Water resources and supply policy in developing countries with special reference to Sudan

A. M. Omer

ABSTRACT

Water resources available to Sudan from the Nile system and underground water resources provide potential for a three-fold increase in the irrigation sector. The national water resources strategy aims at ensuring water security for a variety of uses: domestic, industrial, agricultural and recreational. Sudan is dependent upon surface water and underground aquifers for its supply of water, both for humans and animals. However, these have not been managed well. Present resources must be strictly monitored and managed effectively if further deterioration is to be avoided. Community participation in water management programmes should fully involve women, who play a central role in the provision and safeguarding of water for domestic use in rural areas.

Key words | community water supply, Sudan, water resources, water supply management

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INTRODUCTION

Sudan is geopolitically well located, bridging the Arab world with Africa. Its large size and extension from north to south provide for several agro-ecological zones with a variety of climatic conditions, rainfall, soils and vegetation. In Sudan, with more than 10 million people not having adequate access to water supply, 20 million inhabitants being without access to sanitation, and a very low proportion of domestic sewage being treated, the investment which is needed to fund the extension and improvement of these services is substantial, and this is due to lack of funds, proper policies, and inadequacy of monitoring, evaluation and feedback mechanisms. Most governments in developing countries are ready to admit that they lack the financial resources for proper water and sanitation schemes. Moreover, historical, bilateral and multilateral funding accounts for less than 10% of total investment needs; therefore, the need for private financing is imperative. Many water utilities in developing countries need to work in earnest to improve the efficiency of operations. These improvements will not only lead to better services but also to enhanced net cash flows that can be re-invested to improve the quality of service. Staff productivity is another area where significant gains can be achieved.

Investment and consumption subsidies have been predicated on the need to (a) help the poor to have access to basic services, and (b) improve the environment. Failure of subsidies to reach intended objectives is due, in part, to lack of transparency in their allocation. Subsidies are often indiscriminately assigned to support investment programmes that benefit more middle and high-income families, which are already receiving an acceptable service, and consumption subsidies often benefit upper-income domestic consumers substantially more than low-income ones. A key element to successful private participation is the allocation of risks. How project risks are allocated and mitigated will determine the financial and operational performance and success of the project, under the basic principle that the risk should be allocated to the party which is best able to bear it. Many developing countries (Sudan is not an exception) are encouraging the participation of the private sector as a means to improve productivity in the provision of water and wastewater services, and to increase financial flows to expand the coverage and quality of services. Many successful private sector interventions have been involved. Private operators are not responsible for the financing of works, nonetheless

they can bring significant productivity gains, which would allow the utility to allocate more resources to improve and extend services. Redressing productivity, subsidy and cross-subsidy issues before the private sector is invited to participate, has proven to be less contentious and is also likely to encourage more private sector interventions (Omer 1995).

Water resources available to Sudan from the Nile system, together with groundwater resources, provide potential for a three-fold increase in the irrigated sector. There are also opportunities for increased hydropower generation. The strategy of Sudan at the national level aims at the multi-purpose use of water resources to ensure water security for attaining food security, drinking water security, fibre security, hydro-energy security, industrial security, navigation, waste disposal and security at the regional level, within an environmentally sustainable development context and in harmony with the promotion of basin-wide integrated development of the shared water resources (Noureddine 1997).

The Government has continued to pay for the development and operation of water systems, but attempts are being made to make the user communities pay for water charges. In order to ensure the sustainability of water supplies, an adequate institutional and legal framework is needed. Funds must be generated (a) for production, (b) for environmental protection to ensure water quality, and (c) to ensure that water abstraction remains below the annual groundwater recharge. At present, there are private sector providers who do not have an enabling environment to offer the services adequately. There is a need for the Government to have a mechanism to assist in the regulation and harmonisation of the private sector providers. Privatisation is part of a solution to improve service delivery in the water and sanitation sector. At present, there is a transitional situation characterised by: (i) a resistance to charge; (ii) insufficient suitable laws/law enforcement; (iii) insufficient capacities; and (iv) inadequate interaction between actors.

WATER RESOURCES

Sudan is rich in water (from the Nile system, rainfall and groundwater) and land resources (Table 1). Water resources are estimated at 84 billion m^3 and the annual rainfall varies from almost nil in the arid hot north to more than 1600 mm in the tropical zone of the south (Figure 1). The total quantity of groundwater is estimated to be 260 billion m^3, but only 1% of this amount is being utilised. Water resources assessment in Sudan is not an easy task because of the uncertainty of parameters, numerous degrees of freedom of variables, lack of information and inaccurate measurements. However, according to seasonal water availability, Sudan could be globally divided into three zones: (a) areas with water availability throughout the year which are the rainy regions (equatorial tropical zones); (b) areas with seasonal water availability; and (c) areas with water deficit throughout the year, which occupy more than half the area of Sudan.

The most important research and development policies which have been adopted in different fields of water resources are: (i) the water resource; (ii) irrigation development; (iii) the reuse of drainage water and groundwater; (iv) preventive and canal maintenance; (v) aquatic weed control and river channel development, and (vi) protection plans. The physical and human resource base can provide for sustainable agriculture growth and food security for itself and for others in the region. Failure to do so in the past derives from several causes and constraints, which are manageable. These include misguided policies, poor infrastructure, low level of technology use, recurring droughts and political instability. Perhaps the biggest challenge is that of finding resources for capital improvements in the light of changing water quality regulations and ageing systems (James 1994). Environmentalists and regulators are already working on solving the next set of issues in their constant pursuit of better quality. Increasing watershed and source protection, combating microbial and organic contamination that new detection techniques have enabled us to identify, controlling pesticide runoff, reducing chlorine by-products and upgrading ageing infrastructure are all receiving unprecedented attention. Surface water systems are continuing to rely on conventional treatment (coagulation, flocculation, sedimentation, filtration and disinfection) for particulate removal, but other treatment processes such as ozone and granular activated carbon will see increased use, while new disinfection strategies will be needed to minimise both

Table 1 | Land use, land-resource zones and water resources

(a) Land use ($\times 10^6$ hectares)

Geographical area	250.6
Land area	237.6
Cultivable area	8.4
Pastures	29.9
Forests and woodland	108.3
Uncultivable land	81.0
Area under crops, irrigated rain-fed mechanised, rain-fed traditional	10.0

(b) Land-resource zones

Zone	Area as % of total area of Sudan	Persons per km^2	Mean average rainfall range (mm)
Desert	44	2	0–200
QOS sands (sand dunes)	10	11	200–800
Central clay plains	14	19	200–800
Southern clay plains	12	8	800–900
Ironstone plateau	12	7	800–1400
Hill area and others	8	16	Variable

(c) Water resources

Water resource	Available number	Category water level (m)	Static level
Haffirs	824	0–0	824
Slow sand filters	128	0–0	128
Open shallow wells	3000	0–10	3000
Boreholes and deep wells	2259	0–25	1248
		26–50	478
		51–75	287
		76–100	246

microbial risks and unwanted by-products from disinfection. All these technologies were introduced by the Government just for show (there are many simple, cheaper and natural techniques like slow sand filtration which must be used). Sudan is therefore moving into a new era in the protection of drinking water supplies. It is

now time for water utilities to combine creative management, dependable treatment methods and new technologies to ensure that drinking water is as safe as possible.

COMMUNITY WATER QUALITY AND SANITATION MANAGEMENT

Community water supply and sanitation management is a new form of cooperation between support agencies in the water and sanitation sector and communities. It involves a common search to identify problems with the local water supply and sanitation systems, and the possibilities for, and constraints on, management by communities, as well as possible solutions that may be tested. Some fundamental principles of community water and sanitation management are:

i. Increased management capacity is the basis for improved water and sanitation systems, and each community develops its own specific management systems.
ii. Communities own the process of charge; facilitators and local researchers participate in the community's projects, not the other way around.

Through this approach, the support agency is no longer the provider of technical goods or solutions, but the facilitator of process to enhance the capacity of the community to manage its own water and sanitation systems. Constraints include:

i. A lack of funds or substantial delays in allocating funds for essential requirements such as operation and maintenance of irrigation and drainage projects, deterioration in data collection activities, etc.
ii. A lack of appropriate and consistent policies for water development for both large- and small-scale projects.
iii. Serious delays in completing water projects after major investments such as dams and other hydraulic structures, and main secondary canals not being completed.
iv. An absence or inadequacy of monitoring, evaluation, and feedback at both national and international levels.
v. A lack of proper policies on cost recovery, and water pricing or, if policies exist, absence of their implementation.
vi. A shortage of professional and technical manpower, and training facilities.
vii. A lack of beneficiary participation in planning, implementation, and operation of projects.
viii. Inadequacy of knowledge, and absence of appropriate research to develop new technologies and approaches, and an absence of incentives to adopt them.
ix. General institutional weaknesses and a lack of coordination between irrigation, agriculture, energy, health, environment, and planning departments.
x. Inappropriate project development by donor agencies, e.g. irrigation development with drainage, supporting projects which should not have been supported.
xi. A lack of donor coordination resulting in differing approaches and methodologies, and thus conflicting advice.

As developing nations strive to provide a safe and reliable drinking water supply to their growing and increasingly urbanised population, it is becoming more evident that new approaches to this problem will be needed. To meet this challenge, new methods of reclaiming and reusing water have been developed in cost-effective and environmentally sound ways (ODA 1987; Seckler 1992; Salih & Ali 1992; Omer 2000).

GOALS AND CHALLENGES

Sudan needs assistance in developing and implementing (a) river basin management, (b) diffuse source pollution, (c) environmental restoration, and (d) urban storm drainage. At present the international bilateral donor agencies, and relevant United Nations bodies provide such assistance. The international associations constitute

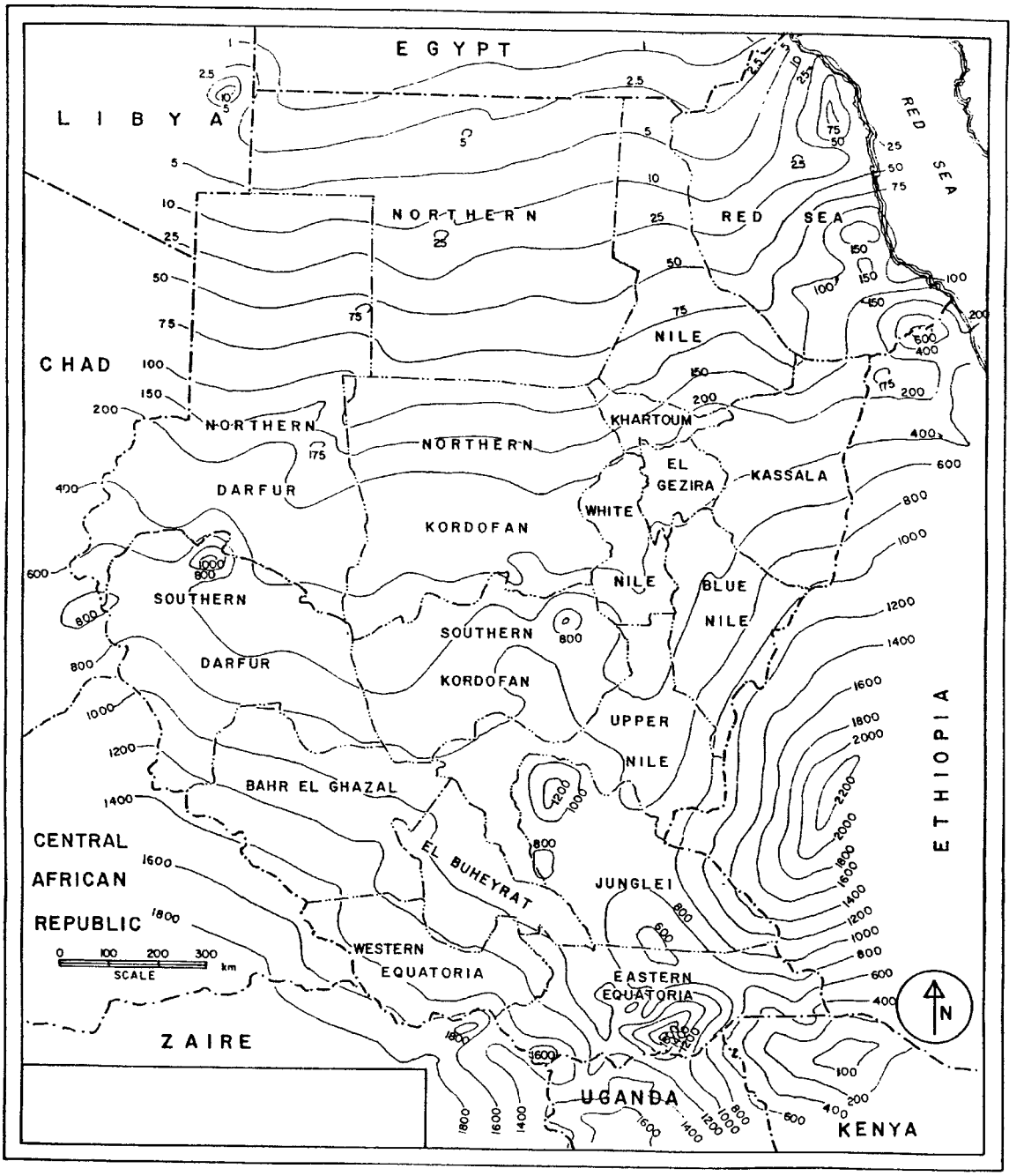

Figure 1 | Average annual rainfall in Sudan 1931–2000 (mm).

an additional, but as yet untapped, source of assistance. The solution, which should be seriously explored, is the forging of partnerships with bodies such as the World Bank and the appropriate United Nations agencies.

Advanced research and technology contribute to resolving water shortage and sanitation problems, and non-conventional reliable water supplies cannot be provided unless the environmental impacts are taken into

consideration. Looking to the future, Sudan has set the following priorities for water resource research and development until the year 2020:

i. Increase overall water-use efficiency to the maximum limit. This could be achieved by (a) improving the irrigation system and assuring it is sufficiently flexible to cope with modern farm irrigation systems, (b) developing the farm system, (c) drawing up a proper mechanism for water charges.
ii. Modify the cropping pattern, for example (a) planning different cropping patterns according to water quality, (b) gradually replacing sugar cane with sugar beet, (c) introducing genetic engineering and tissue culture to develop salt tolerant crops, and (d) reducing the area of clover (*Berseem*).
iii. Reuse all possible agricultural drainage water using proper technological means to deal with its quality, especially after implementing the irrigation development programme.
iv. Plan for the proper reuse of sewage effluent after drawing up guidelines for its use.
v. Research agreements of losses and suggest conservation projects.
vi. The conjunctive use and management of reservoirs and groundwater sources in the Nile valley, giving special consideration to drought conditions.
vii. Develop non-renewable groundwater resources in the deserts on a sustainable basis.
viii. Water harvest rainfall in desert areas and make full use of torrential streams and flash floods.
ix. Use new economical technology for seawater desalination.
x. Raise public awareness about water resource scarcity and government management plans.
xi. Consider laws to match the required development and existing scarcity.

From a visual investigation of the River Nile (Table 2), the major sources of waste are industrial effluents, crude sewage from blocked, broken or overloaded sewers, sewage effluents, surface runoff, and solid wastes which have been dumped into the river. Therefore remedial and improvement measures must be taken before the environment becomes further polluted and the natural resources are completely over-exploited (Clarke 1991).

Table 2 | Wastes in River Nile water

Materials	Percent composition
Paper, wood	50.0
Ferrous residues	12.5
Glass	11.0
Organic wastes	10.0
Plastics	5.0
Non-ferrous residues	1.5
Other	10.0

The challenges facing the environment in the twenty-first century are as follows: (a) drinking water sources should be treated with chemicals; (b) suitable toilet facilities should be provided along the main roads to minimise pollution; (c) proper arrangements should be made for litter dumping and waste disposal; (d) local people should be fully educated about environmental matters and hygiene; (e) previous damage should not be allowed to continue while planning for a balanced development in the future; (f) the concept of the ecosystem (involving education and interpretation of the natural environment) must be promoted; (g) the polluters must be made known.

RECOMMENDATIONS

i. The community must be the focus of benefits accruing from restructuring.
ii. Legislation should be introduced to protect community interests on the basis of equity and distribution.
iii. Handing over the assets to the community should be examined.

iv. Communities should encourage the transfer of the management of water schemes to a professional entity.
v. The Government should provide the necessary financial resources to guide the process of community management of water supplies.
vi. The Government should divert from provision of services and be a facilitator through setting up standards, specifications and rules to help harmonise the private sector and establish a legal independent body by an act of parliament to monitor and control the providers.
vii. The private sector should mobilise and strengthen the technical and financial resources from within and without the country to implement the services, with particular emphasis on utilisation of local resources.
viii. The Government should assist the poor communities who cannot afford service cost.
ix. Social-economic negative aspects of privatisation should be alleviated.

CONCLUSIONS

i. Booming economy, high population, land-locked location, vast area, remotely separated rural areas which are not easily accessible, large reserves of oil, excellent sunshine, large mining sector and cattle farming on a large scale are factors which have most influence on the total water scene in Sudan.
ii. It is expected that the pace of implementation will increase and the quality of work will improve, in addition to building the capacity of the private and district staff in contracting procedures. The financial accountability is also easier and more transparent.
iii. The communities should be fully utilised in any attempts to promote the local management of water supply and sanitation systems.
iv. There is little notion of 'service, invoice and move on'. As a result, there are major problems looming with sustainability of completed projects.
v. A change in the water and sanitation sector approach from a supply-driven approach to a demand-responsive approach calls for full community participation. The community should be defined in terms of their primary role as users/clients. Private sector services are necessary because there are gaps, which exist as a result of the Government not being able to provide water services due to limited financial resources and the increase in population.
vi. The factors affecting the eco-environmental changes are complex. They are interrelated and interact. The deterioration problems of water and sanitation have attracted some attention in recent years. There is an urgent need to study possible rehabilitation measures to ensure a sustainable and excellent water quality and improved sanitation.

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First received 4 January 2001; accepted in revised form 29 August 2002