Regional Strategy for the Utilisation of the Nubian Sandstone Aquifer System

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Annex 2

CENTRE FOR ENVIRONMENT & DEVELOPMENT FOR THE ARAB REGION AND EUROPE

INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT
Regional Strategy for the Utilisation of The Nubian Sandstone Aquifer System

Annex 2

Bibliography

CENTRE FOR ENVIRONMENT & DEVELOPMENT FOR THE ARAB REGION AND EUROPE

INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT
Preface

Throughout history, access to water has been essential to social and economic development and stability of cultures and civilizations. Water is an indispensable commodity of life. Groundwater is considered as one of the principal fresh water resources. Under the thrust of the ever-increasing population in the world, there happens to be a notable deficiency in the fresh water supplies. This state of affairs urged individuals, communities, authorities and international agencies to search for groundwater in an attempt to keep pace with the continually increasing demand for water.

The countries of Northeast Africa, Egypt, Libya, Chad and Sudan share The Nubian Sandstone Aquifer System (NSAS), which represents a huge fresh water reserve. The four countries have expressed their interest to share their experiences and to develop this regional Aquifer System.

With this in mind The Centre for Environment and Development for the Arab Region and Europe (CEDARE) developed a programme for The Development of The Nubian Sandstone Aquifer System. The Programme was then funded by the International Fund for Agricultural Development (IFAD) and executed by CEDARE. The results of the study presented in this report have produced a Regional Strategy for the utilization of this huge common resource, which hopefully will facilitate consultation between the concerned countries and create a sense of sharing a common resource in order to exploit it rationally.

This detailed study has been conducted by a team of experts guided by Dr. Mohamed Bakhbakhi NSAS Regional Coordinator.

May I avail myself to this opportunity to thank the collaborating national institutions for their efforts and cooperation. Last but not least I wish to express, on behalf of the governments concerned, and on behalf of CEDARE, our deep appreciation and gratitude to IFAD for financing the project.

Dr. Kamal A. SABET
Executive Director
Acknowledgments

The “Programme for the Development of a Regional Strategy for the Utilisation of the Nubian Sandstone Aquifer System (NSAS)” is funded by the International Fund for Agricultural Development (IFAD). The execution of the Programme is the primary responsibility of CEDARE. The NSAS Programme team wish to extend their thanks and appreciation to IFAD who has funded this programme and made this publication and the associated study possible. They wish also to express their gratitude to CEDARE for hosting the Programme and making its implementation come true. The guidance and support of Dr. Kamal Sabet, Executive Director of CEDARE is highly appreciated.

The NSAS Programme wish also to convey its gratefulness to the consultants of the Programme whose valuable inputs are highly appreciated, namely Dr. Abdou Shata, Senior Geology Consultant, Mr. Philippe Pallas, Dr. G. Pizzi and Eng. Saleh Nour.

The Programme acknowledges the involvement and the effective contribution of the National Institutions of the four concerned countries whose cooperation, interaction and provision of information throughout the implementation of the Programme was of ultimate benefit and utmost importance towards the forwarding and accomplishment of this study. Special vote of thanks are to the National Coordinators; Dr. Moussa Terap – Chad, Dr. Fatma Attia – Egypt, Dr. Omar Salem – Libya and Dr. Idris M. Idris – Sudan. Appreciation is extended to all the members of the Steering Committee and the Regional Technical Review Committee for their constructive input and time.

Special recognition to Ms. Sahar Ezz El Arab, Secretary of the Programme for typing the report.

NSAS Programme Staff

Dr. Mohammed Bakhabaki Hydrogeologist (Regional Coordinator)
Eng. Amr Abdel-Meguid Water Resources Engineer
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Forward

This study on the development of a regional strategy for the utilization of the Nubian Sandstone Aquifer System has been prepared by Dr. Mohamed Bakhbakhi (CEDARE Regional Programme Coordinator), the Programme’s team of consultants, Professor Dr. A. Shata, Mr. Phillipe Pallas, Dr. G. Pizzi and Engineer Saleh Nour and the staff of The Programme Engineer Amr Abdel-Meguid and Engineer Omar Elbadawy.

In the preparation of this study numerous reports, studies, documents, briefs and write up have been consulted. Below is a partial list of these reports:

1) The final reports of the “special research Project in Arid areas period 1984 – 1987” and on “Hydrogeological investigations in the Nubian Aquifer System”, Eastern Sahara prepared by Klitzsch et al, 1987, as well as research on modeling of the Nubian Aquifer System by Heinl and Binkman (Published in 1989), the hydrogeological investigation carried out by Heinl and Thorweih in Northern Sudan, 1983 and S.W. Egypt, 1993. (annex 1),


3) The many technical reports prepared by the Technical University of Berlin and ACSAD upon request of OSS.


6) Pallas P. (1978) water resources of the socialist People’s Libyan Arab Jamahiriya. 2nd Symposium of geology of Libya-Tripoli.


8) The technical reports prepared by the National institutions and regional organizations (annex 1),


The results achieved during our study are included in a final report made up of four volumes and two annexes.

This is Annex 2 of a 4 volumes and 2 annexes report

Volume 1: Executive summary
Volume 2: Hydrogeology
Volume 3: Groundwater Model
Volume 4: Administration
Annex 1: Information System
Annex 2: Bibliography

Note: The denomination used and the boundaries shown on any map or graphical appendices to this document do not imply, on the part of IFAD, CEDARE or any other party associated with the preparation of this document, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.
List of Abbreviations

ACSAD  Arab Center for Studies of Arid zones & Dry Lands
Bm³/y  Billion cubic meters per year (10⁹ m³/y)
CEDARE Centre for Environment and Development For the Arab Region and Europe
EIA    Environmental Impact Assessment
GIS    Geographic Information System
GWA    General Water Authority, Libya
IFAD   International Fund for Agricultural Development, Rome
IDB    Islamic Development Bank
m.b.g.l meters below ground level
m.a.s.l meters above mean sea level
m.b.s.l meters below mean sea level
MSL    mean sea level
mg/l   milligrams per liter
g/l    grams per liter
Mm³/y  Million cubic meters per year
Mm³/day Million cubic meters per day
GMS    Ground water Modeling System
AQUQA3D Ground water Modeling Software
NSAS   Nubian Sandstone Aquifer System
NAS    Nubian Aquifer System
PNAS   Post Nubian Aquifer System
RC     Regional Coordinator
RIGW   Research Institute for Groundwater – Egypt
RPSC   Regional Programme Steering Committee
RTRC   Regional Technical Review Committee
SSO    Sahara & Sahel Observatory
TDS    Total Dissolved Solids
TUB    Technical University of Berlin
UNEP   United Nations Environmental Programme
UNDP   United Nations Development Programme
U.S.G.S United State Geological Survey
mem    Million Cubic meters
PPM    Parts per Million
GL     Ground Level


Abufila, T. M. (1984) : A Three-dimensional Model to Evaluate the Water Resources of the Kufra and Sarir Basins, Libya, M.S. These, Ohio University. Athens Ohio USA.

Abu Zeid M. (1991), water resources assessment for Egypt Rigwa/ Iwaco (Editors), Round Table meeting (RTM-91) Cairo, Egypt.


Agricultural Development Council(1972) : Final Report by the Sub-Committee for Agricultural Development in Area of Al Kufra, Al Sarir and Jalu, Agricultural Development Council, Tripoli, Libya, 81 p.


Ahmad, M. U. (1979): Preliminary Pumping lift predictions of the Kufra Well Fields, Ohio University, Athens Ohio, USA, 2 p., 2 Tab., 7 sheet.


Al-Abeidi, Eskangi A., Ramadan (1972) : Final Report by the sub-Committee for Agricultural Dev. in Areas of Al Kufrah, Al Sarir and Jalu., Sub-Committee for Agricultural Dev. In Areas of Al Kufrah, Al Sarir and Jalu, 81 p.


Attia, Fatma (1991), Technical evaluation of Groundwater Development schemes in upper Egypt, RIGWA/ IWACO (Editor) Round Table meeting (RTM-91) Cairo, Egypt.


Ball, J. (1927) : Kharga Oasis, its Topography and Geology, Survey Department, Cairo, Egypt.


Barron, T.(1907) : The topography and geology of the Peninsula of Sinai (western portion), Survey Department, 241 p.


Bouton, A.(1973) : Comparison Between Stainless Steel and Fibreglass for the Equipment (casing and screens) of wells in the Kufra-Sarir Project, GWA, 2 p.


Brown and Root (1992) : Biostratigraphy of Cuttings and Core Samples from PZ-518 C-D well, Tazerbo area, Kufra Basin, Libya. Report No. 4764 Ib Project No. Ib/15422.,

Brown and Root (1992) : PZ-618 C-D well, Tazerbo Area, Kufra Basin. Biostratigraphy of Cuttings and Core Samples from interval 3m, 848 m TD. Report No. 4781/IB, Great Man Made River Project, Tripoli, Libya.


Burdon, D.J., Pavlov, M. J.(1959) : Proposed Predevelopment Investigations Prior to large Scale Groundwater Development In the Western Desert of the Egyptian Region, U.A.R.”.


Burollet, P.F., Manderscheid, G., Magnier, Ph.(1971) : Tectonics of Africa. UNESCO Section on NE Africa., UNESCO.


CEC: Commission of the European Communities(1980) : EC directive relating to the quality of water intended for human consumption. 80/778/EEC.

CEDARE: (1994) : Regional programme for the development and utilization of the Nubian sandstone aquifer, project document, CEDARE: Cairo, Egypt, 104 P.


Dachroth, W., Sonntag, C.(1983) : Grunwasserneubildung und Isotopendatierung in


Desio, A.(1935) : Missione Scientifica della Raelle Accademica d’Italia a Cufra (1931-ix) v.1, Studi geologica Sulla Cirenaica, Deserto Libico Sulla Tripolitania sul F.


Land Reclamation. In Salem, M.J. and Busrewil, M.T. (eds.) Geology of Libya.,

Secretariat of Agric. Reclam. And Land Dev., Tripoli (in Arabic), Libya, 55p.,
3 maps.

Quantitative Model of the Kufra Sarir Basin, Libya (No. 3 dated June 1980)”,
Unpublished, Secretariat of Agriculture Reclamation and Land Development, Tripoli,
Libya.

Socialist People Libyan Arab Jamahiriya. Technical report of the Secretariat of
Agricultural Reclamation and Land Development, Unpublished Report, WSD.,
Tripoli., Ministry of Agriculture (Libya), pp. 136 + appendices..

Extraction by the Oil Companies in Eastern Jamahiriya for Oil Wells Injection
Purposes, Secretariat of Agriculture Reclamation and Land Development, Tripoli,
Libya.

El-Ramly, I.M., Fadel, M(1980) : Groundwater Resources Development in Al Kufrah and
Sirt Basins for the Creation of new Urban Centres: Unpublished Report, Secretariat of
Agriculture Reclamation and Land Development, Tripoli, Libya..

El-Shazly, M.M.(1960) : Contribution to the study of heavy minerals in the Nubian
Sandstone section of the New Valley project area, El Kharga Oasis”, Desert Research
Institute Bulletin, Cairo, Egypt.

Amin, N. B.(1976) : Geology of Kharga -Dakhla Oasis Area, Western Desert, Egypt,
from landsat, Nasa Landsat G- 27930, Remote Sensing Center, Academy of Scientific
Research And Technology, 1 Satellite Images.

Element Analysis in the Nubian Sandstone of Southern Libya. 5th Symp. on the

Embabi, N.S.(1969) : The Semi-Playa Deposits of Kharga Depression, the Western Desert,
Egypt, Bulliten of Society of Geography of Egypt, no. 41/42, p. 73 – 88.

of Geophys. Union of Mexico, No. 1, Universidad Nacional Autonoma de Mexic,
Universidad Nacional Autonoma de Mexico.


Ezzat, M.A.(1964) : Hydrogeology of the New Valley Project, Western Desert, Egypt, With Special Reference On Kharga Oasis”, Unpublished Master’s dissertation, Department of Mining Geology, Faculty of Engineering, Cairo University.


Fuad, Jamal, Faraj, Majbiri (1977): Observations on the Behaviour of some summer crops grown at Sarir Production Project, Regional Agricultural Research Centre, Libya.


Gefli(1977) : Detailed Soil Survey; Jalo-Ojla. Scale 1:10,000., Gefli.


GPC: General Petroleum Company of Egypt(1984) : Hydro-Agricultural Study Project,
Bibliography


German Consult (1973): Land Classification - Kufra Settlement Project. Scale 1:5,000., German Consult.


Geyh, M.A (1978), Interpretation of environmental isotope data of groundwater, Arid and


GMBH Agrar and Hydrotechnick (1966): Hydrogeological, Hydrological and Geoelectrical Study in the Agedabia Area and in other Areas near Agedabiya, GMBH Agrar and Hydrotechnick.


langguth, H. R., Voigt, R. (1980) :


Bibliography

Hefny, K. (1991), Planning for Groundwater Development of Nubian Sandstone Aquifer for sustainable Agriculture. RIGWA/IWACO (editors), Round Table meeting (RTM-91) Cairo, Egypt.


Iskander. W.(1986) : Utilization of Ground-water in Combating Desertification in Dongola Area, Northern Region, Sudan; Paper Submitted to International Workshop on Sand
Transportation and Desertification in Arid Lands.


Issawi, B., Said, R., Kerdany, M.(1964) : Contributions to the Pre history of Nubia, No.1, Preliminary Results of a Geological Expedition to Lower Nubia and to Kurkur and Dungul Oasis, Egypt”,, Museum of New Mexico Press.


Jacob, C. E.(1964) : Drawdown Test to Determine Screen Loss and Effective Radius of an Artesian Well, to be Published in Proc. Amer. Soc. Civil Engrs., Proceedings of International Conference On Groundwater and Man.


Johnson, R. C.(1975) : Simulation of the Behaviour of the Kufra Well Fields, Ohio University, Athens, Ohio, USA.


JVQ: Joint Ventura Qattara (1978) : Study Quattara-Depression, Special Volume: Regional; Geology and Hydrogeology, unpublished report of Lahmeyer International Gmbh, Salzgitter Consult G, GMBH Agrar and Hydrotechnick.


Keulen, H. Van (1975) : Simulation of water use and herbage growth in arid regions. – Wageningen.,


Kheir, O., Thorweihe, V. (1987) : Occurrence of water interaction in the Dongola area,


Klitzsch, E.(1985) : Geological interpretation map Africa 1 : 1 000 000, Sheet NE 35. - IFH BERLIN.


Klitzsch, E., Schrank, E(1987) : Research in Egypt and Sudan - Results of the Special Research Project Arid Areas, (Sonderfor- Schungsbereich “Geowissenschaftliche Proleme in ariden, Berliner Geowiss Abh., 7501-3, 967 P.


Klitzsch, E., Schrank, E(1990) : Results of the Special Research Project, Geoscientific Problems in Arid and Semi-arid Areas, Period 1987-1990, Berliner Geowiss Abh., p.120.


Mabrook, B., Abdel Shafi, M. S.(1977) : Hydrological and environmental isotope studies of Bara Basin, Central Sudan. - In: Symposium on trace elements in drinking water, agriculture and human, Middle Eastern Radioisotope Centre and Goethe Institute, p. 123 – 149.


Khartoum., Bonifica-Expert.


OSS: Observatory of Sahara and Sahel (1995) : Common water resources of the OSS region’s countries, transboundary river basins and deep aquifers, Scale 1:10.000.000, OSS 1995, compiled by J.Margat.


Bibliography


RIGW/IWACO, 1988, Hydrogeological Map of Egypt (1:2000 000), Research Institute for Groundwater Cairo, Egypt.


Rohlfs, G.(1976) : Expedition zur Erforschung der Libyschen Wuste. Verlag v. Theodor Fische,


Rudolph, J.(1981) : Edelgastemperaturen und Heliumalter 14C-datierter Palaowasser,


Salama, R. B. (1975) : Ground-water Resources of Sudan; Open Files, Rural Water Corporation.


Schoute, H. R. (1976) : Groundwater Resources in Kufra, Kufra - Sarir Authority., Tripoli, Libya, 93 p., 7 app., 1 fig.


Secretariat of Planning (1977) : Population Census. (1973), Summary Data, Census and Statistical Department, Tripoli, Libya.


Shata, A. et al. (1962), The geology, origin and age of groundwater supplies in some desert areas of U.A.R. Bull. De l’Int. de Desert D’Egypte, pp. 61-120.


Snow, D. T. (1965) : A Parallel Plate Model of Fractured Permeable Media, University of
California, 30 p.


Geowissenschaften in unserer Zeit.


Thorweihe, V. (1990) : Studies on Aquifer Properties the Dongola Area, Berliner Geowiss Abh., vol. 120.1.
Bibliography


Tilho, J. (1926) : Du nil aux confins du Tibesti par le centre du desert Libyque (explorations du prince Kemal el Dine). Comptes rendus des seances de l’academie des sci,


Tipton and Kalmbach Inc. (1973) : Sarir Production Project, Agricultural Development Council, Tripoli, Libya.


Tothill, J. D. (1944) : A note on Drafur from a soil conservation point of view. - In : Soil Conservation Committee’s Report, Appendix XVII, Sudan Government.
Bibliography


UN: (1987) : Proceedings of UN Technical Workshop on Trannational Project on Major Regional Aquifer in North, East Africa, UN.

UN: (1988) : Project Findings and Recommendation; Transnational Project on Major Regional Aquifer in North - East Africa, UN.


UN: (1988) : Transnational project on the major regional aquifer in Northeast Africa: Proceedings of project workshop, UN.


Bibliography


Libya.


Wycisk, P.(1987) : Contributions to the subsurface geology of the Misaha Trough and the Southern Misaha Trough and the Southern Dakhla Basin (Sw-Egypt /NW-Sudan).- This,


