The Nubian Sandstone Aquifer System – A case of cooperation in the making

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Abstract: The focus of this paper is the Nubian Sandstone Aquifer System, shared by Egypt, Chad, Sudan and Libya, and the agreements and other instruments of cooperation in place among the four countries. These combined bear out an evolutionary pattern of cooperation, centred on procedural norms and on a joint institution. In the author's opinion, the NSAS countries should strive to attain a more mature level of cooperation covering substantive norms, and the settlement of disputes. The author recommends the UN Draft Articles on "The law of transboundary aquifers" (2008) as a basis for such agreement.

1. Introduction

The Nubian Sandstone Aquifer System (NSAS) is the largest known fossil aquifer in the world, home to one of the largest reserves of non-recharging groundwater (Margat, Foster, Droubi 2006, pp. 13-19; Thorweihe 1990, pp. 601ss). The aquifer lies in the eastern part of the Sahara. It consists of two large basins: the Nubian Sandstone Aquifer (NSA), which is the more ancient and the larger of the two, and straddles the political boundaries of four North-eastern African States, i.e., Chad, Egypt, Libya and Sudan; and the more recent Post-Nubian Aquifer (PNA), which underlies only Egypt and Libya (Salem, Pallas 2002, p. 19). In the specifics, the NSAS extends over 2.2 sq.km.. Of these, 373,000 sq.km. (17.1%) lie in North-western Sudan, 233,000 sq.km. (10.7%) lie in North-eastern Chad, 754,000 sq.km. (34.7%) lie in South-eastern Libya, and 816,000 sq.km. (37.5%) lie in Egypt, which holds as a result the largest share (Bakhbakhi 2006, p. 80). Estimates of groundwater storage vary, with CEDARE's estimate of 457,570 km^3 reckoned to be the most accurate and reliable (CEDARE 2002, Bakhbakhi 2006, p. 80). Water quality varies, from excellent in the Southern reaches of the aquifer to very salty in the Northern reaches, in Libya (Alker 2008, p.240). Man-made exploitation of this enormous freshwater reserve has been on the rise in the past forty years, with nearly 40 billion km^3 extracted by Egypt and Libya, mainly for irrigation and drinking water supply projects.

The importance of protecting transboundary aquifers from over-exploitation and from pollution, and the importance of cooperation to this end among the countries concerned, must not be under-estimated (Stephan 2009, p.3). State practice in the matter is evolving, as shown by the handful of inter-State agreements on record as regards few transboundary aquifers in the world: these are the Genevese Aquifer (France, Switzerland), the North-Western Sahara Aquifer System (Algeria, Libya and Tunisia), the Guarani Aquifer System (Argentina, Brazil, Paraguay and Uruguay), the Nubian Sandstone Aquifer System (Chad, Egypt, Libya and Sudan), and the Iullemeden/Taoudeni-Tanezrouft Aquifer System (ITAS) shared by Algeria, Benin, Burkina Faso, Mali, Mauritania, Niger, and Nigeria.

This paper focusses on the NSAS, and on the substantive and the procedural rules of inter-State behaviour adopted by the NSAS States through the agreements made from 1992 to-date. These agreements bear out an evolutionary pattern of cooperation, resting on the apparent will of the aquifer States to engage in increasing levels and intensity of cooperation, primarily on procedural grounds.

2. Cooperation among Chad, Egypt, Libya and Sudan as evidenced by some agreements

2.1 The Joint Authority for the Study and Development of NSAS (1992)

The agreements progressively made by Chad, Egypt, Libya and Sudan attest to the slow yet steady cooperation process among the four countries. Cooperation between Egypt and Libya had begun already in the seventies. It crystallized eventually in the establishment of the Joint Authority for the Study and Development of NSAS (JA), on 29 June 1991. Sudan joined the JA on 18 April 1996 , and Chad on 18 March 1999. Use by these two countries, however, is currently limited to the native populations of the overlying oases. The agreement regarding the JA is the first step in the process of cooperation among the Parties. It is worth noting, however, that the only instrument on record regarding the JA is an "internal regulation" of the Authority, setting forth the internal structure, functions, decision-making process, and funding of the Authority. The "regulation" carries no provisions, substantive or procedural, regarding the management of the aquifer and of the groundwater stored in it.

As regards the internal structure of the JA, a Board manages the Authority. Each member State appoints three members to the Board (Art.5). The JA has an administrative secretariat and technical, administrative, legal and other staff. The most prominent functions of the JA are (Art.3):

- to collect and study information and data
- to prepare and execute studies regarding the NSAS
- to develop programmes, plans, and a common policy, regarding the utilization of the aquifer water
- to study the environmental aspects of the development of groundwater stored in the aquifer, including desertification control
- to promote the rationing of NSAS groundwater consumption in the member States.

The financial resources of the Authority consist of annual contributions by the member States, and donations from national and international institutions, organizations, and donor States (Art.21). In particular, Egypt and Libya contribute 35% of the budget, Sudan 20%, and Chad 10%. The JA "regulation" makes no provision regarding the legal status of the JA, or the settlement of disputes (Burchi, Spreij 2003, pp.4-6).

2.2 Agreements on monitoring and information exchange (2000)

Two agreements made in 2000, and setting forth procedural-type rules mostly, mark a significant advance in the process of cooperation among the NSAS States. The agreements sprang from the conviction that constant monitoring and updating of

data and information regarding the NSAS, and sharing of such data and information, are at the heart of the sustainable use of groundwater resources in the aquifer.
The two agreements were brokered by CEDARE. The former – Agreement No.1 – sets forth "Terms of Reference for the Monitoring and Exchange of Groundwater Information of the Nubian Sandstone Aquifer System" (made in Tripoli, 5 October 2000). The latter – Agreement No.2 – provides "Terms of Reference for Monitoring and Data Sharing" (also made in Tripoli, 5 October 2000). In particular, with the former agreement, concerning monitoring and information exchange, the four NSAS countries agreed to share the data which had been collected and systhematized through the "Programme for the Development of a Regional Strategy for the Utilization of the NSAS". With the latter agreement, the countries acknowledged the need for continued monitoring of the aquifer, and for sharing of the results, with a view to the sustainable development and adequate management of the aquifer.

2.3 Regional Action Programme for the Integrated NSAS Management (2006)

Another important step in the process of cooperation among the four NSAS countries is the "Regional Action Programme for the Integrated NSAS Management", funded by GEF and implemented by UNDP, IAEA, and UNESCO-IHP. The project supports the development of a regional strategy for the integrated NSAS management, aimed at the exploitation of the aquifer in the long-term, and at the satisfaction of the water needs of the four aquifer countries. The joint project fosters a better understanding of aquifer issues and of potential responses, while at the same time laying the foundations for a regional Strategic Action Plan (SAP). In particular, the long-term goal of the project is to achieve an "equitable and reasonable" management of the aquifer, for socio-economic development and for the protection of bio-diversity and of natural resources. Four discrete objectives will concur to the achievement of the over-arching project goal:

(a) first, the identification of priority transboundary threats and their root causes, addressed in a Shared Aquifer Diagnostic Analysis (SADA). SADA has pointed to population growth, inadequate governance structures at the regional and national levels, and poverty as the primary causes of the threats to the aquifer;
(b) filling gaps in data and capacity through appropriate technical approaches, necessary to make strategic planning decisions;
(c) preparation of a Strategic Action Plan (SAP) delineating the policy, institutional and legal reforms which will be required to deal with the threats and their causes identified in the SADA;
(d) an institutional structure for the implementation of the SAP.

A legal and institutional framework is envisaged, centred on a NSAS Convention for the management and rational use of the aquifer, jointly by all four aquifer countries.

2.4 The Regional Strategic Action Plan for the NSAS (2013)

The Regional Strategic Action Plan for the joint management of the NSAS (SAP) was signed by the four aquifer countries and the Joint Authority in Vienna, on 18 September 2013. The SAP is, in good substance, a legal agreement binding the Parties to agree, at a later stage, on actions for the sustainable management of the

aquifer, based on the findings in the SADA. Three main objectives emerge from a careful reading of the SAP:

(a) the first is strengthening the role and capacity of the Joint Authority in the management of the shared aquifer. In particular, trans-national mechanisms are envisaged, aimed at strengthening cooperation through the JA, and at opening up new areas of cooperation, notably as regards capacity-building. A complementary line of action is the development of a regional policy inclusive of ecosystem monitoring and management, as part of JA's responsibilities. The Authority is thus expected to engage in regional policy-making, and in the legal and institutional aspects of the NSAS (Elbadawi 2014);
(b) the second objective is to develop a dedicated data exchange cooperation structure, entailing a review and update of prior aquifer monitoring and data exchange agreements, with a view to a management framework for the NSAS;
(c) the third objective is to improve the effectiveness of the JA national offices. There are national offices of the Authority in each member country. They can liaise with the Authority, and provide it with information and data. They can also foster the exchange of personnel and the sharing of experience with other transboundary water commissions.

With a view to the efficient use of water resources, and to minimizing the negative impacts of human activities on groundwater levels and quality, the SAP advocates legal and institutional mechanisms capable of exerting a regional protection and control of groundwater extractions and of priority groundwater uses. The ultimate goal is to enable - through appropriate legal and institutional procedures – transboundary cooperation and integration of aquifer-dependent socio-economic activities, and land use schemes, based on the efficient use of the NSAS groundwater resources, including implications on agriculture (e.g., pollution, chemical standards, industrial discharges), and the control and prevention of migratory flows.

To-date there have been no further developments regarding the SAP, also due to the civil war in Libya. Nonetheless, as late as 2015, on the occasion of the 7th World Water Forum held in South Korea, Chad, Egypt and Sudan re-iterated their intent to cooperate towards the sustainable management of the NSAS. It is to be hoped that the national reconciliation government formed in December 2015 under the aegis of the United Nations will enable Libya to resume cooperation with the other NSAS countries.

2.5 An evolutionary cooperation pattern

The cooperation pattern borne out of the agreements above-mentioned, also as regards the SAP implementation, triggers a number of considerations. First, the Joint Authority has been conceived of as a joint institution, devoid however of authority as regards the management of the shared aquifer. A careful analysis of the 1992 JA "Internal Regulation" discloses in fact that the Authority has ample powers regarding essentially its own internal administrative organization and functioning. The only provision regarding the management of groundwater concerns the responsibilities of the JA. In the 1992 instrument no mention is made of the rationale for the Authority, nor of its legal personality, of prior notification requirements of planned mesures, and

of the settlement of disputes. Despite these limitations, the 1992 "Internal Regulation" represents the first step on the road to cooperation, if only in embryo, particularly between the aquifer main users, i.e., Egypt and Libya.
That instrument can be regarded as the precursor to the subsequent 2000 agreements, signalling a shift from a purely "institutional" agreement to more specific, procedural agreements covering monitoring and data exchange, and monitoring and data sharing. Still, the two 2000 agreements are not flawless. For one thing, their scope is restricted to the listed information and data. Moreover, neither agreement addresses the management of the aquifer and the relevant decision-making processes, for want of a precise mandate for the JA to this effect (SAP pp.35-36).

The 2006 GEF-funded Project, implemented by UNDP, IAEA, and UNESCO-IHP constitutes a significant milestone in the slow but steady path to cooperation in the management of the shared aquifer. Not only does the project enable a better knowledge of the aquifer and of the attendant issues, it also lays the foundations for the implementation of the SAP. The project can therefore be regarded as a preparatory agreement of the SAP. Upon closer observation, some substantive norms can be gleaned from the project, which were absent in the prior agreements. In this connection, the SAP is the implementing instrument of the 2006 project. As already observed, the SAP is an "agreement to agree" on actions to be carried out at different points in time. From the project, one can glean the intent of the Parties to also prepare a convention for the management of the NSAS as the ultimate goal. This is not to say that cooperation thus far has failed, quite the contrary, cooperation has been progressing step-wise, by small mutually reinforcing increments, as shown also by the principles of international environmental law that the Parties have explicitly recalled in the implementation of the SAP.

In sum, all the agreements above-mentioned attest to a pattern of cooperation in-the-works. The agreements on record so far only posit procedural norms, with no reference to substantive norms, and to rules for the settlement of disputes that may arise among the Parties. The need for a legally binding agreement among the four NSAS countries for the equitable and rational management of the aquifer is readily apparent from the embryonic state of cooperation to-date. As one commentator puts it, *"…transboundary cooperation concerning groundwater resources in the region is still in its infancy…"* (Alker 2008, pp.267-268). In this author's opinion, it would be wise to frame a convention for the NSAS, and to pattern it after the principles contained in the Draft Articles on the Law of Transboundary Aquifers adopted by the UN General Assembly in 2008.

3. The rules of international law applicable to the NSAS: the UN Draft Articles on the Law of Transboundary Aquifers (2008)

3.1 The UN Draft Articles on the Law of Transboundary Aquifers

In this author's opinion, a legally binding treaty for the NSAS which included substantive as well as formal and procedural norms for the agreed management of the aquifer, and for the settlement of disputes, is desirable. The principles posited in the 2008 Draft Articles above-mentioned could point in the right direction, as regards substantive norms on equitable and reasonable use, and on the duty not to cause

significant harm, and procedural and environmental protection norms. It would be useful to add norms for the settlement of disputes that might arise among concerned States, something which is not provided for in the Draft Articles.
In the Draft Articles, an aquifer is defined as *a "permeable water-bearing geological formation underlain by a less permeable layer and the water contained in the saturated zone of the formation*" (Art.2). As a result, an aquifer consists of two components, the underground geologic formation which acts as a container, and the water in it. From article 1 it is readily apparent also that the Draft Articles are not limited to the utilization of aquifers, and that they extend to all activities that may impact on them, reaching out as a result to measures for aquifer protection, conservation and management. The balance of the Draft Articles is generally patterned after the UN Convention on the Non-navigational Uses of International Watercourses (1997), with the appropriate adjustments dictated by the peculiar nature and vulnerability to pollution of aquifers (Quadri 2011, pp.136-144).

Let us now turn to the more relevant among the Draft Articles in the NSAS context and, in particular, to the articles regarding the equitable and reasonable utilization principle, the duty not to cause harm, and protection of the environment.

3.1.1 Substantive norms

The substantive norms applicable to the NSAS are the equitable and reasonable utilization principle, and the duty not to cause harm. In the Draft Articles, the former is crystallized in Article 4. In particular, the article states that "*… [States] shall utilize transboundary aquifers … in a manner that is consistent with the equitable and reasonable accrual of benefits therefrom to the aquifer States concerned …"* (letter a). It also insists on the postponement in time of the eventual depletion of a non-renewable resource (letters b to d), thus further characterizing the equitable and reasonable utilization principle. Germane to the equitable and reasonable utilization principle, the duty not to cause significant harm is cast in Article 6 of the Draft Articles. Harm may come from the utilization of transboundary aquifers, as well as from activities impacting on them (Article 6(1) and (2). It is worth noting that the obligation is not absolute, as under Article 6(3) a State causing significant harm may adopt suitable remedial measures. Moreover, the obligation is without prejudice to the equitable and reasonable utilization principle of shared water resources. The work of the International Law Commission on the characterization of "harm" is also relevant in this connection. Some ILC members had suggested lowering the threshold of harm, and expanding as a result the preventative umbrella of Article 6, in view of the vulnerability of aquifers. It can be readily appreciated how relevant such extended notion of harm is to the NSAS. Moreover, some commentators (Brooks 2013) maintain that the no significant harm obligation should take precedence over the equitable and reasonable utilization principle in view of the vulnerability of aquifers to pollution and the near-impossibility of de-contamining a polluted aquifer.

3.1.2 Procedural norms

Article 8 posits the obligation of States to monitor a transboundary aquifer. To this end, States must employ agreed standards and methodologies, and exchange data and information on the state of the aquifer. If the extent and the yield of the aquifer are uncertain, States are under a due diligence obligation to use their best efforts to

collect the necessary information, using agreed or harmonized standards and methodologies (Art.13). Also in the NSAS case, procedural norms would play an important role in support of substantive norms in a hypothetical future aquifer agreement aimed at the equitable and reasonable utilization of this vital resource.

3.1.3 Environmental norms

"Environmental" norms are no less important in the general economy of the Draft Articles, particularly in view of the peculiar nature of aquifers in general, and of fossil aquifers in particular, calling for greater protection. Article 10 carries the obligation of aquifer States "*to take all appropriate measures to protect and preserve ecosystems within, or dependent upon*" transboundary aquifers they share. Measures "*to ensure that the quality and quantity of water retained in an aquifer… , as well as that released through its discharge zones, are sufficient to protect and preserve such ecosystems*" are singled out among the measures to be taken. States therefore are under a duty to safeguard freshwater ecosystems and to protect them, with the aim to preserve to the extent possile their natural state. This, in response to external, mostly anthropogenic, interferences that may threaten the delicate balance of the constituent elements of freshwater ecosystems. States are under an obligation to take measures apt to preventing and minimizing harm to the natural recharge and discharge processes, following the identification of the relevant areas of a transboundary aquifer (Art.11.1). Aquifer States are under a due diligence obligation to prevent "new" pollution and to control and abate existing pollution, that can harm other States.

3.2 The principle of the limited sovereignty of aquifer States

The combined norms illustrated earlier lead to the limited sovereignty of States sharing a transboundary aquifer. The relevant principle enables riparian States to achieve good neighbourly relations, based on a "community of interests" pursued in the utilization of shared watercourses. The limited sovereignty principle is enshrined in Article 3 of the Draft Articles, whereby each State has sovereignty over the portion of a transboundary aquifer situated in its territory. At the same time, however, the exercise of such sovereignty is qualified by the rules of general international law, and by those posited in the Draft Articles, to the effect that "*Each State has sovereignty over the portion of a transboundary aquifer or aquifer system located within its territory. It shall exercise its sovereignty in accordance with international law and the present articles"*. The second sentence, in particular, bears out the limited sovereignty concept, as sovereignty must be exercised in conformity with international law and the Draft Articles. In good substance, States have sovereignty over the portion of a shared aquifer situated in their respective territory, however sovereignty is relative, or attenuated by the principle of equitable and reasonable utilization posited by Article 4, by the duty not to cause harm posited by Article 6, and by the balance of the Draft Articles. Prof. McCaffrey is of a different opinion, arguing that Article 3 posits an absolute sovereignty principle (McCaffrey 2009, p.10). Today, the theories of absolute sovereignty (argued in *United States v Mexico*, 1895), as well as that of the absolute integrity of States riparian to a shared watercourse (Rieu-Clarke, Moynihan, Magsig 2012, pp. 101-105), have been largely superseded by customary international water law, as reflected in the Draft Articles and in the New York Convention, where it is derived from.

4. Towards a joint management of the NSAS: other possible approaches

Some commentators argue that the amount of water required by development projects in Egypt and in Libya is so small relative to the total volumes stocked in the NSAS that no cross-border impact will be felt, at least in the near future. They also argue that, as a result, cooperation limited to data and information exchange suffices (Al Eryani, Appelgren, Foster 2006, pp.25-34). This author disagrees. In her opinion, management of the NSAS requires not only procedural but also substantive norms, as well as norms for the settlement of disputes that may arise among the States concerned.

As observed earlier, Chad and Sudan – being the "upstream" aquifer States – are in a weaker position compared to Egypt and Libya in view of technical and economic limitations to the exploitation of the aquifer in their respective territories, and of political stability factors. One commentator maintains that cooperation is a matter of strategic choice of the four countries, aimed at preventing international conflict over socio-ecoomic and environmental goals, and at ensuring access to water, particularly in a water-scarce region. Under the circumstances, therefore, cooperation is a national security issue (Alker 2008, p.255). Other commentators advocate application of the rules for liquid minerals, like oil and gas deposits, to fossil aquifers (Eckstein G., Eckstein Y. 2003, p.204). However, in contrast to the profit-driven exploitation of oil and gas, the exploitation of fossil aquifers should be driven by the need of States to cater for the satisfaction of the primary water needs of their populations, independent of profit motivations (Eckstein G., Eckstein Y. 2003, p.255).

This author believes that cooperation plays a fundamental role in connection with, in particular, fossil aquifers. An adequate planning and governance structure are pre-requisites for the sustainable management of shared aquifers. In this light, the principles enshrined in the UN Draft Articles appear to be the instrument aptest to ensure the sustainable management of these vital resources.

5. Conclusions

From the foregoing analysis the following conclusions can be drawn:

(a) the NSAS agreements on record, illustrated in this paper, are only about procedural norms of inter-NSAS State behaviour;

(b) the cooperation borne out of such agreements is "work in progress", attesting to the will of the Parties to embark on a cooperation path. However this has not reached full maturity yet. From an "institutional"-type agreement in 1992 the Parties have moved on to more specific accords laying down procedural norms, in 2000. Later, the GEF Project in 2006 laid the foundations for the implementation of the latest agreement on record, i.e., the 2013 SAP, which reflects a shared vision for the cooperative management of the aquifer, and outlines strategies for implementation. There is still a long way ahead, however cooperation is live and kicking, of course within the limits illustrated in this paper;

(c) to-date, the SAP has not moved forward. It is to be hoped that the formation of a stable government in Libya will enable resumption of cooperation with the other three NSAS countries, so as to bring forward what they had envisioned in 2015 for the sustainable management of the NSAS;

(d) the need for a legally binding agreement, providing substantive and procedural norms of inter-State behaviour, and norms for the settlement of disputes, is readily apparent. To this end, this author recommends recourse to the substantive, procedural and environmental norms featured in the UN Draft Articles, with the addition of norms for the settlement of disputes, which the Draft Articles do not provide for;

(e) for want of a global binding agreement governing groundwater, the Draft Articles on transboundary aquifers are a step forward in the development of the international law of shared aquifers, and are without dobt an authoritative reference for States.

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