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Instruments for optimal management of transboundary resources: lessons for the Nile Waters?

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Abstract

The resolve to make meaningful use of the Nile waters has been one of the most important development milestones in Ethiopia over the last Century. Given the transboundary nature of the Nile and the fact that little use has been made of the waters on Ethiopia's part, assessing ways of optimally managing the resource is increasingly attracting attention from national and international researchers and policy makers, as well as the media. The objective of this article is to present an overall review of available economic instruments in optimal management of the resource. The assessment focuses on various economic instruments, namely, insights from efficiency principle, and strategic interactions and market-based instruments to draw policy lessons. The findings generally show that economic instruments could, in principle, be used to address the coordination gaps that act as stumbling blocks against efficient use of the Nile water, to the benefits of all stakeholders. The findings of the study also indicate areas where further quantitative analyses should be focused on.

1. Introduction

Given its contribution of 85% of the 84 billion cubic meters of the Nile waters, Ethiopia's lack of meaningful use of its waters has been a cause of national concern for several centuries [11]. Indeed, despite rarely setting on to directly exploit the resource, exploring possibilities of the country's involvement in the management and use of the waters have been important features of governance throughout Ethiopia's long history of changing political systems and leaderships [24, 26]. The Blue Nile River has also been an object of fascination among Ethiopians, held with great affection and drawing disappointment over always running away with all its vitality, as exemplified by the numerous folk songs about its might, beauty and over-generosity.

Ethiopia's most recent endeavour to build the Grand Ethiopian Renaissance Dam (GERD) is its most significant stride yet in its long- held quest to make use of the waters that originate within its boundaries [26]. Of the 11 countries along the basin, lion's share of the benefits are clustered in the downstream countries of Sudan and Egypt that share common colonial history and are believed to be largely benefitting from brokered colonial treaties [11,18]. Past resource sharing arrangements regarding the Nile waters is widely viewed as one such example which calls for a move towards inclusive, equitable and sustainable approaches, both in terms of implementation and learning from past mistakes [31].

Notwithstanding the bilateral colonial-era agreements, however, the Nile basin has been devoid of any inclusive multinational agreements for long. The new set of agreements and institutions (notably the Cooperative Framework of Agreements) are designed to address such historical injustices to offer the promise of greater efficiency and equity for the management of the resource across the riparian countries [10]. While this new set of fledg-ling agreements is a stride in the right direction, much remains to be done to achieve secure and productive use of this resource. Indeed, there is a long way to go before a resource use/benefit sharing scheme is reached that attempts to be more participatory of all the riparian countries, which ascribes member countries shared-rights to the uses of the resource and puts a greater emphasis on sustainable use of the resource.

In this article, it is argued that optimal management of the Nile waters would lead to improved water availability and water quality to all the riparian countries, compared to what would have been the status quo. As is often seen international river basin agreements, it is not from the outset that agreement on the general principles and procedures for the cooperation in water allocation the resources are all accomplished [21]. Instead, an attempt to rectify and

build on this new set of agreements is also a process that encompasses lessons learnt from specific resource use dynamics for efficient operation of resource use.

Given that the new initiatives are on the right track, albeit at their infancy, it follows that there is a need to scientifically investigate the optimality of alternative economic instruments in maximizing collective gains and in ensuring fair and equitable sharing of the proceeds from the Nile waters. The purpose of this article is, therefore, to give an overview of studies that have examined the benefits of the based instruments in the sustainability and equitable sharing of transboundary resources and attempt to draw policy lessons. Our findings generally show that a combination of efficiency enhancing instruments, bargaining game theoretic approaches as well as inter-state market based instruments could be effectively employed in the management of multi-riparian waters such as the Nile. However, for the gains in the use and management of the resource to be maximized in a sustainable manner persistent efforts need to be carried out in coordinating implementation of economic instruments with transnational political actions. It is further argued that there are important lessons to be learnt from the use of the instruments for duplication in other similar settings.

The article is organized as follows. Section 2 gives a brief description a background to the use of the Nile waters in the past. This is followed by Section 3, which presents a review of economic instruments in the use of transboundary resources. In section 4, conclusions and issues for future research are presented.

2. Historical background and current status of the Nile use

The Nile Basin is the dominant hydro-geopolitical structure in East and North East Africa, flowing through Ethiopia, Sudan, South Sudan, Egypt, Eretria, Congo, Burundi, Uganda, Rwanda and Tanzania, across 6,650 km stretch making it longest river in the world. Of two major tributaries to the river, the Blue Nile originates from the Ethiopian highlands flowing south from Lake Tana and then west across Ethiopian mountains while the White Nile originates around Lake Victoria flowing north ward to Khartoum where it converges with the Blue Nile. The Ethiopian highlands are said to contribute to a lion's share of the Nile waters- more than 85% - while the remaining 15% contribution is from the White Nile[1].

[1] Appendix 1, presents a map of the Nile Basin.

Despite its grandiosity both in terms of its size and 437 million people having claims to it, the Nile Basin has never enjoyed anything that resembles a comprehensive framework of use and management that encompasses all the riparian countries. Indeed, the 1929 colonial treaty between Britain and Egypt and the 1959 bilateral agreement between independent Sudan and Egypt have virtually included the downstream countries of Sudan and Egypt as de facto users of the water. The later agreement, in fact, allocates the entire flow of the Nile with 18 and 55.5 billion cubic meters respectively to Sudan and Egypt [21, 13]. [2].

Perhaps astonishingly, given its massive contribution to the waters, Ethiopia has never exploited the Nile waters for its own use and has virtually remained a bystander for long. Ethiopia's relative docile state started changing from mid-90s with it playing a more proactive role in coming towards a comprehensive and cooperative agreement encompassing all riparian countries. This effort was particularly marked by the so called D3 project, which initiated the establishment of the Panel of Experts where each riparian state nominates three persons to form the core of the dialogue as a precursor to the negotiation process to establish legally binding governing permanent institution in the Nile Basin. This was followed up by the formation of the Nile Basin Initiative (NBI) in 1999 comprising all the riparians of the Nile as its members except Eritrea which is an observer, with the newly formed Republic of South Sudan is admitted on 5th July 2012 [31]. Domestically, Ethiopia took a further stride with the water management proclamation (2000) that provides policy and legislative measures to promote national efforts towards the stipulated goals of 'efficient', 'equitable' and 'optimal' utilization of water resources based upon which it is committed to be ready to fully cooperate with other basin countries [2,7].

It was in the interests of many of the upstream countries that after almost ten years of negotiations, the draft text for the Nile Cooperative Framework Agreement was submitted to the meeting of the Nile Council of Ministers (Nile-COM) for their consideration in June 2007. The CFA is the first multilaterally negotiated agreement in the history of the Nile Basin where all riparian states except Eritrea were part of the process. The CFA has 39 Articles under six parts and two annexes in its current form. The key element of the CFA is that it lay down the basis to establish a permanent legal mechanism and institutional mechanism as Nile River Basin Commission (NRBC) that governs the management and utilization of the Nile

[2] For extensive review of the pre-1929 attempts at possessing the source of the Nile by the British Colonial Powers, see [30].

waters [31]. Above all, though, the CFA is meant "abolish the colonial treaties, agreements and assumptions that legitimize the lingering downstream hegemony that persists in the Nile basin" [2]. To this end the CFA basis itself on the principle of equitable and reasonable utilization of transboundary watercourses. The fundamental issue of fair and equitable use of the Nile waters was, for the first time, brought onto the cooperative agenda of basin countries. With the endorsement of the CFA, it was implied that the principles in the respective national legislations would be included; the Nile Basin Initiative (NBI) would be disbanded; and a permanent Nile Basin Commission simultaneously establishing [2, 31]. As a concrete next step, Ethiopia commenced on building the GERD on the Blue Nile River, with 74 billion cubic meters of water holding capacity, aimed at generating 6000 MW of hydroelectric power [32]. In response to concerns from downstream riparian countries on the potential impact of the dam, Ethiopia initiated the formation of Tripartite Technical Commission, which later named the International Panel of Experts on the GERD, constituting of four international experts and two experts each from Egypt, Sudan and Ethiopia, to study the overall impacts of the project. The report is said to have indicated that the GERD would not cause significant harm on the water flows to downstream countries. Specifically, the report has stated the dam is based on international standards and has benefits to downstream countries too [16, 28].

3. Economic instruments for transboundary resource use

The analytical framework employed in this article combines the so called efficiency principle and game theoretic approaches, with the objective to identify tradeoffs and complementarities in water usage and strategies for the efficient allocation of water resources.

3.1. Efficiency principle: management outcomes that are individually and collectively efficient in terms of resource use

In this section we review instruments that, in view of the economic principles of cost-benefit analysis, are either individually or collectively efficiency enhancing. In view of this, three major economic instruments are discussed: cooperative solutions, maximizing positive externalities, and minimizing negative externalities.

3.1.1. Collectively efficient (cooperative) strategies

One major issue in the (mis)management of transboundary resources is a lack of full understanding of the perceived benefits from cooperation. Economic theory unanimously

puts forward the argument that, barring transaction costs, cooperative solutions always confer higher collective gains than non-cooperative solutions. In the case of the management of water resources, it is widely accepted that cooperative management is a goal sought by governments, policy experts, and water management professionals [23]. Indeed, in many instances, movement from non-cooperative solutions to cooperative solutions is shown to lead to significant progress toward economic efficiency. For example, collective *economic* returns (chiefly power and agricultural production) were shown to be maximized as a solution to Ganges and Brahmaputra dispute that would make Nepal, India and Bangladesh better off than were there no cooperation [29].

In the context of transboundary water management, a systematic framework that incorporates the eight design principles of common pool resource management into the context of transboundary water resources use is the so called Rowland-Ostrom Framework [23]. Examples of common pool resource management operating in conjunction with the law, a powerful strategy for beneficial change include the Los Angeles and Tampa Bay area management regimes [23]. Such a common pool resource management also led to the creation of the Central and West Basin Water that oversees equitable water sharing via the 4 districts across the Los Angeles area [23]. Similarly, in the case of Tampa Bay regional administration committee was formed to offer regional solutions to surface and ground water management.

The Rowland-Ostrom Framework could also involve transitioning from whatever type of water management system adopted by a given region to a common pool system, entailing the possibility of sacrificing individual uses. In line with this, [23]gives the example of the city of Saint Petersburg gave up ownership to its two well fields in exchange for membership in the new regional water authority, that ties its water use to that of neighbouring counties and other cities. It should also be noted that giving up individual rights under the common pool resource management system also means greater security for preventing and resolving transboundary disputes. Out of the Eight Principles of Managing the Commons, principles 5 and 6 happen to be the most relevant to the management of water resources: having a set of sanctions that are graduated based on the seriousness of rule violation, and the availability of low-cost conflict resolution mechanisms [23].

While strict application of the common pool resource management could be difficult in the case of international transboundary water use[3], similar instruments have been seen put into practical use. An alternative water sharing instrument is the Helsinki Rules and the ILC draft articles which suggest a host of non-economic factors such as the riparian' s geographic share of the basin, the proportion of its basin population to total basin population, and its current water abstraction from the basin [29][4].

3.1.2. Maximizing positive externalities

Among ways of increasing individually and collectively efficient use of transboundary resource is the strategy of maximizing positive externalities. Such a scheme leads to increased availability of the resource to other users (uses) over and above its traditional users (uses), without affecting the availability of the resource to its main users. By implication, maximizing on positive externalities ensures that the overall availability of the resource is increased for all parties concerned and hence competition and pressure over the resource reduces. In the case of the Nile, there are three major sources of positive externalities that could be exploited by any of the countries in question to the benefit of all of the riparian countries.

a) Increased efficiency of resource exploitation -tapping into underused features of the resource

Inefficient and wasteful utilization are quintessential features of the exploitation of the Nile waters so far, both through underutilization of available water (and through wasteful evaporation [15, 19]. Hence, increased efficient utilization of the waters is of paramount importance. For instance, both the downstream countries of Egypt and Sudan would benefit from developing projects that lead to a more efficient use of the waters than the current patterns of use. In addition, [25] argues that the construction of the GERD will help in reducing the loss of water in the deserts of Sudan and Egypt to evaporation due to the deep gorge setting of the Dam, minimal exposure to sunlight, and the generally cooler

[3] Rowland (2005) notes that there are no international examples of successful resolution of transboundary disputes via common pool arrangements because the practical application of that system of water management between nations is limited.

[4] It should be noted that benefit sharing is a distinct concept from water-sharing. The focus of benefit sharing is beyond the physical allocation and utilization of the water. Whereas the focus of the water sharing approach is on determining equitable and reasonable utilization of the water to the riparian countries, benefit sharing emphasizes on the benefits from the uses and non-uses of water not the water itself [29].

temperatures of the Ethiopian highlands[5]. Anecdotal evidence on the performance of the Tekeze Dam in Ethiopia also shows that the construction of the dam has helped in improving water availability.

An additional way of enhancing the efficiency of the resource use is through using the waters for hydroelectric power generation. Although the parties would benefit from increased use of the Blue Nile waters, little has been done to that effect, for reasons discussed in sections 1 and 2 of this article. This is despite the fact that downstream countries, particularly Sudan has much to benefit from hydroelectric dams built both for their agriculture and electrification [10]. Indeed, Ethiopia's upstream dam constructions and the subsequent electricity generation will have Sudan and Egypt directly benefitting from it through cheaper and more efficient electricity generation [25].

Furthermore, increased efficiency in the use of the waters by downstream users themselves is imperative. In line with this, irrigation and similar water use projects and programs need to undergo appropriate cost-benefit analysis to determine the worthiness of the projects, accounting for the scarcity value of water as one input in the project, and to ensure that the opportunity cost of water is measured, such that the use of each drop is evaluated against its next best use. As [1] argues, water use efficiency could be learnt from the case of Chile which was able to increase aggregate irrigation efficiency by 22 to 26 percent during the 1975-1992 period through pure policy reform, saving an equivalent of USD400 million that would have been required to accomplish such water efficiency gains.

b) Increased efficiency of resource exploitation -accurate resource pricing and use of efficiency enhancing technology

As economic theory postulates, accurate resource pricing is a prerequisite for allocation of the resource to its most efficient use. Accordingly, many economic studies demonstrate that there is a strong link between water prices and use [9]. Hence, the political authorities of each riparian should encourage every domestic agency or unit that extracts and/or supplies water to apply real or surrogate prices that at least cover the costs of extraction and delivery. This means that ministries of irrigation or public works, regional development agencies, water users' associations, municipal water supply companies etc. adopt such pricing policies. Bulk or metered charges, estimated use charges, service fees or taxes on drainage water may be used for cost recovery and system maintenance [29]. Note, however, that those riparian's who

[5] The total evaporation is estimated to be 14.3 BCM from Egypt's Aswan and 4.7 BCM from Sudan's other dams, compared to just 0.4 BCM from the GERD annually (Tesfa, 2013).

have traditionally built their claims on the principle of acquired rights generally suffer from perverse incentives to avoid technological innovations that improve efficiency. Were they to demonstrate their ability to do more, or as much, with less water, they would be undermining their claims to specific amounts of water [29].

In the case of the Nile, [17] argues that water use in the agricultural sector in Egypt consumes disproportionate share of limited supplies, although the sector's contribution to GDP is low or minimal. Such preferential treatment of water use, and encouragement of the production of water-intensive crops, available free of charge, has been justified through the objective of food self-sufficiency. In addition, water intensive irrigation methods are still employed although water is not sufficient to irrigate enough land to realize a reasonable food security ratio. Indeed lot of gains could be realized through policy reforms such as subsidy reduction [1]. Needless to say, such a wasteful use of the waters comes at significant cost to both the Egyptian society and claimants to the Nile waters (all other riparian countries) at large.

Urban and industrial use of water in Egypt is also no more efficient than that in the agricultural sector. Water supply systems are provided at heavily subsidized rates under the justification of ensuring public health and asserting the legitimacy for the government. However, low or non-existing water charges and poor cost recovery are both unsustainable and lead to misuse of an undervalued resource [1].

Accurate measurement of the value of the resource would also imply that the opportunity cost of the resource at a basin level be correctly incorporated. Indeed, this would imply that the water at the downstream level be seen as a resource that also has its alternative uses at the upstream level. This has two further implications: 1) the value of the water downstream will be increased, which will enhance its allocation to its best uses, avoiding wasteful and inefficient use; and 2) this will create a common ground for sharing the benefits of the waters such that the downstream water users will be able to compensate the upstream water users for the waters used in the downstream ends only.

c) Diversifying into alternative (substitutable) resources

As discussed in sections 1 and 2, the socioeconomic and demographic settings in the 11 riparian countries (in response to rising population and greater competition for scarce water resources) puts the Nile waters in great demand. Hence, it is imperative that attention be shifted from surface water management to other alternatives. For instance, groundwater

exploitation could be one alternative, which, by all accounts Egypt happens to have rich reservoirs of [12,]. Ethiopia's ground water reservoir estimates are a mere 1/5th of that of Egypt and 20% less than that of Sudan [14]. Furthermore, efforts should also be made towards desalination of sea water is another alternative as it has becoming commonly practiced in water scarce regions such as in the Middle East such as in Qatar, Israel and the like. In line with this, [29] argues that reliance of one country on a single source of water that other countries have claims to, would inevitably constitute harm to other riparian countries.

3.1.2 Reducing negative externalities

While the Ethiopian Blue Nile contributes to the majority of water used by downstream countries, more than 95 per cent of the silt in the main Nile waters also comes from the Ethiopian highlands. This forms a negative externality for Ethiopia in the form of soil erosion and land degradation. An additional negative externality is accrued downstream in the form of siltation and degraded water quality threatening both the quantity and quality of Nile waters. Reducing siltation problems could come in the form of soil conservation and afforestation programmes in the Blue Nile catchment area. This is also being complemented by building of upstream dams [10].

Indeed part of the reason water is lost through evaporation downstream is because none of the water is stored or used in the cooler highlands of Ethiopia. The estimated to 10–16 bmc (billion cubic meters) annually, would be better spent and stored in highland Ethiopia where evaporation would be less due to lower temperature and reduced water surface from storage in deep valleys. Besides, Ethiopia faces problems with excessive erosion and land-cover loss, Sudan is challenged by floods and silt accumulation, and downstream Egypt is troubled with excessive water loss through evaporation in Lake Nasser [10].

3.2. Game theoretic solution/Strategic interactions

Despite the benefits of cooperative agreements (discussed in section 3.1), most international river basins are not governed by any comprehensive agreements on the use and allocation of the basin' s water. [29] identifies two major constraints to cooperative solutions in the management of transboundary water. First, that sovereign riparian's will have very different incentives to cooperate, ranging from opposition to indifference and on to enthusiastic support leading to those with the least to gain retaining veto power to cooperative solutions and those indifferent choosing not to be involved. Second, designing compensatory schemes

is difficult due to the uncertainties of binding cooperation and the actual transaction costs of carrying out compensation. In other words, the beneficiaries of cooperation are not sure of what they will gain or the losers of the extent of their potential losses and actual task of compensating losers could be prohibitively costly due to complexity of compensatory formulae [4]. Therefore, given all the transaction cost, awaiting the advent of basin-wide accords for integrated development of water resources based on some notion of optimality, could be long to be fruitful [29]. Given this, two major strategies can be identified in the realm of non-cooperative game theory that is applicable to transboundary water management: the Non-cooperative Bargaining solution and Interlinked Games solution.

An example of non-cooperative (strategic interaction) solution in multilateral negotiations involving water use is [11]. [20] use the framework to water allocation in California, whereby the three major stakeholder groups informally negotiated over the degree to which water rights are transferable, the type and level of environmental standards, and the level of infrastructure development. They find a shrinking of the bargaining set – the mutual gains to be had through negotiations are lower and conclude that significant gains from bargaining are lost due to reduction in bargaining space. In addition, [27] and [20] apply the Rausser-Simon model to negotiations over water use, water storage capacity, and user prices in France, where seven stakeholders bargain over seven policy dimensions. Analysing the impact of changes in the institutional setting indicate that as a consequence of unanimity being the decision rule, stakeholders' preferences influence the negotiated agreement even when their political weight is zero, but they take part in the negotiation process without intervening.

When it comes to international river basins, Rogers (2010) argues that strategic (non cooperative) interactions would benefit a lot from a strong river basin authority that could allocate the costs and the benefits according to the core, such that there would be no incentive for coalitions to form to block those allocations. Examples of international river basin agreements that benefitted from such interactions include the Ganges-Brahmaputra basin.

In interconnected games, negotiations over separate issues are joined in a repeated game in order to allow for equilibrium solutions not attainable in isolated games that may yield higher joint payoffs. Solutions may also avoid side payments when isolated solutions do not [11]. Recognizing that nations in weak negotiating positions often try to improve their leverage by linking issues, it is recommended to use the interconnected game modelling approach for international river basins.

3.3. Transboundary water marketing instruments

An inherently guiding principle towards ensuring efficient water allocation in a given basin as water is allocated according to its scarcity value to the highest valued uses and, once those are satisfied, to other uses, so long as the overall economic profit from water use across the basin increases. While sharing of the proceeds is considered first best in the analysis of alternative water allocation mechanisms, transboundary compensation mechanisms could be functionally impossible making such a policy option remains questionable [21]. Hence, to achieve both equitable and optimal benefits from water use across countries and sectors, market mechanisms could such as establishment of water markets and tradable water entitlements [22].

As discussed in the previous sections, accurate measurement of the value of the resource would also imply that the opportunity cost of the resource at a basin level be correctly incorporated. Indeed, this would imply that the water at the downstream level be seen as a resource that also has its alternative uses at the upstream level. This has two further implications: 1) the value of the water downstream will be increased, which will enhance its allocation to its best uses, avoiding wasteful and inefficient use; and 2) this will create a common ground for sharing the benefits of the waters such that the downstream water users will be able to compensate the upstream water users for the waters used in the downstream ends only.

As [17] argues, it is market-based instruments that ensure reasonable allocation of water resources at the transboundary level and appealing to water 'requirements' or 'needs' is insufficient to justify preferred allocations. Market based instruments can be used as ways of increasing the welfare gains from water use across basin countries directly or indirectly. A direct instrument is establishing water markets such that water quotas could be sold across regions and countries [5]. In addition to the direct water markets across countries, products of differing water use intensity could be traded across the riparian countries to further enhance basin-wide water use efficiency. In line with this, [32] argue that for water-scarce countries it could be attractive to achieve water security by importing water-intensive products instead of producing all water demanding products domestically. Reversibly, water-rich countries could profit from their abundance of water resources by producing water-intensive products for export.

In the case of the Nile, this implies that once a fair allocation of water shares is agree upon, waters could be traded across the basin countries such that transfer of quotas could

occur between sellers willing to sell and buyers willing to buy. In instances where exorbitant transaction costs hinder direct water trading, trade in water intensive products (virtual water trade) across the Nile Basin countries could be a more realistic option.

4. Conclusions

The essence of this article has been to examine the availability of economic instruments used in transboundary resource management in general and in the management of transboundary waters in particular with an in light of their use in the management of the waters of the Nile. The importance of such instruments could not be overemphasized in settings where the riparian countries are characterised by poverty, high land pressure, great demand for energy and increased agricultural productivity. We identify three sets of instruments based on the specific areas of resources use each is best at covering. One such strategy considered is the efficiency criteria that hinges on nations putting the resource into its best possible use, either collectively or individually. Looking at particularities, exploitation of the Nile waters was argued to benefit from common pool style collective management, reduction of negative externalities and enhancement of positive externalities. In areas where the transaction costs of cooperation are prohibitively exorbitant, the strategic solutions and interlinked game strategies could be employed. Finally, market/incentive based instruments could be used for inter-state allocation of resources where water/its uses could be traded among riparian countries.

The sound applicability and worthiness of each of the available instruments requires a full cost-benefit analysis that enables comparison amongst the instruments. This can be accomplished with a comprehensive analysis of the costs of implementing each of the instruments in terms of time, knowledge and resources required to implement the instruments vis-à-vis aggregate quantification of the welfare gains.

It should be noted that the purpose of the paper is to provide an overview of available instruments that can be possibly applied in the case of the Nile. While the methods presented are fitted for the purpose of using transboundary resources/waters, their full blown application requires thorough empirical analysis on their own merits, and in the context of the Nile basin.

In light of this, further analysis is required on understanding the institutional and market settings of the riparian countries. Furthermore, while the current set of instruments have generally looked into possibilities of future shocks and technological change, it might be

imperative to assess ways of incorporating such dynamic and stochastic aspects of the process of management and use of the resource. Related to this, considerations should be given to possibilities of integrating the implementation of such incentive-based instruments into political negotiation processes.

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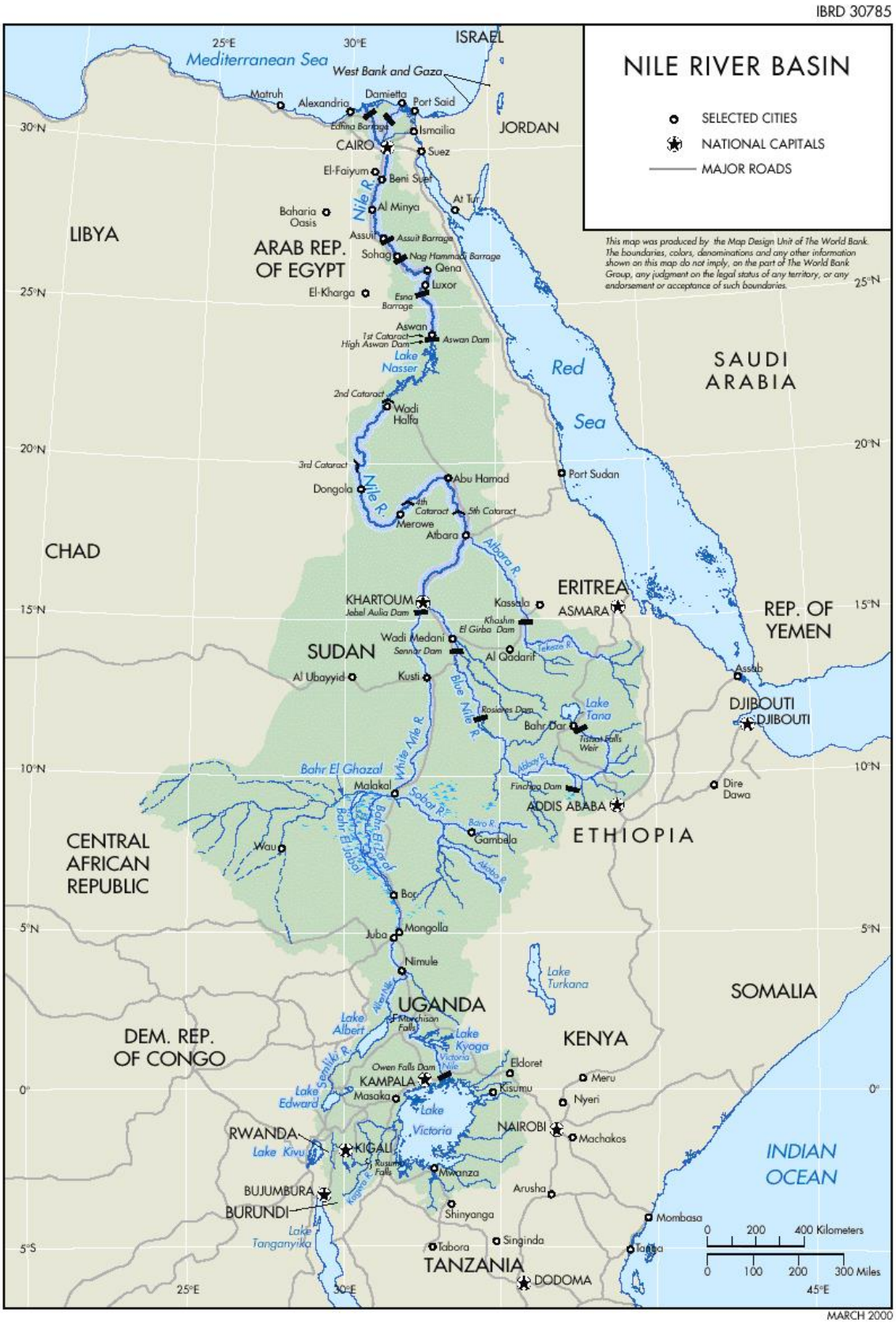
A map of the Nile Basin



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