan 1984-1985 and including the following aspects:
   - functioning and use of the water supply systems;
   - number of house connections/is the whole village population able to benefit from the system;
   - need for bathing and washing facilities; cattle troughs;
   - productive use of the water;
   - (constraints to) the upkeep of the system/durabiltity of the system;
   - training needs for operation and maintenance;
   - health benefits and (new) health risks.

   The evaluation should be directed to proper adaptations of the project activities, where necessary.

8. a close cooperation between the engineering section, the women section and the local MCH (Mother and Child Health Care), in order to set up effective programmes for water supply, sanitation and related (health) aspects. This cooperation should also lead to a more reliable answer to the question why many villages in the RIRDP area have not yet put a request for the construction of a water supply system (see also recommendation 1).

9. to develope procedures to assist villages that are in need of an improved water supply but unable to formulate a request or to meet requirements for approval to overcome these problems.

10. a constant monitoring and review of the water supply systems in the Al Bayda Province in order to develop an approach that could be applied elsewhere in the Yemen Arab Republic.

4.5.2. Sanitation

As to the pilot projects of RIRDP on sanitation, the mission stresses:

1. the need to test more alternatives of liquid and solid excreta disposal;

2. the importance to look for low-cost, simple improvements rather than for expensive ones;

3. the need to carefully select suitable households and/or public buildings (e.g. schools) for pilot sanitation projects for demonstration and testing of alternatives;

4. a proper study on the impact of piping (treated) waste water and liquid excreta into garden plots, fields and orchards by the agricultural section;

5. the need for an extensive participation programme in the sanitation pilot villages. The women section of RIRDP an MCH is to be involved in the development and implementation of such a programme;

6. the need for a close monitoring and backstopping of the pilot sanitation projects. As such, it strongly recommends the assistance of a sanitation expert for a regularly consultancy, approximately 1 month per year.

4.6. References

Preliminary design of pilot sanitation projects in Al Bayda Province
Yemen Arab Republic Technical note no. 16,
Discussion paper March 1984

Project Memorandum
Rada Integrated Rural Development Project, 1984

Rada' Integrated Rural Development Project
Domestic practices in the Rada' district
Technical note no. 11, February 1983
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Household water use in Al Bayda Province
Technical note no. 10, February 1983
Ilaco, Arnhem, The Netherlands

Rada Integrated Rural Development Project: Project Plant 1984-1985
YAR-Neth., June 1983,
Ilaco, Arnhem, The Netherlands

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Study into water resources in Al Bayda Province
Volume I - Main report
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Yemen Arab Republic - Kingdom of the Netherlands
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Ilaco, Arnhem, Netherlands

Rada' Integrated Rural Development Project
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Technical note no. 4, November 1979,
Ilaco, Arnhem, The Netherlands

Rada Integrated Rural Development Project Progress Reports
January-March 1984 and April-June 1984,
1984, Ilaco, Arnhem, The Netherlands.

Report of evaluation of Rada Integrated Rural Development project
March 1-13, 1981,
May 6, 1981.

5. RADA URBAN DEVELOPMENT PROJECT

5.1. Introduction

The Rada Urban Development Project (RUDP) was a joint effort of the Government of the Yemen Arab Republic and the Government of the Netherlands. The aim of the project was defined as assisting the Yemeni Government in the planning of the development of Rada Town and its immediate surroundings. The studies constituting the project were carried out between November 1981 and June 1982.
The results of the studies were presented in a final report (volume 1-11) in April 1983.

Although this project was note explicitely mentioned in the Terms of Reference, the mission briefly studied the current water supply and sanitation problems of Rada town and discussed the findings and recommendations of the RUDP study with representatives of the Rada Town Council.

5.2. Water supply and sanitation in Rada Town

As to water supply it was noted that the present storage capacity is insufficient. The reservoir at the castle (800 m3) is out of order because of technical reasons; the other reservoir at Masala (200 m3) can not provide for more than 50% of the town's consumption. So in the old city of Rada, water is pumped straight from the wells (the town is served by five wells) into the distribution system. Every house in Rada is connected; every user pays YR 35.- per month for the water. No meters are being used. Water quality is rather poor: it has a salty taste (evidence of the brackish groundwater backflow into Rada basin?) and is often polluted because of breakages in the distribution system (90% of the piped system is exposed). To avoid the salty, polluted water some inhabitants collect their drinking water at rather far away distances. The water supply system is often out of order and water sellers, who collect water at wells at considerable distances, make good business by selling water at YR 25.-- per m^3.

The water supply system is run by the Town Council itself. The Council regularly complains about the poor situation of the Rada water supply system to the responsible Ministries.

As to sanitation the Town Council runs a small sewage disposal unit, in charge of the disposal of human excreta and waste water from private sewage pits. Every house has a sewage pit of its own, connected to the various types of traditional and modern toilets. Pits are emptied at cost of YR 150.- to YR 200.-. As many inhabitants are quite indifferent to proper water and excreta disposal, pits are often emptied too late and not well kept, causing overflowing and the formation of sewage pools in various parts of the town. The Town Council sometimes has to force inhabitants to have the sewage pits emptied. Moreover, the Town Council prefers to construct a central sewage system, but requests to the responsible Ministry have not been valued as yet.

The Town Council is very concerned about the sanitation problems around the slaughterhouse, where wastes (mainly blood and water) are allowed to flow freely into the nearby wadi.

Solid waste disposal is a major problem as well. Up till now solid waste is not being collected. Private persons do sometimes burn their solid waste which is forbidden because of fire hazards and only partly solve the problems as much "modern" waste cannot be incinerated.

In view of the problems mentioned above and considering that Rada Town, a rural centre of some 18,000 people (including suburbs and annexated villages), cannot be left out of an integrated rural development plan, the mission recommends to study the possibility of providing Netherlands assistance in some form to solving the water supply and sanitation problems of Rada Town.

5.3. References

Yemen Arab Republic/Ministry of Municipalities and Housing
Kindom of the Netherlands/Ministry of Foreign Affairs
Rada urban development project
Final Report, Volume 1, The Rada Area Development Plan - executive summary of the project.
DHV consulting engineers
Amersfoort, April 1983

6. WADI RIMA SUPERVISION

6.1. Introduction

The Wadi Rima irrigation scheme has been developed to improve the conditions for spate irrigation (a kind of basin irrigation during floods). The works included one main weir and intake structure and two main canals. The design of the structures and the supervision of the construction was financed by the Government of the Netherlands. The new irrigation scheme was completed by September 1984. The evaluation mission visited the scheme to get an impression of its functioning.

6.2. Project description

Activity:	Wadi Rima supervision
Place:	Wadi Rima area
Executing authority:	Tihama Development Authority
Consultancy firm:	DHV Consulting Engineers
Duration:	2½ years
Starting date:	April 1981
Termination:	September 1984
Netherlands contribution:	Dfl. 2,080,000.*

Summary of activity:
Supervision of construction of Wadi Rima irrigation scheme.

Justification of the project:
A more assured and more timely supply of water to the individual farmers will have a positive effect on yields (an increase of 10% is estimated).

Long term objectives:
Improving conditions for spate irrigation and thus;
- increasing the yield per ha;
- diminish risks for crop failure by lack of irrigation water;
- increase in farm income.

Immediate objectives:
- construction of one main weir and intake structure;
- construction of two main canals (partly completely new canals, partly reconstruction of existing canals);
- construction of several hydraulic constructions.

Plan of activities and Workplan:
- prequalification of contractors;
- selection of contractor (1 April 1981 - 15 December 1981);

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* The total construction costs are Dfl 50,800,000.. The construction of the works itself is financed by the World Bank and the Kuwait Fund.

- construction supervision and design (15 December 1981 - 15 April 1984);
- water distribution (15 December 1981 - 15 October 1983).

6.3. History and progress of the project

Following the feasibility study of the irrigation and agricultural development in the Wadi Rima, executed by the Land Resources Division of the British Ministry of Overseas Development, DHV Consulting Engineers was assigned by the International Technical Assistance Department of the Netherlands Ministry of Foreign Affairs to prepare an additional feasibility study on Wadi Rima Irrigation Development. The main objectives of this study were:

- proposing alternative preliminary designs, which should be structurally safe, functionally adequate and economically viable;
- selecting the most economic system for diversion of the irrigation supply in the primary canal groups;
- determining the benefits which would accrue to the wadi agriculture as a result of controlled irrigation;
- preparing a detailed feasibility report.

The field work was carried out in May/June and October of 1978. The final results of the study have been laid down in two volumes in January 1979.

Based on the feasibility study the construction of the dam and the hydraulic structures in the main and primary canals started in April 1982.

From 20 November to 4 December 1982 a Yemeni-Netherlands mission evaluated the construction supervision of the Wadi Rima Irrigation Scheme. The conclusion of the mission was that overall performance seemed to be very good. Some points that were noted are:

- To prevent silting up, much attention should be paid to the maintenance of the canals, once in operation;
- More attention should be paid to an equitable distibution of the irrigation water (study of water rights and necessary changes in water rights);
- More attention is needed to involving the farming population in the project activities as the farming population did not seem to be very well informed during the preparation and implementation of the works. It is not only necessary to start an extension programme to make the farmers familiar with the opportunities the new system will offer, but also to prepare the farmers that they will have to contribute in cash instead of labour to the maintenance of the system.
- To get more profit from the improvements, more attention should be paid to better marketing organization, improvement of formal education, health care etc.;
- The improved spate irrigation system will speed up the exhaustion of the ground water reservoir. In the long run this will create problems for farmers who apply well irrigation. It also can cause intrusion of salt water in the coastal zone.

The new irrigation system was completed by September 1984.

Experiences with the system have been more or less obtained during one wet season.

6.4. Conclusions and recommendations

The mission likes to draw the following conclusions:

- The proposed works have been constructed by the contractor and are functioning. No serious problems seem to exist between the contractor Khan, DHV and TDA;
- Some problems hamper a proper operation of the system:
  . rubbish in the wadi, like leaves, sticks and even trees cause more problems than expected;
  . the structures are insufficiently staffed with operators. As a result water is spoiled and more sediments come into the system than necessary;
- The farmers make various constructions (like new dams) in the main and primary canals and/or breach existing dams to get more water to their fields. As a consequence the water distribution over the fields is far from adequate and a lower overall efficiency of the system than expected is the result;
- The population makes an extensive use of the water in the canals for washing and drinking, both for themselves and for their animals.

Based on the conclusions above the mission likes to make the following recommendations:

- to increase the number and skills of the operators of the structures. To this end an instructor should be made available to train the operators and to supervise a proper functioning of the system during two wet seasons.
- to increase the benefits of the system, it is proposed that the area served by one of the main canals on the south bank will be improved.
  This means:
  . extension services both with regard to crop selection and irrigation methods;
  . set up of an irrigation schedule that is accepted by the farmers within the served area;
  . construction of additional structures - if required - in the main canal, secondary canals and on farm scale. A contribution of the farmers to the construction costs will probably have to be agreed upon.
- to make some simple drinking water constructions for the animals along the canals near the villages.
- to provide safe water to the villages in order to prevent the use of unsafe water from the canals.

6.5. References

Kingdom of the Netherlands
Yemen Arab Republic
Wadi Rima Irrigation Development Feasibility Study
DHV Consulting Engineers
The Netherlands, 1979

Ministry of Overseas Development
Yemen Arab Republic
Montane and Plains and Wadi Rima Project
A land and water resources survey
Irrigation and agricultural development in Wadi Rima, volume 2
Project Report No. 16
Land Resources Division, Tolworth Tower
England, 1977

Yemen Arab Republic
Tihama Development Authority
Wadi Rima Irrigation System
Construction Supervision and Design
DHV Consulting Engineers
The Netherlands, 1977

Water Resources Study Tihama Coastal Plain
Wadi Rima Irrigation Scheme
Evaluation Report
Utrecht, February 1983

IRRIGATION COMPONENT
RADA INTEGRATED RURAL DEVELOPMENT PROJECT

7.1. Introduction

Since 1977 the Ministry of Agriculture and Fisheries (MOA) of the Yemen Arab Republic and the Directorate General of International Cooperation (DGIS) of the Netherland Ministry of Foreign Affairs cooperate in the Rada Integrated Rural Development Project (RIRDP). This project comprises of a number of closely related activities, all contributing to an integrated development in the Rada district (see annex 4). Up till 1983 a Netherlands consultancy firm (ILACO) has been in charge of project management and staffing; over the years a number of Netherlands volunteers and associate experts (DGIS) has been assigned to RIRDP as well.

Since 1983 a Yemeni staff leads the project, whereas the Netherlands consultants, associate experts and volunteers remain to be involved in an advisory role, the Netherlands Technical Assistance Unit. At the same time MOA seeks to expand RIRDP's activities across the borders of the Rada district, in order to cover the entire Al Bayda Province. The "Al Bayda Water Resources Study" (as discussed on page 15 and further) is one of the first results of this expansion.
The irrigation component of the "Al Bayda Water Resources Study" forms an integral part of this study.

7.2. Present situation

7.2.1. Potential

Estimations of irrigation potential in the Al Bayda Province indicate some 11,125 ha of irrigable land, dispersed over eight major areas (Rada basin, Al Bayda North-East and West, Wadi Juban, Wadi Mansur, Abbas, Wadi Dhi Na'im and Wadi Matar/Ar Rin). Out of this potential, around 2,500 ha (or 22%) are currently being irrigated, mainly in the Rada basin, Wadi Juban and Wadi Mansur.

7.2.2. Types of irrigation

In Al Bayda Province surface water as well as groundwater is being used for irrigation.

Surface irrigation includes:
- rain water, collected at terraces up the hill slopes, from where the water is led to lower located lands;
- flood water of short lasting streams formed after a rain storm are - by means of diversion dams - diverted to the lands neighbouring the intermittent stream or wadi (so called spate irrigation). This type of irrigation is mainly used for cereals (sorghum, maize, barley, wheat).

Well irrigation is especially practised in more flat areas, where water from dug or drilled wells is pumped into previously prepared basins or furrows. In general, well irrigation is

especially used for more renumerative crops like qat, alfalfa and other non-cereals, although large areas of cereals are served by this type of irrigation as well.

The furrow system requires somewhat more skill than basin irrigation and is mainly used for crops like water melons, tomato, potato, tobacco and sweet paprikas.

7.2.3. Irrigation techniques and practices

Traditional irrigation techniques (water harvesting systems, spate irrigation) in the Al Bayda Province are amazingly well adapted to geological, hydrogeological and hazardous climatic conditions. However, one may question whether these systems are still sufficient to meet the growing demand for food by the local population, or can be adapted to new cropping patterns.

On-farm irrigation practices reflect a less caring attitude of farmers towards water conservation and proper water use. Especially in areas dependent upon well irrigation fields are not properly levelled, canals not well kept, losses occur through seepage and evaporation, etc.
Unfortunately, up till now, agricultural extension services provided by the RIRDP have dedicated more attention to cultivation practices, improvement of cropping patterns and plant protection than to the improvement of on-farm irrigation practices.

7.3. Major findings

In the opinion of the mission, these is still some scope for improving and extending irrigation systems, as well as improving on-farm irrigation techniques and practices in the project area.

7.3.1. Irrigation systems

In view of the irrigation potentials in the Al Bayda Province and the agro-economic analysis as presented in the Al Bayda Water Resources Study (see also page 15 - 22), the proposed extension of the irrigated lands with some 1,500 ha by means of groundwater irrigation seems to appear realistic.

It will be evident that a further extension of irrigated lands cannot be realized by upgrading traditional water collection systems into technically more advanced structures. It appears that these structures are already quite efficient. Moreover, the mission noticed quite some structures that were recently erected by private contractors with heavy equipment. At the same time, during field trips no evidence of abandoned structures - which could point at a substantial outmigration - was found.
As a consequence, a possible extension of irrigated lands in the Al Bayda Province can only be realized either by expansion of water retention structures (to capture more surface water) or by improved and extended well irrigation. In this respect, the mission would like to refer to the debate concerning the use of surface water versus groundwater in the Yemen Arab

Republic, as presented in the Main Report of the evaluation mission. As to the Al Bayda Province, the mission does not feel confident that an expansion of water retention structures is feasible. Nearly all surface water in the province is already being used, whereas the danger of water loss through evaporation and salinazation because of water storage behind retention dams should not be taken too lightly.

7.3.2. On-farm irrigation techniques

As to the on-farm irrigation techniques in the well irrigated areas, the mission discerns some scope for improvements as well. As present water losses are substantial, a series of measurements to increase water use efficiency is necessary. The measurements could include the use of pipes (PVC) instead of open canals for water distribution, levelling of the fields, better maintenance of the dikes, a more rational use of water for the plants (too often crops receive either too much or too little water).
Apart from improvements of current irrigation techniques, a more efficient water use could also be attained through the introduction of more sophisticated techniques, such as drip irrigation.

7.3.3. Crop-water use

Priorities for certain crops in irrigation are not easy to present in the Yemeni situation. As such, the specific macro-economic situation of the agricultural sector, caused by the system of quotas (see also the Main Report of the evaluation mission), is a distortive factor. In the Al Bayda Province farmers tend to give priority to irrigate their most remunerative crop, qat. In areas where qat cannot be grown (because of night frost), quite contrary to world market conditions, where - for instance - cereals like sorghum are seldom irrigated, enormous amounts of water are spent on far less remunerative crops. Still, it has to be borne in mind that a crop like alfalfa (the main fodder crop in the area) and also sorghum (of which even the stalks are sold for fodder) yield high prices on the markets.

7.3.4. Irrigation services

It will be evident that in farming systems where water is often one of the major limiting factors (together with manpower and sometimes land) as is the case in the Al Bayda Province, agricultural extension services should pay a lot of attention to water saving techniques, adapted cropping patterns and the need for a growing awareness of the farming population of water conservation requirements.
Up till now, the Agricultural Extension Service of RIRDP harly paid any attention to these matters, as it was most occupied with other -also very important - items.

7.4. Conclusions and recommendations

In view of its findings, the mission recommends to put more emphasis on extension services related to irrigated agriculture.

In this respect the mission strongly recommends to appoint an extension (associate) expert, specialized in irrigated agriculture. This (associate) expert would be a member of the Netherlands Technical Assistance Unit and pay special attention to:

. improvement of current irrigation techniques;
. development of new, water saving irrigation techniques;
. promotion of the awareness of the farmers to apply water conservation techniques.

The extension expert will have to select a number of demonstration farm(er)s, preferable near the extension centres of RIRDP. Also, it can be considered to execute a number of irrigation trials on the Al Khabar project farm near Rada. As such, it has to be noted that the Al Bayda Water Resources Study of 1984 also stresses the need for and proposes a setting up of studies on optimum use of irrigation water, including:

. irrigation trials;
. farm management investigations;
. crop feasibility studies.

The expert on extension services related to irrigated agriculture will have to be appointed for a period of at least three years. The mission recommends to appoint the expert as soon as possible, preferably by the beginning of 1985.

7.5. References

Rada Integrated Rural Development Project: Project Plan 1984-1985
YAR-Neth., June 1983, (code 4.08.038)
ILaco, Arnhem, The Netherlands

Rada' Integrated Rural Development Project
Study into water resources in Al Bayda Province
Volume I - Main report
Volume II - Annexes
Volume III - Maps
Volume IV - Appendices
Yemen Arab Republic - Kingdom of the Netherlands
February 1984 (Code 4.08.038)
Ilaco, Arnhem, Netherlands

Rada Integrated Rural Development Project Progress Reports
January-March 1984 and April-June 1984,
1984, Ilaco, Arnhem, The Netherlands.

8. TIHAMA INTEGRATED AGRICULTURAL EXTENSION SERVICES IRRIGATION COMPONENT

8.1. Introduction

The "Tihama Integrated Agricultural Extension Services" project is the fourth phase of a series of consecutive extension projects in the Tihama region since 1973. It is being executed by UNDP/FAO and financed under the Netherlands bilateral co-operation prgramme since 1978.
The present phase (1984-86) consists of a multi-disiplinary extension operation oriented towards the implementation of farming systems suitable for the Tihama through field operations (extension farms, field demonstrations), training, support communication activities, and institution building.

In accordance with its terms of reference, the mission has evaluated the irrigation component of the field operations only. Effective June 1984, the project was integrated in the Tihama Development Authority (TDA) by UNDP/FAO.

8.2. Project description

Activity:	Tihama Integrated Agricultural Extention (phase four)
Place:	Tihama region with headquarters in Hodeidah
Executing authority:	Ministry of Agriculture and Fisheries (MOA), Tihama Development Authority (TDA)
Executing agency:	Food and Agricultural Organization (UNDP/FAO)
Duration:	two years
Starting date:	1 June 1984
Sector:	Agricultural Extension
YAR contribution:	YR 6,000,000.-
Neth. contribution:	Dfl. 10,000,000.-

Summary of activity:
- reinforcing the Tihama agricultural extension service;
- integration of this service with the agricultural extension service of TDA;
- actual improvement of extension services to the farmers in the Tihama region with the aim of increasing agricultural production.

Justification of the project:
A crucial component in the Yemeni Governement's strategy for achieving the national targets of the agricultural development plans is an agricultural extension service to assist farmers to accelerate agricultural development. Previous UNDP/FAO technical assistance projects have laid the foundations for such an extension service in the Tihama. Follow-up of the project will enable the further development of effective

services and the handing over of responsibilities to the YAR authorities.

Long term objectives:
- to establish a functional and efficient extension system in the Tihama region;
- to raise the standard of living of the farm households by applying improved farming technology;
- to improve family life including better nutrition and household hygiene.

Immediate objectives:
- increasing crops and livestock production in the region, while paying attention to the interests of the different groups of the rural population;
- twenty functional and efficient extension centres (of which five to be constructed by the project);
- an adequately staffed extension service, integrated in the TDA with one approach for the whole region;
- a training programme for extension workers at all levels, in-country and abroad;
- extension materials (pamphlets, audio-visual aids, radio and television programmes).

Plan of activities:
- training of national staff at all levels;
- increasing the number of pilot farms with an integrated (multi-disciplinary) approach to water management, crop choice, cultural practices, plant protection, crop rotation, animal production and cost-return analysis;
- construction of five extension centres;
- organization of field demonstrations on request of the farmers;
- further establishing of functional relations with agricultural and rural development institutions, e.g. Agricultural Research Authority;
- integration of this agricultural extension services project under the Hodeidah Office of Agriculture with the agricultural extension service of TDA.

Inputs:
a. Inputs YAR
   - counterpart experts and extension staff (in total some 85 people);
   - running costs and office facilities;
   - operational supplies and materials.
b. Inputs Netherlands
   - senior extension experts, junior extension experts, associate experts and consultants (in total some 14 experts);
   - travel costs;
   - equipment and materials.

Workplan:
A detailed workplan entitled "UNDP/FAO", Tihama Integrated Agricultural Extension, Project YEM/84/002, Programme of Activities 1984/85, Hodeidah, June 1984, has been prepared.

8.3. History of the project

Dating back to 1973 the UNDP have operated three consecutive projects in the Tihama region. The first project (YEM/73/011) was launched to support the agricultural services including extension in the Hodeidah Governorate, and to conduct field trials and data collection. This project was followed by a second one (YEM/77/003) to develop a functional extension service in the Tihama and to introduce improved seeds. The third project (YEM/82/001) which terminated May 31, 1984, was designed to consolidate, strengthen and to expand, if necessary, the agricultural extension service in the Tihama. The last two projects were financed by the Government of the Netherlands.

In December 1983, a tripartite review was held, attended by representatives of MOA, CPO, the project staff, FAO, UNDP and the Government of the Netherlands. It was suggested by the parties concerned that the new phase of the project (YEM/84/002) be a three year project with an integrated extension service covering input supply, production, marketing, farmers' organization, home economics and organization of rural women. The Ministry indicated special emphasis on fruit production to be introduced in the project. The Ministry also stressed that under the limited budget of the Ministry, construction of field extension centres should be included in the Netherlands assistance.

In January 1984, a Netherlands delegation was sent to the YAR to evaluate the progress of the project and to discuss the proposal for a continuation of the project for 1984 to 1986, for which FAO had prepared a draft project document. The Netherlands evaluation mission proposed a revised outline by accelerating the take-over by Yemeni staff and reducing the project duration to two years. This and other curtailing of planned expenditures led to a modified project budget.

The present phase of the project started June 1984 and will be executed within the framework of the agricultural extension service of TDA.

8.4. Water management practices

8.4.1. *Background and objectives*

When the Netherlands evaluation mission visited the Tihama agricultural extension project in January 1984, the apparent eagerness of the farmers to utilize the extension services was considered a most favourable prospect of the project. With respect to on-farm irrigation practices the mission stated in its evaluation report (page 5) that:
"Water management practices on the farm level have been improved spectacularly, due to extension activities. The installation of PVC pipelines in 17 farms, instead of the existing, badly leaking irrigation canals, has opened the eyes of most farmers for the possibilities of water savings. Leveling of the fields and proper ridging for the different crops has further improved the water use efficiency. Water

savings amount to 40 to 50% of the previous water requirements. Thus considerably more land can be irrigated with the same amount of water".

Changes in the irrigation conveyance network from water wasteful earthen canals to burried PVC piping systems continue to be emphasized in the present project period.

Two types of activities are to be undertaken:

- Improvement of water conveyance system
  The technology consists of changing the irrigation network of the farm from inefficient and water wasteful earthen canals to burried PVC pipes. Such a low pressure water conveyance has several advantages, like 40% water saving from non-seepage and evaportation, 75% labour saving, less fuel consumption and conveyance over longer distances in gained popularity in the Tihama and increasing demands are received from farmers for the installation of PVC pipes. Technical files prepared by the project are used by the Credit Bank for the provision of loans. It is proposed that during the season 1984/85 an investigation and cost estimation will be prepared for 40 farms. Installation of PVC pipes will cover 25 farms.

- Irrigation practices
  Improved irrigation practices will be demonstrated to a more efficient use of land and water for crop production. Improved practices include long furrows, strips and improved basins As the success of these practices depends on good levelling and fine seed bed preparation this will also be demonstrated. Farmers will equally be shown the role of irrigation during regular frequencies in order to provide the real water requirements to the crops and to ensure a more economic use of water. It is planned to demonstrate the improved irrigation practices on about 50 farms.

8.4.2. Effectiveness

To assess the effectiveness of the proposed changes in the irrigation system and practices, an attempt has been made to estimate the value of water savings on 4 ha cultivated land as a result of the introduction of an advanced irrigation network based on 400 mts of pipe units connected with a tube well. For each farm where a piping unit is installed, water savings may enable an increase in cropping intensity if at least two crops per year can be grown, and/or a shift from present crops to higher-value cash crops can be made.

The initial investment of 400 mts of pipes costing approximately YR 26,000.- can be shown to result in an annual value of water savings of YR 10,000.- if cash crops are grown that require 5,000 m^3 per 1 ha and the cost of water is YR 0.50 per 1 m^3. For a reasonable life-time of the piping network, the rate of return of the water saving investment is therefore in order of magnitude of 30%. This figure includes, of course, the effect of extension services on efficient water use and selection of crops.

If the water saved is used for planting an additonal 4 ha, the annual net profit from cash crops is estimated to be YR 20,000. doubling the rate of return at prevailing prices.

8.5. Recommendations

In general, the mission supports the conclusions and recommendations of the Netherlands evaluation mission of January 1984. With regard to water management, discussions with the project management at TDA and field vistis to farms using the new pipe systems, convinced the mission of the need to:

- continue and deepten extension efforts for on-farm irrigation;
- monitor the spatial distribution of farmers who accepted the new pipe system;
- evaluate regularly the size distribution of farms operating the pipe system.

The mission reiterates the need to carry out indicative economic analysis to determine the profitablility of various farm operations, including improved irrigation practices, as result of the extension services.

The mission emphasizes that in those areas where groundwater extraction leads to over exploitation of groundwater the TDA extension services should aim at water conservation through improved irrigation practices rather than expanding the cultivated area with the water saved.

It is the impression of the mission that the successful changes in on-farm irrigation practices through the use of PVC pipes is still mainly confined to selected areas in the Tihama. Highest priority should therefore be given to introduce this sytem in other areas in the Tihama by TDA as well as in other parts of the Yemen Arab Republic where appropriate agricultural extension services and/or integrated rura development projects dealing with extension are operating.

8.6. References

Yemen Arab Republic, Tihama Region
Tihama Agricultural Extension Services Project YEM/82/001
Report of the Netherlands Evaluation Mission Sana'a, 27 January 1984

Yemen Arab Republic, MOA, TDA
UNDP/FAO Tihama Integrated Agricultural
Extension Project YEM/84/002
Programme of Activities 1984/85
Hodeidah, June 1984

Yemen Arab Republic, MOA, TDA
UNDP/FAO Tihama Integrated Agricultural
Services YEM/84/002
Integration of Field Crops and Industrial Crops
Work Programme 1984-85
I.S. Quaddoura and A. Metekohy
Hodeidah, May 1984

WATER SECTOR EVALUATION YEMEN ARAB REPUBLIC

TERMS OF REFERENCE

Joint evaluation mission of the Government of the Yemen Arab Republic and the Government of the Netherlands, September 1984.

1. **Introduction:**
The Netherlands supported water sector activities in the Yemen Arab Republic presently concentrate on:

Water Resources
a. "Water Resources Assessment YAR"
b. "Tihama Water Resources and Water Use Study"
c. "Al Bayda Water Resources Study"

Domestic Water Supply and Sanitation
a. "Support Rural Water Supply Department"
b. "Water and Sewerage Dhamar/Ibb"
c. "Water Supply and Sanitation Component "Rada Integrated Rural Development"

Irrigation
a."Wadi Rima Supervision"
b. Irrigation component "Rada Integrated Rural Development"
c. Irrigation component "Tihama Agricultural Extenstion"

Whereas there is no doubt that these water sector activities form important elements in the social and economic development of the Yemen Arab Republic less clarity exists as to which elements and strategies should be given priority in view of the future Yemen-Dutch co-operation programme.

2. **Objectives of the evaluation**
The objectives of this joint evaluation are:
A. to review the projects as listed above in order to submit recommendations on priorities for furter Yemeni-Dutch development co-operation in water related activities.
The recommendations should include a description of the type of projects, counterpart organizations, manpower requirements, target population, local cost component, financing and cost consequences in the long run. The recommendations should aim at a comprehensive programme on water related activities in line with the Yemeni and Dutch development policy.

B. to study objectives and progress of the "Water Resources Assessment" project and comment on its effectiveness and efficiency in order to submit recommendations on possible follow up activities after termination of the present project period.

C. to study objectives and progress of the "Support Rural Water Supply Department" project and comment on its effectiveness and efficiency in order to submit recommendations on possible follow up activities after termination of the present project period.

Given the recognition that the role and position of women have been very much neglected in development processes and projects, the mission should pay special attention to the integration of women in the project activities and to the interests of women in relation to project objectives, results and recommendations.

The recommendations will be presented to the Government of the Yemen Arab Republic, the Government of the Netherlands and the various projects involved.

3. Sectoral evaluation of Netherlands supported water related activities.

3.1. The sectoral evaluation as formulated under 2A should deal with the following aspects:
- Examine to what extend the YAR policy is reflected in the actual programme of development projects
- Review of the significance of the individual projects in relation to
  + problem perception
  + project objectives
  + target population
  + plans and priorities of the Yemen Arab Republic
  + Netherlands policy on development co-operation;
- Review of the effectiveness and efficiency of the project activities;
- Comparative assessment of the development impact of the individual projects in terms of significance, efficiency and effectivity;
- Identification of possible follow-up activities;
- Recommendations on priorities for future Yemen-Dutch development co-operation in water related activities with a clear indication of type of projects, counterpart organizations, manpower requirements, target population, local cost financing and cost consequences in the long run.
- Possible adjustments for ongoing activities.

3.2 Special points to be examined are:

A. <u>General</u>
- Manpower requirements, human recource development, trainingsprogrammes;
- Strengthening of institutional and administrative structures versus implementation capacity;
- Integration of women in the development process: participation of women in project activities; effects of project activities on the position of women;
- Identification and co-ordination of donor activities in water rescources management, water supply and sanitation and irrigation;
- Planning for continuity after ending the project;
- Support for individual projects by a sector policy and appropriate institutions;
- Question whether demand surveys were carried out for the various services.

B. <u>Water Resources</u>
- Policy aspects:
  . Role and functioning of the Supreme Water Council and action taken to a more rational exploitation of water resources;
  . the contribution of the central hydrological department to improvement of water resources management; information transmission to "users"; relation to Supreme Water Council.

- Organizational aspects:
  . Co-ordination of different water resources projects, expertise and data both within Yemen-Netherlands co-operation programme (WRAY, Tihama Water Resources Study, Al Bayda Water Resources Study) as well as between water projects in general;
  . The need to integrate water resouces studies with water development projects (e.g. RIRDP).

- Technical aspects:
  . Reliability and usefulness of the collected data;
  . Appropriate technology for data bank development (use of models, automation);
  . Institution building versus technical studies.

- Economic aspects:
  . Assessment of costs involved with the start and functioning of a hydrological department in relation to expected benefits, comparison to international standards.
  . Feasibility of an economic cost-benefit analysis of the DOH activities and/or water resources studies in general.
  . Possibilities to charge for supply of hydro(geo)logical information.

C. Domestic Water Supply and Sanitation

- Policy aspects:
  . Conformity of projects to National Sector policy.
  . Integration of water supply, sanitation and hygiene education.
  . Criteria for the selection of villages which will be served first.
  . Public versus private water supply and sanitation facilities;
  . Rural versus urban water supply and sanitation projects;
  . Co-financing versus bilateral aid.

- Organizational aspects:
  . Appropriate counterpart organizations for the development and implementation of village water supply and sanitation (RWSD; LDAs/CYDA).
  . Co-operation and co-ordination of agencies and organizations involved in water supply and sanitation (MPW; RWSD; LDAs/CYDA; MOA; MOH; MOMH; MPWS; DOH; donor organizations).
  . A "single track" approach versus an integrated rural development approach in water supply and sanitation projects.
  . Attention for water recources management.
  . Organization of operation and maintenance for water supply and sanitation facilities.

- Technical aspects:
  . Need for water resources studies in the planning phase.
  . Physical implementation and appropriate technology.
  . Level of service and choice of technology compared to need, health aspects, manpower requirements, cost-effectiveness, maintenance aspects.
  . Functioning of the facilities.
  . Maintenance capability.
  . Water quantity and water quality control.
  . Water reuse and utilization of sewerage effluent.
  . Standards applied both technical (engineering) as well as with regard water demand.

- Social aspects:
  . Need for water supply and sanitation facilities.
  . Contribution of water supply and sanitation projects to an improvement of the living conditions of the rural poor; who benefits.
  . Participation of the local population in project planning and implementation.
  . Participation in operation and maintenance.
  . Accessability of the facilities; equal distribution of water and sanitation facilities.
  . Use of the facilities.
  . Productive use of water (cattle, garden, small scale industries).
  . Constraints for work in sanitation.

- Health aspects:
  . Health risks and health benefits of water supply and sanitation facilities.
  . Involvement of health agencies (MOH, MMH, etc) in water supply and sanitation projects.
  . Safe disposal of human waste, solid waste and waste water.

- Economic aspects:
  . Financing of schemes; local contributions to investment and running costs; cost/benefit ratio's.
  . Financial management of operation and maintenance; system of contributions.
  . Increased production through health improvement.
  . New water supply schemes versus upgrading of existing facilities.
  . Cost effectiveness and adaption to local circumstances.

D. Irrigation

- Policy aspects:
  . Improvements of irrigation systems on regional level versus local (farm) level in relation to an alleviation of the position of rural poor;
  . The importance of irrgation water for the national food supply (as a contribution to economic independence of the country);
  . Use of well irrigation for qat production and its consequences for food production.
  . Netherlands involvement in planning and design services (studies, supervision) versus implementation services.
  . Pumpirrigation versus surface irrigatie.

- Social aspects:
  . Analysis of problems and possibilities in water harvesting and water management resulting from present developments in social structures in the project areas.
  . Study of distribution systems of irrigation water, possibly leading to suggestions for optimizing the water distribution systems.
  . Distribution of the benefits of the projects.

- Organization aspects:
  . Appropriate counterparts in project implementation, e.g. Rural Development Agencies, Central Government Agencies.
  . Organization of operation and maintenance.

- Technical aspects:
  . Physical implementation, including appropriate technology.
  . Functioning of the constructed systems.
  . Attention for water resources aspects in small scale projects.

- Health aspects:
  . Schistosomiasis transmission through field irrigation.
  . Domestic use of irrigation water.

- Economic aspects:
  . Financial and economic rentability of irrigation projects with due observance of investments at farm level as well as the necessity of large scale investment programmes on regional level in relation to scarce financial means.
  . Organisation of (re)payment of investments and running costs.

3.3 Specific topics per individual project

Apart from the general approach given under 3.1. and the points of attention for the various fields within the watersector mentioned under 3.2, a number of special topics will receive (extra) attention during the review of the individual projects of the co-operation programme.

For the two projects that are to be evaluated with a view on possible additional financing in 1985 these topics are mentioned in section 4. Regarding the other projects mentioned on page 1 the following issues are of importance.

A. Tihama Water Resources and Water Use Study"
- Depending on the stage of finalisation of the project document, discussions with the TDA management on the context of the project and further execution of the project, with special attention to the socio-economic component, the organisational structure of the project and the fitting in the TDA organisation, the development priorities within the Tihama as a whole and the co-operation with other donors.
- Storage of data obtained in phase I
- Present level of data collection.

B. "Al Bayda Water Resources Study"
- Review of the main conclusions of the Ilaco report in relation to possible follow-up of RIRDP
- Possibilities for further (ground) water development; role of the project
- Relation between surface and ground water; possible improvements of water retention (diversions, dams)
- Tasks and organisation of water resources monitoring unit; level of sophistication and amount of equipment required
- Application of ground water models
- Well siting techniques.

C. "Water and Sewerage Dhamar/Ibb"
- Review of the studies executed, including the recent change in design
- Discussions with NWSA on the successive phases of the project
- Link to health education
- Handling/use of treatment plant effluent

D. "Rada Integrated Rural Development/Water Section"
- Integration in local institutions/LDA, provincial council/RWSD activities
- Sanitation programma (technical report Ilaco)
- Relation construction section/Woman section
- Type of water facilities (house connections)

E. "Wadi Rima Irrigation Supervision"
- Functioning of the new irrigation system sedimentation problems; infiltration in canals)

F. "Irrigation component RIRDP"
- Possibility to influence water use/irrigation development
- Crops irrigated/priorities
- Water collection systems/dams

G. "Tihama Agricultural Extension (Irrigation component)"
- Effect of improved efficiency on water resources
- Possible extension of activities outside Tihama
- Effect on income position of various groups within the Tihama.

4. Project evaluations "Water Resources Assessment" and "Support RWSD"

4.1. Evaluation points project "Water Resources Assessment YAR" (WRAY)

In addition to what has been mentioned under section 3.2.A "General" and B: "Water Resources" the following points should be examined:

- Policy aspects
  - Were the original objectives in the framework of existing conditions realistic?
  - If the project encounters problems with improving office skill and work, how could improvements be reached?
  - Has a division on responsibilities taken place among the several governmental institutions involved in water study and development. What consequences does this have on the work of DOH?
  - What is the policy with regard to DOH's position now and in the future; e.g. in relation to the Supreme Water Council.
  - Who are the actual users of information provided by DOH? What is their opinion on DOH up till now? What is their opinion concerning DOH's future?
  - Should DOH itself execute regional studies or should DOH's task be limited to
    a. co-ordination (the water resources studies to be executed by others)
    b. centralized data processing (computerized data bank) and maintainance of a national hydro(geo)logical network
    c. provision of hydro(geo)logical data to users (NWSA, TDA, CAMA, RWSD, Sana'a University, Supreme Water Council, Regional Development Projects etc.)

- Organizational aspects
  - Relation between DOH and the project "United Geological and Water Resources Mapping of the Two Yemens" and the "Yemen Project for Joint Natural Resources"?

.Co-ordination between the several water resources studies executed recently (a.o. those supported by Netherlands: Tihama, Al Bayda and Sadah and Wadi Surdud) in terms of well numbering, accuracy, techniques (questionnaires, equipment), approach to data processing etc.

- Technical aspects
  - Standardisation of computer equipment within the several institutions (DOH, TDA, CAMA, etc)
  - How much of the existing data (hydro(geo)logical, meteorological have been collected so far? What were the bottlenecks? What is their quality?
  - Results of the fieldwork, (quantative and qualitative) in Sada and Wadi Surdud
  - What insight has been obtained in the water resources of YAR as a whole?
  - How are the collected data processed and stored?
  - How is the accessability of the data for further use?

- Economic aspects
  - Cost comparison with similar studies executed in YAR.

4.2. Points of attention for evaluation "Support Rural Water Supply"

In addition to what has been mentioned under section 3.2. A: "General" and C: "Domestic Water Supply and Sanitation" the following points should be examined:

- Objectives and progress
  - Were the original objectives realistic? Did or do they need reformulation?
  - Which is the relation between the three project components (reinforcement RWSD; 16 implementation schemes; 3 pilot projects)? Did this materialize?
  - Were the proposed project activities appropriate to reach the objectives?
  - Assessment of the progress being made in relation to objectives and original time schedule. Were adaptations necessary? Which are the achievements and constraints? Are target groups/target villages being defined and priorities set?

- Organizational aspects
  - The position of the project within the RWSD
  - The relation between and the co-ordination of WHO support activities and Netherlands support activities within RWSD
  - Intergration of Netherlands experts in the RWSD
  - Co-operation between Yemini and Netherlands project personnel and division of responsibilities and tasks
  - Procedures to identify needs and priorities for village water supplies (preparation of a national rural water supply master plan).
    .The role of the RWSD in relation to other governmental, private and external donor agencies aiming at rural water supply and/or integrated rural development.
  - The role of the RWSD in relation to organizations and institutions involved in water resources assessment and water recources management. Which steps have been taken to actual co-operation and co-ordinaton?
  - Possibilities and contraints to include sanitation activities in the water supply projects.
  - Possibilities and constraints to include hygiene education in the water supply projects (given the fact that this is primarily the responsibility of MOH/PHC programmes)

.Appropriate structure and organization for operation and maintenance of village water supply and sanitation facilities
- Should Netherlands support be more directed to strenghtening of institutional and administrative structures or to physical implementation of water supply and sanitation facilities?
- Is direct Netherlands support to CYDA/LDA's recommended in water supply and sanitation activities?

- Technical aspects:
  - Technical support in site selection of wells, and design, preparation and construction of water supply schemes
  - Tendering and construction of water supply systems. Experiences with local contractors compared to foreign contractors
  - Installation of sanitary facilities
  - Water quality control
  - Monitoring of water resources; geophysical measurements and set up and adequate sampling of drilled formations
  - Design and construction of three pilot water supply schemes

- Economic aspects:
  - Is a cost benefit or cost effectiveness analyses of the three project components possible and desireable.
  - Cost and quality comparison with other Water Supply Projects (e.g. LDA-schemes).

- Manpower requirements:
  - Review of manpower requirements and the availability of skilled staff
  - Review of training needs
  - Assessment of formal and informal training activities within the project.

5. Reporting

The draft report and conclusions will be submitted to and discussed with the Yemeni Authorities before departure. The final report, including the annexes will be submitted to the Government of the Yemen Arab Republic, the Government of the Netherlands and the various projects involved before 15 December 1984.

Annex 2: List of organizations and people met.

Ministry of Agriculture
- Dr. Al Hamdani, Minister
- Mr. Lutf Al Ansi, Director of projects
- Mr. Ali Khawlani, Director of integrated rural development
- USSR team (hydrological study Sana'a basin)

Ministry of Public Works
- Mr. Al Kurshumi, Minister
- Mr. Al Hamdani, Deputy Minister

British Embassy
- Mr. Harry M. Robertson, Attache technical cooperation
- Mr. Jeremy Macadie, Attache technical cooperation

Confederation of Yemeni Development Associations (CYDA)
- Mr. Muhammed M. Al Shabri, Deputy Chairman Foreign Relations Committee
- Mr. Ali At-Mikdad, Chief of information committee
- Mr. Ashari Mohammed, Translator
- Mr.Ahmed Al Atab, Chief of Food and Nutrition Committee
- Mr. Mohammed Al-Hadad, Director Assistant of Foreign Relations Committee
- Mr Abedul Salam Mohammed, Manager of Foreign Relations Department
- Mr. Kaid Saif, Chairman of specialized co-operatives Committee

Consultants for Management of Development Programmes (CDP)
- Mrs. Riet Turksma, consultant

Department of Hydrology (DOH)
- Mr. Ahmed Wahib, Director
- Mr. Saad Saleh, Observer Saadah area
- Mr. Tahir Mosle, Technician
- Mr. Abdel-Latif
- Mr. Mohamed Abdul Hamid
- Mr. Noory Gamal
- Mr. Mohammed Danikh

Dhamar Governorate Health Services Programme (DGHSP)
- Mr. K. Schaapveld, Co-manager
- Mrs. T. de Haas, Public Health Supervisor
- Mr. S. Smits, Co-director Dhamar hospital
- Mr. E. Coster, Public Health Officer
- Mr. R. van Dijk, Sociologist

DHV Consulting Engineers
- Mr. J. Oosterman
- Mr. H. Borgstein

Hydrosult Inc.
- Mr. Ismail Nojjar

Local Development Associations
- Mr. Abdulla Zeid Amran, Head LDA Dhamar Area
- Mr. Mohammed Abdul Al-Qater, Chairman LDA-Rada

National Water and Sewerage Authority
- Deputy Director
- Mr. Rihlman, Technical advisor
- Mr. Adel Abbas M. Ali, Resident Engineer Dhamar
- Mr. Jim Ziegler,
- Mr. Ali A. Almohanni, Hydrologist

Organization of Netherlands volunteers
Stichting Nederlandse Vrijwilligers (SNV)
- Mr. R. Wanrooy, Director

Pacific Consultants International (PCI)
- Mr. Fetsuji Niwano

Primary Health Care Clinic (Mother and Child Care) Rada
- Mr. Anwar, Director
- Mrs. Ann Kristen, Mid-wife

Provincial Office Ministry of Health, Dhamar
- Mr. Klywani, Director

Rada Integrated Rural Development Project (RIRDP)
- Mr. Samawi, Project manager
- Mr. J.W. Erdman, Team leader Technical Assistance Unit
- Mr. Shimmy, Extension Specialist
- Mr. J. Dop, Advisor water engineering section
- Mrs. Nadia, Head women participation section
- Mrs. M. Boonman, Home economics extension worker
- Mr. J. Duys, Water resources specialist
- Mr. M. Peek, Agricultural specialist
- Mr. D. Bekker, Sanitation specialist
- Mr. Hassan
- Mr. A. Vriens
- Mr. Adil
- Mr. G.J. Winkelhorst
- Mrs. Loni Scheffer, Research assistant
- Mr. H. Wissink (ILACO)

Rada Town Council
- Mr. Ali Abu Alrigal, Head of office

Royal Netherlands Embassy
- Mr. Alphons Hennekens, First secretary
- Mr. Maarten A. Poolman, Fist secretary
- Mrs. N.H. Jurriens

Rural Water Supply Department (RWSD)
- Mr. Abdul Albari Saleh, Director General RWSD
- Mr. Ibrahim Al Shami, Dep. Gen. RWSD
- Mr. Mohammed Mahdi, Director Design Department
- Mr. A. Malik, Director Drilling and Hydrogeology section
- Mr. Mardi, Engineer
- Mr. Gazali, Engineer
- Mr. Osman Nuri
- Mr. Yaya Sannabanni, RWSD representative Dhamar
- Mr. Dinkar Shresta, Surveyor
- Mr. Bashir ul Haq, Civil Engineer

Support Rural Water Supply Department Project (SRWSD)
- Mr. T. Haagsma, Project manager
- Mr. J. Noteboom, Assistant construction supervisor
- Mr. A. v.d. Perk, Construction supervisor
- Mr. D. v.d. Meer, Hydrologist
- Mr. M. Keyzer, Associate expert Hydrologist

Ministry of Water and Electricity
- Mr. Basaïd, Head technical bureau

Tihama Development Authority (TDA)
- Mr. Ahmed Ali Humad, Chairman
- Mr. Ibrahim Eldomi, Deputy Director
- Mr. Mohammed Anwar, Head hydrology department

Transcentury
- Mr. D. Carner
- Mrs. Susan Hoops, Sanitary Engineer

United Nations Development Programme
- Mrs. Chr. Abel, Assistant resident representative

UNICEF
- Mr. K.R.R. Pandian, Project manager water supply
- Mr. Taha Amar, Counterpart, Surveyor
- Mr. P. Manandar, Project officer water supply

USAID
- Mrs. Lynn Carter

Water Resources Assessment YAR (WRAY) Project
- Mr. J. v.d. Gun, Project co-manager
- Mr. P. Nauta
- Mr R. van Overmeeren

WHO project to strenghthen the RWSD
- Mr. Juliusz Kozinski, Project manager

World Bank representatives
- Mr. D. Coyaud
- Mr. P.J. Bonron

Yemen Oil and Mineral Corporation (YOMINCO)
- Mr. Mohammed Ahmed Al Saidi
- Mr. Abdullah Salam Nagi, Deputy director

Interpretor: Mrs. Kawkab Al Joofi

Annex 3: Composition of the Dutch eveluation mission

The Dutch evaluation mission was composed as follows:

- W.A. Segeren, Land and Water Development Specialist, teamleader of the mission
- J. Blom, Water Sector Specialist
- M.T. Boot, Development Sociologist
- A. Kuyvenhoven, Economist
- E. Schultz, Civil Engineer/Hydrologist
- G.J. Tempelman, Rural Sociologist

J.L. IJzermans, desk officer YAR of the Netherlands Ministry of Foreign Affairs, accompanied the mission as a resource person.

Annex 4: Project summary Rada Integrated Rural Development Project

The project comprises an integrated development programme for the province of Al Bayda in the Yemen Arab Republic. This programme concentrates on agricultural development, livestock, road construction, water-supply and women's participation in development. It is implemented in two phases: 1977 - 1983 and 1984 - 1985.

Phase 1 (1977 - 1983) was first characterized by the establishment of the project infrastructure. During this time operational and executive decisions were mainly directed towards solving local problems, mostly of a short-term character. Amongst others a start was made with road construction. In the years 1979 - 1983 the project was more typified by further extension of the project organization and the management strength.
Phase 2 (1983 onwards) is distinguished by direct responsibility and involvement of the Yemeni project staff and local and regional institutions in project activities, intensification of activities within the project area and gradual extension of project activities into the rest of the Al Bayda Province.

The general objective of the project has not been changed over time and is still the improvement of the life of the rural population. The intermediate objectives of the project as formulated for the project period 1984 - 1985 are:

- to increase the productivity of agriculture and livestock activities through applied research and verification trials; development of extension services and provision of inputs such as seeds, planting materials, pesticides, the distribution of layers and goats, veterinarian and other services and advise for which there is immediate need or demand;
- to improve drinking water supply on village level and give more attention to sanitary aspects and to improve the construction of secondary feeder roads and village roads i.e. the removal of bottlenecks in the existing network;
- to contribute to the preservation of the natural resource base by groundwater study and monitoring to obtain more systematic data on the potential of water resources in the projects area and the rest of the Al Bayda province and to co-operate with other projects particularly in charge of rangeland studies and improvement programmes;
- to promote women's participation in development by programmes including home-economic activities, gardening, poutry, and handicrafts, in co-operation with government agencies and primary health care projects;
- to promote off-farm employment;
- to extend the literacy programme to remote areas and the RIRDP employees;
- to strengthen the implementation and organization capacity of government and other development institutions in the region as the provincial administration, the Local Development Authorities (LDA's) and the Baladyas of Rada and Al Bayda;
- to identify training needs and possibilities, to select candidates and arrange for suitable training for RIRDP staff and the staff of other development institutions and private enterprise in the province.

The total project cost for both phases will be Dfl. 77.9 million (ECU 30.4 million) of which Dfl. 28.2 million (ECU 11.0 million) in the second phase. The EEC agreed to contribute in the project cost of the second phase to the amount of Dfl. 7.0 million (ECU 2.7 million) for feeder road construction and development of water supply. (See Table 1).

Table 1 Total contributions RIRDP 1977-1985 (x '000)

	Y.A.R.		Netherlands		E.E.C.		Total	
	Dfl.	ECU	Dfl.	ECU	Dfl.	ECU	Dfl	ECU
Phase I, 1977-1983	14 193	5 531	35 513	13 839	-	-	49 706	19 370
Phase II, 1984-1985	12 199	4 754	9 000	3 507	7 031	2 740	28 230	11 001
Grand Total	26 392	10 285	44 513	17 346	7 031	2 740	77 936	30 371