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REPUBLIC OF NAMIBIA
MINISTRY OF AGRICULTURE, WATER AND RURAL DEVELOPMENT
DEPARTMENT OF WATER AFFAIRS



PROJECT PROPOSAL

TERMS OF REFERENCE FOR RECHARGE STUDY OF THE STAMPRIET
ARTESIAN BASIN

THE DEPUTY PERMANENT SECRETARY
DEPARTMENT OF WATER AFFAIRS
Private Bag 13193
WINDHOEK

COMPILED BY:
GEOHYDROLOGY DIVISION

AUGUST 1997

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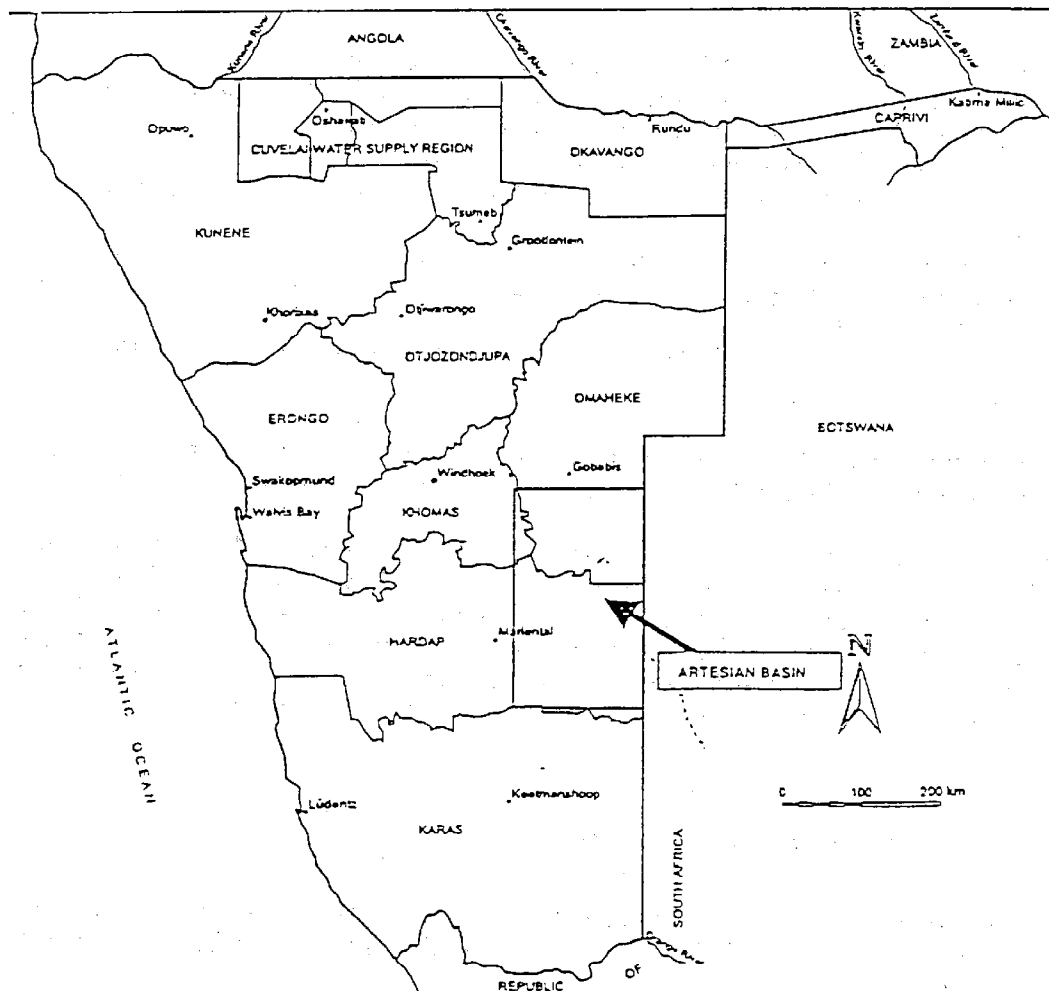
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1. INTRODUCTION

The purpose of this Terms of Reference (TOR) is to describe the scope of work to investigate the groundwater potential of the Stampriet Artesian Basin in the Omaheke, Hardap and Karas regions of Namibia (see Figure 1), and to obtain financial support for such an investigation. The full potential of this vast groundwater system has never before been quantified, therefore careful planning on the optimal utilisation of the resource has never been realised.

The Stampriet Artesian Basin is situated in the south-eastern portion of the country (see Fig 1). It extends eastwards into Botswana and the system is almost entirely overlain by the Kalahari Sequence. It is the largest aquifer system in Namibia and covers an area of some 65000 km². It is utilised by both commercial and communal farmers for drinking water, livestock and irrigation. It also supplies the towns of Stampriet, Gochas, Aranos and Leonardville with bulk water.

Map of Namibia indicating position of Stampriet artesian Basin



Within the Stampriet Artesian basin groundwater abstraction is controlled by a permit system, as the area overlying the basin is a water-controlled area. Extensive abstraction for irrigation purposes by commercial farmers occurs in the northern and central parts of the basin. According to data from a limited number of monitoring

wells that were installed during 1978, the water levels have declined continuously since 1985.

From 1986 to 1988 investigations were carried out by the Department of Water Affairs (DWA) in order to define the impact due to irrigation. Since then no further work was done, but irrigation activities have steadily increased to nearly double that of 1988.

In order to prevent a total over-abstraction DWA needs an understanding of the entire aquifer system. Therefore studies of the recharge mechanism and the groundwater flow characteristics are essential. Because of illegal users and poor returns from some permit holders, a practical control system regarding irrigation has to be established, like remote sensing. However, the studies should result in a groundwater model that can be used by DWA for future groundwater management purposes.

2. GEOLOGY AND HYDROGEOLOGY

The aquifer system can be sub-divided into three categories:

- The upper phreatic to semi-confined Kalahari Aquifer. The Kalahari Sequence consists of unconsolidated to semi-consolidated sand and silt. This upper aquifer is in most cases separated from the Auob sandstone aquifer by an aquiclude of Karoo claystone. In the central portion of the basin a clay layer window links the two aquifers.
- A claystone layer also separates the Auob sandstone aquifer or middle aquifer from the lower Nossob sandstone aquifer. No direct links between the Nossob and Auob sandstone are known.
- The Nossob aquifer is underlain by glacial claystones of the Dwyka Formation that act as an Aquitard.

Some artesian springs along the Nossob river system indicate a natural up-welling of groundwater from the sandstone aquifers into and through the Kalahari aquifer.

The average annual rainfall decreases from north (300-400 mm) to south (<100 mm). Isotopic (C14) and chemical research by few authors indicate recharge areas in the northern and western parts of the system. These proposed recharge areas are not directly linked to the outcrop of the sandstone. Furthermore, the authors mentioned a deterioration of the water quality along the main flow direction (south-easterly) to the so called "Salt block" in the extreme south-east.

3. NECESSARY INVESTIGATION TASKS

- The first step is to determine the geometry of the aquifer system by analyzing the existing sources of borehole information in the DWA and the Geological Survey of Namibia.
- Establish a control system for detecting illegal users and for monitoring of irrigation in general by using remote sensing techniques.
- An overall hydro census regarding the actual borehole situation must be undertaken for the extension of the monitoring system. Further test pumping of

certain key boreholes should be undertaken and water-sampling strategies must be defined.

- Recharge studies based on groundwater table fluctuation, chloride profiles and stable isotopes must be done for all three aquifers. The drilling of additional exploration boreholes may be necessary for undertaking some of these studies.
- To understand the aquifer system and for management purposes a three dimensional numerical groundwater flow model should be generated.

4. PROPOSED EXECUTION OF THE WORK

The following main activities are considered necessary to properly investigate the groundwater potential of the aquifers and to establish a sound management policy for the area. The total duration of the of the project is anticipated at around 24 months.

4.1 Desk Study

Duration: 1 month

The purpose is to assemble all available geohydrological information for the area. This would include the plotting of details of existing boreholes recorded in the DWA database on suitable maps for subsequent verification in the field.

All relevant reports, aerial photographs and satellite imagery pertaining to the study area must be studied for proper orientation in order to recommend any further adjustments to the program.

4.2 Hydro census

Duration 4 months

The purpose is to verify positions and water levels of existing boreholes and to record current production rates. Water samples are to be collected to determine whether water quality and age determinations. Newly acquired data must be compared with historic data to determine trends such as change in water levels and water quality with time.

Subject to results obtained from this survey adjustments to the program may be required.

4.3 Isotope Studies Further Drilling and Groundwater Flow Modeling

Duration 15 months

Recharge studies based on groundwater table fluctuation, chloride profiles and stable isotopes must be done for all three aquifers. The drilling of additional exploration boreholes and test pumping may be necessary for undertaking some of these studies.

Groundwater flow modeling must commence after the recharge studies. After further drilling, and test pumping, the final groundwater flow model will be the feasible instrument to discuss the stored reserves and to work out a sustainable management policy.

4.4 Final Report

Duration 3 months

The report will contain a full evaluation of the aquifer potential of the Stampriet Artesian Basin and will make recommendations on further action monitoring to be carried out in order to refine the model with time.

5. APPLICATION

The knowledge and level of expertise regarding modern recharge studies in semi-arid areas is currently lacking within DWA. Informal discussions were recently held with Mr. de Vries and Mr. Hans Beekman of the Free University of Amsterdam (VU) who have been actively involved in joint Geohydrological investigation projects with Botswana. The Department is keen in obtaining the expertise of the VU in order to undertake a full investigation of the Stampriet Artesian Basin. Mr. de Vries and Mr. Beekman expressed their interest in such a joint project. It is also intended to undertake such a study with the participation of Botswana as the system extends into that country. DWA would also like to utilize both MSc and PhD students to assist with the comprehensive study regarding recharge mechanisms of this important water source. DWA is furthermore interested in capacity building of its own staff (Technicians and Geohydrologists) through such a joint venture.

6. OFFERS

- DWA can provide transport to participants.
- Counterpart training will form an important part of the project.
- DWA will provide a team leader who will oversee the entire investigation and will be responsible for the overall co-ordination of all projects in the study area.

7. COST ESTIMATES

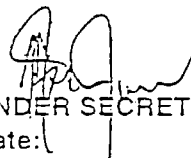
Costs for the project are estimated as follows:

Table 0-1 Total Cost Estimate for the Project

ITEM DESCRIPTION	COST (NS)
Desk Study	100 000
Hydrocensus	200 000
Recharge Studies	1 000 000
Drilling and Test Pumping	1 500 000
Groundwater Modeling	1 000 000
Final report	100 000
Contingencies	400 000
TOTAL	4 300 000

8. RECOMMENDATION

It is recommended that external funding agencies be approached in order to facilitate possible funding for the investigation required to realise the full groundwater potential of the Stampriet Artesian Basin in order that the system can be managed on a sustainable basis.


 UNDER SECRETARY FOR WATER AFFAIRS

Date: _____

2. Scope of Work

SCOPE OF WORK
FOR
THE STUDY
ON
THE GROUNDWATER POTENTIAL EVALUATION
AND MANAGEMENT PLAN
IN
THE SOUTHEAST KALAHARI (STAMPRIET) ARTESIAN BASIN
IN
THE REPUBLIC OF NAMIBIA

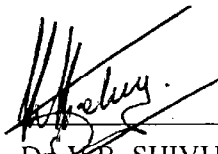
AGREED UPON BETWEEN


THE MINISTRY OF AGRICULTURE,
WATER AND RURAL DEVELOPMENT
AND

JAPAN INTERNATIONAL COOPERATION AGENCY

REPUBLIC OF NAMIBIA MINISTRY OF AGRICULTURE, WATER AND RURAL DEVELOPMENT
P/BAG 13184 1999 -01- 27
PERMANENT SECRETARY, AGRICULTURE, WATER AND RURAL DEVELOPMENT,

Done at Windhoek on the 27th of January, 1999


Dr. V.P. SHIVUTE
Permanent Secretary
Ministry of Agriculture, Water
and Rural Development


Mr. Shozo MATSUURA
Leader of the Preparatory Study
Team,
Japan International Cooperation
Agency

I . INTRODUCTION

In response to the official request of the Government of the Republic of Namibia (hereinafter referred to as "the Government of Namibia"), the Government of Japan decided to conduct a study on the groundwater potential evaluation and management plan in Southeast Kalahari (Stampriet) Artesian Basin in the Republic of Namibia (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the Department of Water Affairs of the Ministry of Agriculture, Water and Rural Development of the Government of Namibia and other authorities concerned.

The present document sets forth the Scope of Work with regard to the Study.

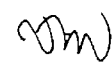
II . OBJECTIVES OF THE STUDY

The objectives of the Study are:

- (1) to investigate the groundwater flow mechanism and groundwater recharge mechanism in the Southeast Kalahari Artesian Basin
- (2) to evaluate the groundwater potential for sustainable usage in the Southeast Kalahari Artesian Basin
- (3) to formulate a groundwater management plan in the Southeast Kalahari Artesian Basin
- (4) to pursue technology transfer to counterpart personnel in the course of the Study

III . STUDY AREA

The Study will cover the Southeast Kalahari Artesian Basin (65,000km²) as shown in Appendix I .



IV. SCOPE OF THE STUDY

Stage I: Data Collection and Evaluation of Present Condition

1. Collection, review and analysis of related data and information
 - a. natural conditions
 - b. social and economic conditions
 - c. aerial photography
 - d. maps (topographical maps, geological maps)
 - e. existing boreholes
 - f. structure and institution of related organization
 - g. environmental considerations
 - h. other relevant data and information
2. Landsat imagery and aerial photo interpretation
3. Field reconnaissance
 - a. topographical and geological investigation
 - b. water levels of existing boreholes
 - c. water quality of existing boreholes
 - d. water usage
 - e. preliminary environmental survey
 - f. other relevant investigations
4. Geophysical exploration
5. Present water usage and water consumption forecast

Stage II : Groundwater investigation

1. Test well drilling, well logging and pumping test
2. water quality analysis
3. Recording of groundwater levels

4. Study of precipitation, evaporation and surface water run-off

Stage III: Analysis and interpretation

1. Constitution of groundwater recharge and flow mechanism
2. Water balance analysis
3. Groundwater modeling
4. Evaluation of the groundwater potential for sustainable usage
5. Formulation of groundwater management plan
 - a) Abstraction of groundwater
 - b) Monitoring plan
 - c) Institutional arrangement
 - d) Environmental management plan

V. SCHEDULE OF THE STUDY

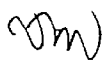
The Study will be carried out in accordance with the tentative schedule as attached in the appendix II. The schedule is subject to modification if the necessity arises during the course of the Study and mutually agreed upon by both Parties.

VI. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Namibia. (See attached Appendix II)

1. Inception Report:

Twenty (20) copies in English at the commencement of the first field survey in Namibia. This report will contain the schedule and methodology of the Study as well as outline of the field survey.



2. Progress Report (1):

Twenty (20) copies in English at the end of the first field survey. This report will summarize the findings of the first field survey.

3. Progress Report (2):

Twenty (20) copies in English at the end of the second field survey. This report will summarize the findings of the second field survey.

4. Interim Report:

Twenty (20) copies in English at the beginning of third field survey.

5. Draft Final Report:

Twenty (20) copies in English at the beginning of fourth field survey. The Government of Namibia shall submit its comments within one (1) month after the receipt of the Draft Final Report.

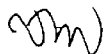
6. Final Report:

Thirty (30) copies in English within two (2) months after the receipt of the comments on the Draft Final Report.

VII. UNDERTAKINGS OF THE GOVERNMENT OF NAMIBIA

1. The Government of Namibia shall:

- (1) Take reasonable measures to ensure the safety of the Team for the duration of their assignment in Namibia,
- (2) To permit the members of the Team to enter, leave and sojourn in Namibia for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees,



- (3) To exempt the members of the Team from taxes, duties, fees and any other charges on equipment, machinery and other materials brought into Namibia for the conduct of the Study,
 - (4) To exempt the members of the Team from income tax and charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study,
 - (5) To provide necessary facilities to the Team for remittance as well as utilization of the funds introduced into Namibia from Japan in connection with the implementation of the Study,
 - (6) To secure permission for the Team to enter into private properties or restricted areas for the implementation of the Study,
 - (7) To secure permission for the Team to take copies of all data and documents (including photographs and maps) related to the Study out of Namibia to Japan, and
 - (8) To facilitate medical services as needed, expenses for which will be chargeable to the members of the Team.
2. The Government of Namibia shall bear claims, if any arise, against the members of the Team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the member of the Japanese survey team.
3. The Department of Water Affairs, Ministry of Agriculture, Water and Rural Development shall act as a counterpart agency to the Japanese Study Team and also as a coordinating body in relation with other governmental and non-governmental organizations for the smooth implementation of the Study. The Department of Water Affairs shall, at its own expense, provide the Team with the following, in cooperation with other organizations concerned:

- (1) available data and information related to the Study
- (2) counterpart personnel
- (3) suitable office space with necessary equipment in Windhoek and a regional office of the Department of Water Affairs.
- (4) credentials or identification cards

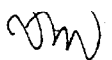
VIII. UNDERTAKINGS OF JICA

For the implementation of the Study, JICA shall take the following measures:

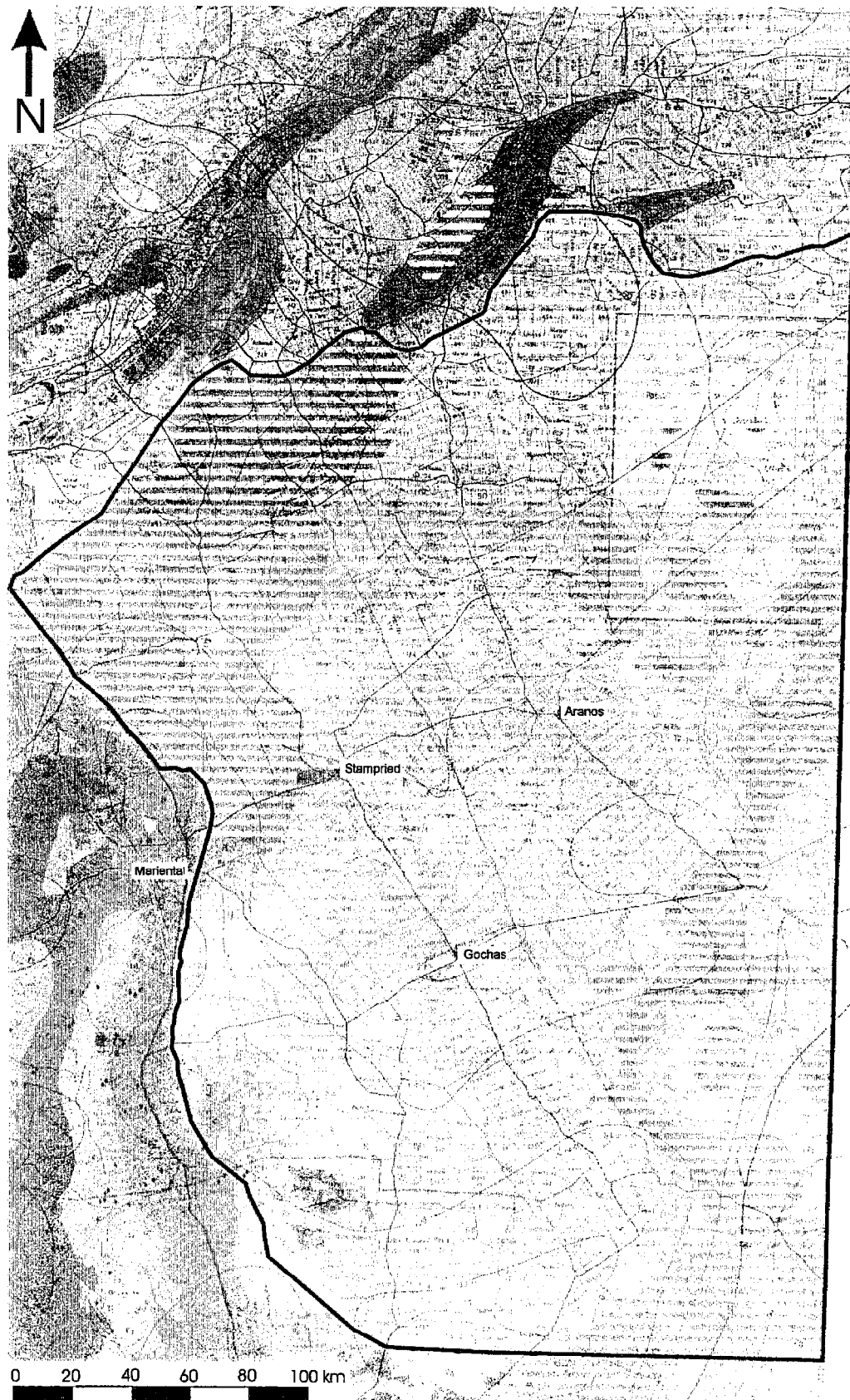
1. to dispatch, at its own expense, the team to Namibia
2. to pursue technology transfer to counterpart personnel in the course of the Study.

IX. CONSULTATION

JICA and the Department of Water Affairs shall consult with each other in respect of any matter that may arise from or in connection with the Study.



Appendix 1: Boundary for the study area of the Southeastern Kalahari Artesian Basin



APPENDIX II

The Study on
the Groundwater Potential Evaluation and Management Plan
in the Southeast Kalahari (Stampriet) Artesian Basin in the Republic of Namibia

TENTATIVE SCHEDULE

MONTH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
WORK IN NAMIBIA																														
WORK IN JAPAN																														
REPORT PRESENTATION																														

NOTE IC/R : Inception Report
P/R : Progress Report
IT/R : Interim Report
DF/I : Draft Final Report
F/R : Final Report

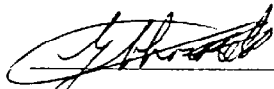
3. Minutes of Meeting

MINUTES OF MEETINGS
ON
SCOPE OF WORK
FOR
THE STUDY
ON
THE GROUNDWATER POTENTIAL EVALUATION
AND MANAGEMENT PLAN
IN
THE SOUTHEAST KALAHARI (STAMPRIET) ARTESIAN BASIN
IN
THE REPUBLIC OF NAMIBIA


AGREED UPON BETWEEN

THE MINISTRY OF AGRICULTURE,
WATER AND RURAL DEVELOPMENT
AND
THE JAPAN INTERNATIONAL COOPERATION AGENCY

Done at Windhoek on the 27th of January, 1999



Mr. Greg CHRISTELIS
Deputy Director: Geohydrology,
Ministry of Agriculture, Water
and Rural Development



Mr. Shozo MATSUURA
Leader of the Preparatory Study
Team,
Japan International Cooperation
Agency

In response to the request of the Government of the Republic of Namibia (hereinafter referred to as "the Government of Namibia"), the Government of Japan has decided to conduct a Study on the groundwater potential evaluation and management plan in the southeastern Kalahari (Stampriet) Artesian basin in the Republic of Namibia (hereinafter referred to as "the Study") through Japan International Cooperation Agency (hereinafter referred to as "JICA").

The Japanese Preparatory Study Team (hereinafter referred to as "the Study Team"), headed by Mr. Shozo MATSUURA, visited the Republic of Namibia from January 12th to January 28th, 1999, where a field survey of the study area was carried out and a series of meetings were held with the Department of Water Affairs, the Ministry of Agriculture, Water and Rural Development (hereinafter referred to as "DWA") and other authorities concerned. Both sides agreed upon Scope of work for the Study which was signed on January 27, 1999.

As a result of discussions between both sides, the issues, clarification and consensus with regard to the Study are outlined as follows:

1. The Namibian side proposed that the Study would be of a comprehensive and thorough nature. The Japanese side responded that the Study would be carried out in step wise manner by mutual consultation whenever it is necessary in the process of the Study, with a view to the wide range and complex nature of the Study, considering the effective use of funds allocated to the Study. The need for flexibility was recognized by both sides and each investigation item in the succeeding steps of the Study would be determined from the results of the previous stage.
2. Study Area
Study stage I covers the entire study area. However the details of the area covered by the groundwater model will be determined from the results of the stage I and stage II studies in close consultation and examination between both sides.
3. The Japanese side emphasized the importance of the field investigations to be implemented smoothly and effectively as they form the basis of detailed analysis in the Study. The Namibian side will make every effort to inform the local public of the plan

of the operation of the investigations and will furthermore facilitate in obtaining the consent of local landowners when needed.

4. Both sides agreed that for the smooth and effective implementation at the study, a steering committee will be formed. Members of the steering committee will include delegates from Japanese consulting team, NamWater, the Namibian Geological survey and other appropriate related organizations under the chairmanship of DWA.
5. The Japanese side requested that all the reports produced by the study could be made open to the public. This is in order to promote transparency and accountability during the duration of the Study. The Namibian side agreed to honor this request.
6. The Namibian side emphasized the desire to include local expertise in the Japanese Study team. This is in order to build up local expertise for the benefit of the counter part. The Japanese side agreed to promote this by subcontracting and/or adoption of the relevant local study members in accordance with the procurement regulations of JICA.

Handwritten signature and initials, possibly 'NM' or 'NW', located at the bottom right of the page.

4. 主要面談者リスト

1. ナミビア側関係機関

(1) 農業・水資源・地方開発省

(MAWRD: Ministry of Agriculture, Water and Rural Development)

Dr. Vaino Shivute Permanent Secretary

Mr. K. S. Kahuure Deputy Permanent Secretary

(1)-1 水資源局 (DWA: Department of Water Affairs)

Mr. Piet HEYNS Directorate Resource Management (Director)

Mr. G. Christelis Deputy Director (Head of Geohydrology Division)

Mr. Dudley BIGGS Deputy Director (Head of Planning Division)

Mr. Guido Van Langenhove Deputy Director (Head of Hydrology Division)

Mr. D. Louw Sub-division Geohydrological Investigation

Mr. I Bardenhagen Sub-division Ground-water Management (独国専門家)

Mr. Strub Sub-division Ground-water Management (独国専門家)

Mr. D. Louw Chief Drilling Foreman/ Section Drilling

Mr. Ben Groom Environmental Economist/ Planning Division

(2) 国家計画委員会 (NPC: National Planning Commission)

Mr. A. F. Ndishishi Permanent Secretary

Mr. Wina K. Kawana Economist/ Secretariat

(3) ナミビア地質調査所 (GSN: Geological Survey of Namibia)

Mr. Rainer Wackerle Senior Geophysicist

Mr. Berti Roesener Chief Economic Geologist

(4) ナミビア石油公社 (NAMCOR: National Petroleum Corporation of Namibia)

Dr. Roger Swart Technical Manager

(5) 国家リモートセンシングセンター／森林局／環境・観光省 (National Remote Sensing Center/ Direction Forestry/ Ministry of Environment and Tourism)

Mr. Harold Kisting Director

(6) ナミビア水会社 (NAMWATER)

Ms. Marylinda Conradie	Lab. & Research/ HQ(Windhoek)
Mr. Hannes Grobbelaar	Geohydrologist/ HQ(Windhoek)
Mr. Hennie Val Heerden	Acting Area Manager of Mariental
Mr. Mg Richter	Acting Regional Head of Mariental

(7) スタンプリート農家連合 (Farmers' Union of Stampriet)

Mr. B. Joubert	Member of Committee
Mr. Joe Katjaita	
Mr. Derick Strauss	

(8) ウーレンホースト政府農場 (Uhlenhorst Government Farm)

Mr. Simeon Niingwenojh

(9) 民間コンサルタント/業者 (南ア業者を含む)

Mr. Greg Symons	Poseidon Geophysics/ Windhoek
Mr. Martin Frere	Geodass/ Sunnighill, 南アフリカ
Mr. Arnold Bittner	BIWAC: Bittner Water Consult/ Windhoek
Mr. E.R. d'Engelbronner	INTERCONSULT/ Windhoek
Mr. Fred Solesbury	GEOTEC/ Windhoek
Mr. Pierre Botha	Water Sciences cc. / Windhoek
Mr. Viv Stuart Williams	PARKMAN Namibia/ Windhoek
Dr. Jurgen Kirchner	Groundwater Investigation/ Windhoek
Ms. Naomi van der Walt	Aqua Alpha/ Pretoria
Mr. Carl Mendelsohn	Atlas Copco / Windhoek
Mr. Jan de Bever	ICV: Industrial & Commercial Vehicles/ Windhoek
Mr. Renier Jooste	Super Rock Drills/ Pretoria

(8) その他

Dr. Gideon Tredoux	CSIR/ Stellenbosch, 南アフリカ
Mr. A.S. Talma	CSIR/ Pretoria, 南アフリカ

2. 日本側関係機関

(1) 南アフリカ日本大使館

OTSUKA Seiichi	公使
ISHIZUKA Hayato	一等書記官
UTSUBO Kuniaki	三等書記官

(2) 国際協力事業団（南アフリカ事務所）

下村 則夫	所長
中村 俊之	所員

5. 質問票及びその回答

ITEM	EXISTANCE			If Exist : AVAILABILITY			
	Exist	None	Indefinite	Possible to provide	Available	For sale	Exclusive
1. GENERAL MATTERS	—	—	—	—	—	—	—
1.1 Development plans and policies	—	—	—	—	—	—	—
1.1.(1) Current five year sectorial development plan	◎First National Development Plan			◎	✓	✓	—
①Water resources development		✓		◎ Water supply Policy only			
②Agricultural development	✓			◎			
③Urban development		✓					
④Industrial development	✓			◎			
1.1.(2) Medium to long term water supply plan	✓				✓ in Namwater		
1.1.(3) Investment program for the water resources development	✓				✓ in Namwater		
1.1.(4) Current regional development plan for the study area	✓				✓ in Namwater		
1.1.(5) Basic policy of water supply	✓			◎			
1.2 Law, regulation and customary practice related to water	—	—	—	—	—	—	—
①Water law	✓			◎			
②Other regulation	✓						
③Customary practice		✓					
1.3 Census and statistical data in the study area	—	—	—	—	—	—	—
①Population by district and main city	✓			◎			
②Population density map		✓					
③Administrative district division map	✓			◎			
④Important products of agriculture, industry and mining	✓			◎			
	—	—	—	—	—	—	—

注： ◎ 収集資料として入手

ITEM	EXISTANCE			If Exist : AVAILABILITY			
	Exist	None	Indefinite	Possible to provide	Available	For sale	Exclusive
2. BASIC SOCIOECONOMIC DATA FOR THE STUDY AREA	—	—	—	—	—	—	—
2.1 Population forecast by district and main city	✓			◎			
2.2 Current water consumption	✓			◎	partly		
2.3 Water demand projection	✓			◎	partly		
	—	—	—	—	—	—	—
3. BASIC TECHNICAL DATA AND INFORMATION FOR THE STUDY AREA	—	—	—	—	—	—	—
3.1 Geographical data and information	—	—	—	—	—	—	—
3.1.(1) Topographical maps	—	—	—	—	—	—	—
① 1/250,000	✓			◎			
② 1/100,000		✓					
③ 1/50,000	✓			◎			
④ 1/2,5000		✓					
3.1.(2) Aerial photos	—	—	—	—	—	—	—
① 1/150,000							
② 1/50,000	✓			✓		✓	
3.1.(3) Map of catchment area and river system	✓			✓			
3.1.(4) Land use maps	✓						
3.1.(5) Meteorological data	—	—	—	—	—	—	—
① Location maps of observation stations	✓				✓		
② List of stations including: name, observation items and period			✓				

注： ◎ 収集資料として入手

ITEM	EXISTANCE			If Exist : AVAILABILITY			
	Exist	None	Indefinite	Possible to provide	Available	For sale	Exclusive
③ Observation data at several typical stations regarding : temperature, humidity, evaporation, wind speed, sunshine hour etc.	✓				✓		
3.1.(6) Rainfall data	—	—	—	—	—	—	—
① Location map of observation stations	✓			◎			
② List of stations including: name, observation items and period, type of gage and recorder etc.	✓				✓		
③ Monthly data obtained at several typical stations	✓			◎			
④ Rainfall intensity-duration curves of typical stations	✓				✓		
⑤ Isohyetal map showing annual mean	✓			◎			
3.1.(7) Flood runoff data	—	—	—	—	—	—	—
① Location maps of observation stations	✓			◎			
② List of stations including: name, observation items and period, type of gage and recorder	✓				✓		
③ Runoff data obtained at several typical stations and each flood system	✓			◎			
	—	—	—	—	—	—	—
3.2 Geological data and information	—	—	—	—	—	—	—
3.2.(1) Geological maps	—	—	—	—	—	—	—
① 1/1,000,000	✓			◎			
② 1/250,000	✓			◎			
③ 1/100,000		✓					
④ 1/50,000		✓					

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ITEM	EXISTANCE			If Exist : AVAILABILITY			
	Exist	None	Indefinite	Possible to provide	Available	For sale	Exclusive
3.3 Other	—	—	—	—	—	—	—
3.3.(1) Well inventory	✓			◎	partly		
3.3.(2) Database	—	—	—	—	—	—	—
①Groundwater data	✓				✓		
②Meteorological data	✓				✓		
③Hydrological	✓				✓		
	—	—	—	—	—	—	—
4. WATER SUPPLY SYSTEM	—	—	—	—	—	—	—
4.1 Current water supply volume data	✓						
4.2 Outline of existing water supply system including facilities, current state of operation, and managing body	✓						
4.3 Proposed plan of water supply system							
4.4 Water tariff tables (domestic, industrial, agricultural, livestock)							
4.5 Water right	—	—	—	—	—	—	—
①Regulation and customary practice of water right	✓						
②Location map of permitted water right							
③List of registered water right	✓						
4.6 Water quality standard (potable, industrial, agricultural)	✓			◎			
	—	—	—	—	—	—	—
5. GROUND WATER IN THE STUDY AREA	—	—	—	—	—	—	—
5.1 Hydrogeological maps	—	✓	—	—	—	—	—

注： ◎ 収集資料として入手

ITEM	EXISTANCE			If Exist : AVAILABILITY			
	Exist	None	Indefinite	Possible to provide	Available	For sale	Exclusive
5.2 Well data	—	—	—	—	—	—	—
5.2.(1) Number of existing wells	—	—	—	—	—	—	—
① Sallow well		✓					
② Borehole	✓						
5.2.(2) Situation of existing wells	—	—	—	—	—	—	—
① Location map of existing wells	partly				✓		
② Well structure of several typical wells	✓				✓		
③ Static groundwater level of several typical wells	✓			◎			
④ Dynamic groundwater level of several typical wells	✓				✓		
⑤ Production amount of several typical wells	✓				✓		
5.3 Groundwater quality	—	—	—	—	—	—	—
① Groundwater quality data of several typical wells	✓				✓		
② Groundwater dating results of tritium, carbon14 etc.	✓			◎			
5.4 Existing groundwater monitoring system	—	—	—	—	—	—	—
① Location map of monitoring wells	✓			◎			
② Monitoring items	✓			◎			
③ Monitoring results of several typical wells	✓			◎			
	—	—	—	—	—	—	—
	—	—	—	—	—	—	—
	—	—	—	—	—	—	—
	—	—	—	—	—	—	—

注： ◎ 収集資料として入手