



# Playing chicken on the Nile? The implications of microdam development in the Ethiopian highlands and Egypt's New Valley Project

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*How Egypt and Ethiopia will defend or promote their interests in the Nile basin has recently become clearer. Egypt will again seek to create 'facts on the ground', this time a large new land reclamation and settlement scheme called the New Valley Project. Ethiopia too will create facts by proceeding with water resources development in the Blue Nile basin, including the construction of low-cost microdams. If Egypt and Ethiopia pursue these two unilateral initiatives, they may find themselves on a collision course that both may have difficulty changing. The challenge facing the Nile riparian countries is to find a balance between the upstream countries' support for the principle of 'equitable use', and Egypt's and Sudan's support for the principle of 'no appreciable harm'. Of all the riparian states, Egypt has the most to gain from the establishment of a basin-wide framework for water resources development. It can ill afford a future in which upstream riparians take unilateral action with respect to water development projects. If Egypt would reduce its existing water use by 5 billion m<sup>3</sup> and scale back or abandon the plans for the New Valley Project, there would be enough water available to strike a deal that would bring Ethiopia and other upstream riparians into the framework of a comprehensive Nile Waters Agreement. © 1998 United Nations Published by Elsevier Science Ltd*

It is clear that the next century, if not the next millennium, will witness rising international tensions over natural resources. What is not at all clear is the way in which those tensions will be expressed and, one hopes, resolved. The issue facing nation states will be how best to conduct and manage the arduous, time-consuming search for cooperative solutions to resource utilization challenges. This search is under way for the most efficient ways to use trans-boundary waters, but it has so far yielded meagre results. Without greater success in the future, the daunting challenges of satisfying the demands of growing, and, one hopes, better-off, populations will not be met.

The problem is that the search for cooperation and the search for economic efficiency do not always complement each other. Countries, states, or communities like the European Union, cannot fully control the economic benefits arising from their own investments. Reducing power plant emissions may mitigate rain acidity and global warming, but

also allow other countries to avoid undertaking similar investments. When the threat of such 'free-riding' is large, no one has much incentive to invest at home, nor is the situation right for a search for binding cooperative undertakings.

International rivers provide striking examples of these problems, none more so than the Nile Basin. The authors have spent decades studying and writing about issues of water development and coordinated resource use among the ten countries that share the Nile.<sup>1</sup> This article does not propose to cover all or even most of the complex issues facing the Nile riparians, but rather to focus on one set of bilateral relations, and arguably the most important, that between Egypt and Ethiopia.

The Nile is a very long river but not one with much water. Its discharge is dwarfed by those of the Congo/Zaire, the Amazon, the Mississippi, and the Mekong. Its annual discharge is now pretty much used in its entirety by Egypt and Sudan, except in years of exceptional floods. In fact, by the terms of a 1959 agreement, significantly called the 'Treaty

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<sup>1</sup> They are roughly from north to south: Egypt, Sudan (Main Nile), Eritrea, Ethiopia (the Blue Nile watershed), Kenya, Tanzania, Burundi, Rwanda, Uganda, and Zaire (Kagera Basin, Lake Victoria Basin, Lake Albert, and the White Nile).

for the Full Utilization of the Nile', Egypt and Sudan divided the annual flow between them with 66% going to Egypt, 22% to Sudan, and the remaining 12% allocated to surface evaporation and seepage at the Aswan High Dam (AHD) reservoir. It was on the basis of this treaty that construction of the AHD went forward.

No other riparians were party to this accord, nor was any share in the annual flow prudentially set aside for them. The treaty did anticipate future demands from the excluded riparians, but merely stipulated that Egypt and Sudan should deal with those demands jointly. Predictably, the upstream riparians, many at the time still under British control, were not pleased. However, Cold War rivalries, their own political instability combined with bouts of civil war, and their feeble economies did not allow upstream riparians to press any realistic claims to Nile water arising in or traversing their territories. The economic weakness has endured until today, although there are signs of recovery in Uganda, Eritrea, Ethiopia, and Tanzania. Some political stability has been secured in the last decade in Eritrea (independent in 1993), Ethiopia, and Uganda.<sup>2</sup> The time has come when a few upper basin riparians may test the Egypto-Sudanese status quo (Waterbury, 1997).

None of the projected demand scenarios involve truly large amounts of water. Many potential projects are hydroelectric power stations, which do entail reservoirs and attendant storage losses. But, even though the upper basin states have relatively abundant rainfall, it is erratic, seasonally concentrated, and not often in the regions where the soils are best for agriculture. Capturing river water for irrigation is an option that few upper riparians have exercised, but, with increasing demand for food from growing populations, they inevitably will in the near future. Because the flow of the Nile, so Egypt and Sudan claim, is fully used today, reductions in flow caused by an upstream state could disrupt existing patterns of agricultural production in the downstream states.

Egypt in particular has insisted that sunk costs in harnessing the Nile within its national boundaries give it a kind of property right to the resource. This right is all the more vital to Egypt in that it does not add a single drop to the Nile's flow through its territory. Therefore, Egypt will probably not relinquish any part of its 'right' except under duress.

Ethiopia, by contrast, on average provides 80–85% of the annual discharge of the Nile (through the Akabo-Baro, Blue Nile, and Atbara/Teccaze tributaries) yet to date uses virtually none of it. International law and the guidelines of international financial bodies such as the World Bank make it extremely difficult for an upstream riparian to undertake unilateral development of its portion of the river in the absence of consultation with and the consent of the downstream states. In this sense the downstream states hold veto power over third-party financing of upstream development. Ethiopia does not yet have the financial strength to undertake more than a few large-scale water resources development projects on its own and thus finds itself in a box.

<sup>2</sup> The fact that Sudan is still locked in civil war, Rwanda and Burundi trying to deal with the aftermath of or to avoid genocide, and Zaire (now the Congo), under the as-yet untested grip of Lauren Kabila, means that any coordinated stance among the upper basin riparians will be nearly impossible to achieve.

Egyptian and Ethiopian interests are thus in potential conflict.<sup>3</sup> How they will defend or promote their interests has recently become clearer. Egypt will seek, once again, to create 'facts on the ground', this time a grandiose scheme of land reclamation and settlement called the New Valley Project (Figure 1). Ethiopia too will create facts by proceeding with low-cost construction of microdams. As the two strategies unfold, we expect to see a game of 'chicken' on the Nile.<sup>4</sup>

### Microdams in the Ethiopian highlands

In Tigray province alone, Ethiopia has plans to build 500 microdams over the next decade.<sup>5</sup> These are small-scale projects that typically provide water for irrigating a few hundred hectares. They can be built without foreign technical assistance or financing, largely with local labor. They are simple to design and can be constructed quite rapidly. Ethiopian farmers already possess many of the skills necessary to proceed with a microdam strategy. A tradition of small-scale irrigation is well established; there are many small-scale irrigation schemes along streams and tributaries throughout the Ethiopian highlands. If peace and economic growth continue, these farmers will almost certainly pursue further efforts at small-scale irrigation and microdam development. It is unclear how many sites exist in the highlands for these microdams, but there are probably thousands (although many potential sites are not in the Blue Nile watershed, and thus their development would not affect Blue Nile flows).

These microdams have numerous potential problems. Many sites appear likely to silt up rapidly, and thus lose water storage capacity. Malaria may spread through the highlands as sites for the mosquito vector increase (Cropper et al., 1998). Moreover, it is not clear how much water such schemes will use and what the effect of this use will be on downstream flows. However, if Ethiopia is to undertake, through microdams, anything that would have a significant effect on downstream flows, it would have to build thousands of microdams.

There is currently little literature on microdam development in Ethiopia, but the storage capacity of approximately 500 microdams planned for North Gondar appears to be in the range 100 000–500 000 m<sup>3</sup> each. However, for purposes of illustration let us assume microdams with larger storage

<sup>3</sup> Although Egypt's and Ethiopia's interests do conflict, there are important opportunities for cooperation and sharing of joint gains (Whittington and McClelland, 1992).

<sup>4</sup> This image has already been invoked with respect to the Nile by Wolf (1996). The game of 'chicken' is played in various forms in different cultures, but the essence of the game is to set in motion a course of action that will lead to a collision for both parties unless one party takes action to prevent the calamity. But then the party that takes action, instead of being rewarded for averting disaster, loses the game because he is thrown off course. For example, a game of chicken is sometimes played by automobile drivers who start at different places on a road, and start driving straight at each other. If they continue on course they will crash and both be killed. The driver who veers off course first prevents the crash, but ends up off the road, and is termed the 'chicken' because his fear of death overcame his desire to 'win' the game.

<sup>5</sup> Tigray has historically been drought and famine prone. It is also the province from which several of Ethiopia's most powerful leaders, including Prime Minister Meles Zenawi, hail.



capacities than these. Suppose that 5000 microdam schemes were developed in the Nile drainage system in Ethiopia, each with sufficient storage capacity to supply water to an associated irrigated area of 200 hectares. This would involve a total irrigated area of one million hectares. If each hectare of irrigated land used 5000 m<sup>3</sup> annually, the total water use would be 5 billion m<sup>3</sup> per year (ignoring evaporation losses from the microdams). Again, for purposes of illustration, let us assume that 5 billion m<sup>3</sup> of water use in the Ethiopian highlands resulted in a net reduction at Aswan of 4 billion m<sup>3</sup>. This is over twice Egypt's anticipated increase in long-term yield from the Jonglei Canal, should it ever be finished.<sup>6</sup>

There is evidence from other parts of Africa that microdams can indeed affect downstream flows. For example, in his study, 'The impact of small farm reservoirs on urban water supplies in Botswana', Meigh (1995) concludes:

These results ... show clearly that development of small dams upstream of major reservoirs should never be allowed to proceed unplanned. Small dams can have significant effects on the runoff into and the yield from the large reservoirs, and therefore it is necessary to assess these effects and weigh the benefits of rural developments against the adverse effects of urban water users ... The development of fewer, somewhat larger dams, which minimizes evaporation losses, should be preferred to numerous smaller dams of the same total capacity, if it is found that this reduces the downstream impact.

Thus, if one takes a long-term view, the effect of thousands of microdam projects on water use in the Blue Nile basin and downstream flows should not be dismissed lightly.

There are at least three important features of the microdam projects that would appear to make them especially attractive to Ethiopia. First, such microdam projects do not require international financing. Second, it will be difficult to estimate accurately how much such projects reduce downstream flows of the Nile. Third, the microdam projects are militarily invulnerable. In the past Egypt has periodically threatened to intervene militarily if any upstream riparians interfered with its water supply. If Ethiopia's use of water was based on thousands of small-scale irrigation schemes and microdams, Egypt would have few military options other than attempt to occupy Ethiopia. It does not seem that this would be a credible threat. One can hardly imagine a worse place for Egypt to conduct a military campaign than the heavily-populated Ethiopian highlands.

If Ethiopia continues to liberalize its economy and is politically stable, it may be anticipated that funds will be available from a variety of sources to finance microdams and other, larger water resources development projects in the Blue Nile watershed. Because Ethiopia is now a major recipient of donor funds, it has considerable flexibility with its development budget. Local finances can be shifted away

from projects that donors will fund to projects that they will not support.<sup>7</sup> Donors can be played off against one another in the competition to finance attractive projects.<sup>8</sup> Moreover, international capital markets will be an increasingly attractive option for financing many infrastructure investments. One must remember that potential hydroelectric projects in the Blue Nile basin, first described in the US Bureau of Reclamation (1964) study, have some of the highest economic rates of return of any hydroelectric projects in the world, assuming the power generated could be marketed regionally (Guariso and Whittington, 1987). Investment opportunities such as these have a certain inevitability about them, particularly in a world awash with private capital.

There is a linkage between the development of hydroelectric projects in the Blue Nile drainage area and a microdam strategy. Very little of the Ethiopian highlands is now served with electricity. Thus, many microdam projects will have to rely on diesel pumps to lift water to fields (some can be gravity-fed). This will be expensive and often unreliable. Electricity from hydropower projects is thus needed to supply households in towns and villages throughout the highlands, and also to run pumps for microdam schemes. One of the problems associated with hydroelectric development in the Blue Nile basin is the lumpiness of most investment opportunities and the inability to use all of the hydropower generated quickly. The pumping necessitated by thousands of microdams might ameliorate this difficulty somewhat.

It is sometimes argued that Ethiopia does not really need irrigated agriculture because it has the alternative of rain-fed agriculture, while Egypt has no alternative except increasing its irrigated area. Two points need to be made about this argument. First, many parts of the Ethiopian highlands are quite arid during the dry season, and farmers in such areas would clearly benefit from irrigation.

Second, both Egypt and Ethiopia have the option of pursuing economic development strategies that will enable them to pay for imported food rather than expanding irrigated agriculture, and if their populations increase at current rates, both will have to do this. In the long term, irrigated agriculture is not a feasible alternative for achieving food security for either Egypt or Ethiopia.

There is precedent throughout the semi-arid regions of the world for what Ethiopia intends to do. A fairly dramatic example lies in Syria's development of its watershed in the Yarmouk river basin. This river, which has an annual discharge of only 380–400 million m<sup>3</sup>, serves as the border between Syria and Jordan, before emptying into the Jordan River. For decades Jordan and Syria proposed the construction of a dam on the Yarmouk to capture winter flood waters and to generate hydroelectricity. Part of the stored flood water was to be diverted into Jordan's East Ghor Canal and

<sup>6</sup> The Jonglei Canal project, begun in the late 1970s and suspended in 1983, is designed to reduce spillage of the Albert Nile into the swamps of the southern Sudan, and to channel water that would otherwise be lost to evaporation downstream to northern Sudan and to Egypt.

<sup>7</sup> Consider, for example, the Fincha Dam, currently the only water storage facility in the Ethiopian Blue Nile Basin. This project was commissioned ca. 1970 exclusively as a hydropower scheme (to our knowledge, the only project identified by the US Bureau of Reclamation to have been implemented). However, with some assistance from the United States Agency for International Development, construction of a sugar cane refinery was initiated in 1995. The Ethiopian government intends to finance an irrigated cane sugar scheme of some 6000 hectares downstream of Fincha.

<sup>8</sup> Also, the World Bank has fewer restrictions on funding projects which improve or expand existing projects—so microdams are a kind of foot in the third-party funding door.

used in the Jordan–Dead Sea valley for agriculture. The hydropower was destined exclusively for Syria. The dam, first known as the Maqarein project and later as the Unity Dam, has never been realized because of initial objections by Israel (the downstream state).

What is important for our story is that in the intervening years Syria proceeded quietly and unilaterally to construct dozens of small dams in its portion of the watershed. These dams store in the order of 155 million m<sup>3</sup> of water. Since 1975 alone, 19 dams have been constructed with an aggregate storage of nearly 100 million m<sup>3</sup> and five more are on the drawing boards (Soffer and Kliot, 1991; Gärber and Salameh, 1992). Even if Israeli acquiescence to the Unity Dam were obtained, it is now doubtful that the dam would make good economic sense, at least on the scale that it was originally conceived. Syrian action has reduced the average annual flow by roughly a third.

Ethiopia's microdam strategy does not preclude the development of larger water resources development projects in the Blue Nile basin. Indeed, Ethiopia is proceeding with both types of projects. In the fall of 1997 the Government of Ethiopia issued tenders for the construction and supervision phases of the first major hydroelectric power project on the Tekeze River. Located on the Upper Tekeze southwest of Mekelle, the final project is likely to have a total storage capacity of about 8 billion m<sup>3</sup> and an installed capacity of 200 MW. Ethiopia is financing this project itself, and, importantly, has not formally notified Egypt or Sudan of its plans.

### Egypt's New Valley Project

Information about this project available to the authors is limited to reports in the international and Egyptian press, and these news stories have often contained self-contradictions and obvious mistakes. However, the general scope of the project seems clear. Egypt plans to pump about 5 billion m<sup>3</sup> of water per year from the AHD Reservoir, and put it in a new canal that will transport it to a series of new land reclamation projects in the Western Desert. When the plan is finished, perhaps 25 years from now, about 250 000 additional hectares will be irrigated.<sup>9</sup>

The interesting question, of course, is: Where does Egypt imagine that it will get this much additional water? There was some confusion in the initial press reports that this would be surplus water from the Tushka canal spillway. The Tushka canal spillway was built to discharge excess flood waters from the AHD Reservoir when it reached extremely high levels (Whittington and Guariso, 1983). Discharges into the Tushka canal spillway have been and will be very rare; indeed, if the New Valley Project is finished as now envisaged, and its water demands factored into the

operation of the AHD Reservoir, the Tushka canal spillway will probably never be used again. So it is important to be clear that water for the New Valley reclamation efforts will be needed every year and thus must come from Egypt's long-term water allocation.

Egypt contends that it will find the water supplies needed for the New Valley Project by using existing irrigation water supplies more efficiently, fostering water conservation efforts, abstracting groundwater, using reclaimed wastewater, and shifting out of sugar cane and rice to less water-intensive crops.<sup>10</sup> These measures, particularly conservation efforts and shifts in crop mix, could have a significant effect on Egypt's water use. Egypt thus argues that it will not withdraw more than its share specified in the 1959 Nile Waters Agreement.

The international press has consistently reported that Egypt's allocation of Nile waters is 55.5 billion m<sup>3</sup>. This misses the real story.<sup>11</sup> As all the Nile basin riparians are well aware, Egypt's allocation under the 1959 Nile Waters Agreement is best understood as a deal with Sudan. Egypt's allocation of 55.5 billion m<sup>3</sup> is *contingent* upon zero water use by upstream riparians. At the time the 1959 Agreement was signed, both Egypt and Sudan recognized that this assumption of zero water use by upstream riparians was not realistic in the long run, and they made provision for how the 1959 Agreement would be revised as upstream riparians started to claim rights to use Nile waters. Specifically, Egypt and Sudan agreed to reduce their water allocations equally to accommodate increased use by upstream riparians.

In 1994 the authors proposed that the 1959 Nile Waters Agreement should be revised soon to include Ethiopia (Whittington et al., 1994). At the time, the authors argued that a reasonable reallocation of Nile water should give Ethiopia something on the order of 12 billion m<sup>3</sup>; and that Egypt and Sudan would need to reduce their water allocations by approximately 3 billion m<sup>3</sup> each—assuming Jonglei I and II and other 'water conservation projects' in the White Nile basin (Machar Marshes and Bahr el Ghazal) are not undertaken. The difference of 6 billion m<sup>3</sup> could probably be made up by more efficient operation of an expanded system of reservoirs, including new dams on the Blue Nile, and reduced evaporation losses from the AHD Reservoir.<sup>12</sup>

Even if the upstream riparians did not use any Nile water in the future, Egypt would still need to find water savings on the order of 5 billion m<sup>3</sup> per year to complete the New Valley Project. While Egyptian policymakers' willingness to take on the task of using Egypt's existing water supplies more efficiently is laudable—this is without question the right thing to do—it is not clear, however, what it will cost to achieve water savings of this magnitude, nor how long it will take. It will clearly be an expensive undertaking that

<sup>9</sup> The costs of the canal, the pumping stations, and ancillary projects in the New Valley, have been estimated at LE 300 billion over the next 20 years, or about US\$90 billion at the 1997 exchange rate. Projected investments of that magnitude will attract many multinational firms. The Arab Fund for Social and Economic Development, representing the member states of the League of Arab States has in principle agreed to finance some of these investments. Private investors, such as Prince Al-Walid Bin Talal of Saudi Arabia, intend to reclaim over 162 000 hectares in the New Valley (see *al-Ahram Weekly*, July 24–30, 1997, p. 8). By contrast, Ethiopia cannot contemplate projects even fractionally as large or nearly as attractive to international contractors, purveyors of equipment, and agri-businesses.

<sup>10</sup> It is important to note here that groundwater in the old Nile Valley is not a different water source, i.e. it is replenished by Nile river water. In the New Valley, groundwater supplies are nonrenewable, and the groundwater level will likely fall rapidly as intensive pumping begins.

<sup>11</sup> For an exception, see 'Water fight: Egypt faces problem it has long dreaded, less control of the Nile' (*The Wall Street Journal*, Friday, August 22, 1997, p. 1).

<sup>12</sup> Reservoirs upstream on the Blue Nile would reduce evaporation losses from the AHD Reservoir because the surface-to-volume relationships are more favorable than at Aswan, and evaporation rates are lower.

will require not only substantial capital investments, but changes in the institutional arrangements for farm-level irrigation management.

As water becomes increasingly valuable in the Nile basin in economic terms, all riparians—not just Egypt—will need to use water more efficiently. However, since Egypt is by far the largest user of Nile water, its efforts in this regard will have the largest effect on the availability of basin-wide supplies. It is useful to separate two issues: (1) the extent to which Egypt can use its existing water supplies more efficiently, and (2) whether these water savings should be applied, or allocated, to the New Valley Project.

For example, if Egypt really does have the ability to save 5 billion m<sup>3</sup> of water annually, these savings could conceptually be allocated in a variety of ways. For example, they could be used to:

- (i) achieve a revised Nile Waters Agreement;
- (ii) accommodate future industrial, municipal, and tourism growth in Egypt;
- (iii) undertake the New Valley land reclamation projects.

Stated most simply, the New Valley Project requires water that could be used to reach a new Nile Waters Agreement that accommodated the upstream riparians.

### Implications for Nile Basin development

The New Valley Project and the microdam strategy would appear to carry significant risks for Egypt and Ethiopia. If Egypt and Ethiopia pursue these two unilateral initiatives, they may find themselves on a collision course that both may have difficulty changing.

To better understand the nature of the problem, assume that Egypt is indeed committed to proceeding with the New Valley Project, and that it is as yet unclear: (1) whether Egypt will succeed with its efforts to save 5 billion m<sup>3</sup>; and (2) whether Ethiopia will proceed with a microdam strategy. Table 1 presents the four possible outcomes; the numbers are not meant to be precise. In Case A, Egypt succeeds in saving 5 billion m<sup>3</sup> and Ethiopia pursues the microdam strategy. There is still a 4 billion m<sup>3</sup> water deficit (measured at Aswan). In Case D, Egypt fails to achieve its water savings and Ethiopia does not pursue a microdam strategy: there is a 5 billion m<sup>3</sup> deficit.

Case B is the worst scenario. Here Egypt fails to achieve the promised water savings, but still pursues the New Valley Project. Ethiopia proceeds with a microdam strategy, and the riparian countries are faced with a 9 billion m<sup>3</sup> deficit. Only in Case C are serious problems avoided. Even in this case it is still assumed that the economics of both the water savings and land reclamation work in Egypt's favor.

Because there is no comprehensive agreement on the Nile basin, any deficits will fall on Egypt and Sudan. The economically rational solution to the problem caused by water deficits is to import more grain (Allan, 1996). Egypt is in a much better position to pursue this option than the other riparian states because of its stronger, more diversified economy and better infrastructure. But water deficits create not only economic problems but political difficulties as well. Farmers and communities that run short of water may have difficulty perceiving that the best solution is to import more grain; such parties may feel that their water has been stolen from them and seek non-economic (diplomatic or military) solutions to their problems.

In light of this analysis, let us examine the basic character of the 'game' that appears to have developed between Egypt and Ethiopia. We will simplify greatly in hopes of capturing the essence of the problem and look at just three 'moves'. In the first move, the Egyptian leadership must decide whether to proceed with the New Valley Project; this has already been decided in the affirmative, but let us try to better understand this decision.

Assume that Egypt has two choices: to pursue the New Valley Project or not (ignoring the question of the scale of the New Valley Project). If Egypt pursues the New Valley Project, Ethiopia can react in two ways: it can pursue its own water development options, or it can abandon (or delay) them. Consider each outcome from Egypt's point of view. If Egypt proceeds with the New Valley project and then Ethiopia proceeds with its water development options (e.g. a microdam strategy), Egypt confronts a major water deficit. The Egyptian leadership can either deal with this deficit by importing food or pursuing a non-economic strategy to force Ethiopia to reduce its water use. By this we mean that Egypt will use the political, diplomatic, or military powers at its disposal to pressure Ethiopia to reduce its water use.

If Egypt reasons that it can easily deal with such a deficit by importing food, this outcome is perhaps not too bad. On the other hand, if Egypt proceeds with the New Valley Project, and Ethiopia does not pursue its water development options (in order to avoid a confrontation with Egypt), then Egypt wins the game: pursuing the New Valley Project has forced Ethiopia to back off of its water development plans.

Now consider Egypt's option not to pursue the New Valley Project. If Egypt decided not to proceed with the New Valley Project and Ethiopia proceeds with its water development options, Egypt faces a modest water deficit that it can choose to deal with either by importing food or by non-economic means. If Egypt does not proceed with the New Valley Project and Ethiopia does not proceed with its water development options, the status quo is preserved.

The difficult calculation from Egypt's point of view is

**Table 1** Four hypothetical scenarios for Nile Basin development

	Egypt proceeds with the New Valley Project and succeeds in achieving 5 billion m <sup>3</sup> in water savings at an acceptable cost	Egypt proceeds with the New Valley project and does not succeed in achieving 5 billion m <sup>3</sup> at an acceptable cost
Ethiopia proceeds with a microdam strategy that uses 4 billion m <sup>3</sup> (measured at Aswan)	Case A: Egypt is short 4 billion m <sup>3</sup> annually	Case B: Egypt is short 9 billion m <sup>3</sup> annually (the collision)
Ethiopia does not proceed with a microdam strategy that uses 4 billion m <sup>3</sup> (measured at Aswan)	Case C: Egypt has sufficient water supplies	Case D: Egypt is short 5 billion m <sup>3</sup> annually

whether pursuing the New Valley Project will change the probability that Ethiopia will pursue its water development options. It is possible that Egypt hopes the New Valley Project will deter Ethiopia (and perhaps international lenders) from proceeding with water resources development in Ethiopia because the latter parties can foresee where this collision course might lead (i.e. to Egypt pursuing non-economic alternatives for dealing with a water deficit). Seen from this perspective, the Egyptian decision to proceed with the New Valley Project has a certain strategic rationality because it provides Egypt the possibility of achieving the best outcome without major risks.

In the second move, the Ethiopian leadership must decide how to respond to Egypt's decision to proceed with the New Valley Project. Assume Ethiopia's choice is whether or not to proceed with a water resources development option. If Ethiopia proceeds with water resources development, the most severe of the water deficits will occur (Table 1). The Ethiopian leadership must attempt to forecast how Egypt will respond in move three to this water deficit. If Egypt were to respond to Ethiopian water resources development by reducing water use and importing more food, this is the best outcome for Ethiopia: in effect Ethiopia wins the game. On the other hand, if Egypt responds by non-economic means, Ethiopia has much to lose. Although this could be a very poor outcome for Ethiopia, it is by no means clear that it is the worst. Failure to develop its water resources may leave Ethiopia with increasingly complex political and economic problems, as population growth, soil erosion, and deforestation contribute to a downward spiral of environmental degradation, decreasing food supplies, and famine.

If the Ethiopian leadership responds in move two by not pursuing a water development option, they avoid a possible collision with Egypt, but pay a high cost: an inability to develop irrigated agriculture. Also, it may be the case that the Ethiopian leadership would not be able to prevent micro-dams and small-scale irrigation development in the highlands even if it wanted to. If millions of peasants come to believe that small-scale irrigation will lead to a better life for them, it is questionable whether any government would have the political capital to stop them.

We do not know, of course, which option the Ethiopian leadership will choose. Let us assume that they decide to proceed with the water resources development option. We then turn to move three: how will Egypt respond to an Ethiopian decision to proceed with its water resources development option? From a rational perspective, Egypt's choice should almost certainly be to deal with the resulting water deficit by importing more food and scaling back the New Valley Scheme. However, the Egyptian leadership may not be able to contain popular opinion in Egypt in favor of a confrontational response to Ethiopian water development.

It should now be clear why Egypt's first move of proceeding with the New Valley Project carries such large risks. Under some plausible scenarios, the Egyptian and Ethiopian leadership could lose their ability to control events. Just as it is important to recognize that there are win-win situations for the Nile riparian countries (e.g. moving long-term storage upstream could provide water savings that can be shared), it is equally important to understand that there are lose-lose scenarios.

We believe that, of all the riparian states, Egypt has the most to gain from the establishment of a basin-wide framework for water resources development. It can ill afford a future in which upstream riparians take unilateral action with respect to water development projects. Yet that is the precedent that Egypt has established by proceeding with the New Valley Project. If Egypt would reduce its existing water use by 5 billion m<sup>3</sup>—as it says it can do—and abandon the New Valley Project, there would be enough water available to strike a deal that would bring Ethiopia and other upstream riparians into the framework of a comprehensive Nile Waters Agreement.

There is another conceivable option for Egypt to find the water necessary to do a deal with Ethiopia: water could possibly be saved from the White Nile swamps of Sudan. The White Nile water conservation projects (Jonglei I, Jonglei II, Machar Marshes, and Bahr el Ghazal) are estimated to yield a total of 18 billion m<sup>3</sup> in water savings. Given their environmental repercussions, it seems unlikely that all of these projects will be built within any meaningful planning horizon. But Jonglei I and II alone would result in water savings of about 8 billion m<sup>3</sup>, roughly what is needed to bring Ethiopia into a new Nile Waters Agreement (in combination with water savings from resulted evaporation losses from the AHD Reservoir). At some point in the future, Sudan might conceivably find itself in a pincer movement, in which Egypt and Ethiopia both want Jonglei I and II water savings for their joint purposes. Sudan could thus come under strong pressure from both Egypt and Ethiopia to press ahead with Jonglei I and II, but not share substantially in the projects' benefits.<sup>13</sup>

However, in the medium to long term, Sudan needs these water savings from the White Nile projects itself. Indeed, increased Sudanese water use may pose a greater problem for Egypt than water use in Ethiopia. Sudan has at least 8 million cultivable hectares between the Blue and White Niles; it currently irrigates only about 10% of this area. It is hard to imagine a Sudanese future that is not based on intensive agricultural production. The day will come when Sudan may push ahead with this development option, even though it will be reluctant to confront Egypt. The development of Sudan's potential would be best realized through cooperative development with Ethiopia, i.e. water storage sites in Ethiopia for transborder irrigation projects and the export of hydropower from Ethiopia to Khartoum-Omdurman. In the long run, a strategic alliance between Sudan and Ethiopia is thus a possibility, and is an outcome that Egypt would try to avoid at all cost.

### Discussion: the opportunity cost of water

It would seem appropriate for the Egyptian people to have a serious discussion about the water requirements of the New Valley Project, because the decision to proceed with the

<sup>13</sup> The implementation of the White Nile water conservation projects would have another important consequence for the hydrogeopolitics of the Nile basin. As long as water from the Equatorial lakes is lost in the Sudd swamps, the regulation of these lakes has little value to Egypt. But if the White Nile water conservation projects are ever completed, then Egypt will have an intense interest in the development and regulation of reservoirs on what is Ugandan territory (particularly Lakes Victoria, Kyoga, and Albert). Uganda will then find itself in an entirely new political relationship with Egypt.

existing plans will have profound economic and security implications for their country. Central to this discussion should be an examination of the opportunity cost of water in different uses and locations. Thoughts on this issue are shared in this concluding section of the paper.

The Nile Basin is water-scarce not because of too many people but because of too much agriculture relative to water supply. Agriculture here, as just about everywhere else in the world, accounts for upwards of 80% of all water use. Moreover, water is in most instances used inefficiently, above all in agricultural systems like Egypt's, where farmers are not made to pay anything for the water itself.

In proposing the New Valley Scheme, Egypt, in a back-handed way, has acknowledged just how much waste and misallocation exists in the current system. By shifting cultivation from more to less water-intensive crops, by recycling more water, and by improving irrigation practices (from open surface delivery systems relying on gravity to pressurized drip or sprinkler irrigation), the 5 billion m<sup>3</sup> that the New Valley Project will require can be found. Egypt had heretofore been at pains to assert that it had very little slack in its system, thereby defending the absolute necessity of retaining its full share as stipulated in the 1959 Nile Waters Agreement.

However, this leads to the question whether or not there might be a better way to achieve the goals of the New Valley Scheme without using anywhere near the same amount of water. This is not to contest the goals themselves. It is a fact that Egypt's 60 million people are crammed into only 19 000 square miles, or a territory roughly the size of Switzerland. Over 90% of Egypt's surface is uninhabited. The New Valley project aims to move population out of the crowded Nile valley and into a sparsely inhabited set of oases lying to the west of the Nile valley. These oases are separated from the valley and major markets by several hundred miles of desert, and they are equally far from the Mediterranean coast and Egypt's major ports.

We should not lose sight of the fact that in the last 100 years, Egypt's densely inhabited areas have expanded significantly and in a manner that seems more logical than what is now being proposed. At the same time that the Suez Canal was excavated so, too, was the Ismailia Canal (named after Khedive Ismail, Egypt's governor at the time) to bring fresh water from the Nile to the new cities in the canal zone. From the 1870s on, the Ismailia canal has supplied irrigation water to what eventually became Sharqia Province, an agricultural zone that today is a region virtually indistinguishable from much more ancient areas of settlement. The governorate of Sharqia, which directly benefited from the new canal, witnessed major population influx and growth. The census of 1907 recorded Sharqia's population as 876 000. By 1976, it had grown to 2.6 million, and in 1986 reached 3.4 million. It boasts several large towns and cities, and it is fully integrated into the road and power grid of the Delta downstream of Cairo.

More recently, beginning in the mid-1950s, a similar expansion took place along the western fringe of the Nile Delta, fed by the Western Nubaria canal. However, the process of settlement is relatively new, and at present farming in the western zone is not in the hands of peasant smallholders but rather in those of commercial, mainly urban-based farmers. The point is, that Egypt has expanded its settled areas, and it has done so in a way that minimizes

transport costs and disruption of existing patterns of settlement. If new settlement is to be a function of expanded areas of cultivation and attendant use of water for irrigation, it is suggested here that it is best to build out from the Delta and the valley lying to its south. Rather than distant and costly satellite colonies scattered across Egypt's desert hinterland, the authors envisage new contiguous layers adjacent to the zones of traditional settlement.<sup>14</sup>

However, there is a further question. We are not convinced that such settlement expansion need be dependent on agriculture. President Anwar Sadat launched, in much the same way as has President Mubarrak, his own scheme for breaking out of the old Nile valley. He proposed and launched a series of new cities in the desert, but not far from the settled areas. Although the schemes were seen at the time as a kind of publicity stunt, real money was invested and, in some instances, such as The 10th of Ramadan City, a real boom in medium and light manufacturing, all in the private sector, has taken place. Real, as opposed to fictitious, residency in these cities has been slow in coming, but it will doubtless come if their economic bases are sound.<sup>15</sup>

It is suggested here that it is in this vein that the real opportunity cost for the water to be used in the New Valley Scheme, and for the capital that will be required to deliver it, should be seen. A simple bit of arithmetic will show what is at stake. Assuming that the New Valley will bring 250 000 new hectares under cultivation, and that reclamation and initial cultivation of those lands will require 20 000 m<sup>3</sup> per hectare per year for at least twenty years after the water is first delivered.<sup>16</sup> That would mean a water duty driven by agriculture of 5 billion m<sup>3</sup> per year or 18% of Egypt's 1959 allotment.

Supposing, on the other hand, that Egypt decides to develop a new city of 200 000 inhabitants over the same 20-year period. Assuming also that each inhabitant uses 140 litres a day (a kind of mid-range average for households with private water connections in low and middle income countries). Households in this new city would use about 10 million m<sup>3</sup> in 1 year. If one increases this by 50% to allow for commercial and industrial use, the city would use 15 million m<sup>3</sup> per year. The agricultural water use for the New Valley project (5 billion m<sup>3</sup> per year), would be sufficient to support over 333 new cities of this size (with a total population of over 65 million people).

Would food security be sacrificed by pursuing an urban, industrial economic development strategy instead of expansion of irrigated agriculture? Not really. As Egypt's population grows, albeit at slower rates, it will have little

<sup>14</sup> Such new settlements should, however, be located far enough away from the coast to avoid the risks associate with sea level rise from long term climate change.

<sup>15</sup> The Government has offered a host of incentives to encourage businesses to locate in the new cities, and many entrepreneurs have established 'dummy' firms in them in order to take advantage of the incentives. Even when the firms are real, both management and labor may prefer to commute from near-by urban centers rather than to take up residence in the new cities.

<sup>16</sup> Note that in this illustrative calculation we have used much higher water use per hectare estimates than we did for irrigation in the highlands of Ethiopia. This is because: (1) evapotranspiration is higher in the western desert of Egypt; (2) the Egyptian estimates assume year-round irrigation, while Ethiopian farmers may need irrigation only part of the year; and (3) the Ethiopian microdams may not have the storage capacity to supply higher amounts of water for irrigation.



choice but to import at least half of its food and food-product needs. Increasing its cultivated surface by 15% will not make much of a dent in that reality. Egypt's future has to lie in the non-agricultural sector and the exports of manufactured goods and of services. New cities can be platforms for both.

Why then is Egypt pursuing the New Valley Scheme? In part, President Mubarrak is surely emulating both predecessors and contemporaries. In the 1950s, Egypt's President, Gamal Abd al-Nasser, captured the country's imagination with the AHD project, and, in the last decade, Mo'ammr Qaddafi certainly captured attention—if not admiration—for his Great Man-Made River scheme in Libya. Engineering projects on this scale spin off billions of dollars in contracts, which is politically attractive (but alternative projects, such as new cities, would yield similar benefits). There may be a strategic consideration: to wit, that Egypt would like to create a buffer center of population in its hitherto mainly empty western desert.

Finally, if the New Valley Scheme is brought to completion, it will be a major bargaining chip when and if Egypt is obliged to enter into negotiations with the other Nile riparians over reallocation of shares in the river. Established facts, based on actual water use and sunk costs, have always weighed heavily in establishing legitimate claims to shares in transboundary rivers. If the New Valley Scheme proceeds as planned, Egypt will have created a huge 'fact.' In that sense, and even though Egypt may not use any water beyond the share allotted in the 1959 Agreement, it will have effectively precluded accommodation of the growing needs for water of its upstream neighbors, especially those of Ethiopia.

### Concluding remarks

To summarize the above discussion: the challenge facing the Nile riparian countries is to change the existing property rights regime to the waters of the Nile without running the risks of the collision course described. This will require that the Nile riparians find a balance between the upstream countries' support for the principle of 'equitable use', and Egypt's and Sudan's support for the principle of 'no appreciable harm'. These two principles are in conflict, and their balancing will require accommodation and compromise on the part of all parties.

Albeit in fits and starts, the Nile riparian countries now seem to be committing themselves to a process of dialogue,

and international donors are apparently ready to underwrite this effort with a major infusion of funds. However, both Egypt's New Valley Project and Ethiopia's microdam strategy create serious problems for this long-term strategy of dialogue and consensus building because they offer Egypt and Ethiopia unilateral water resources development options that both will find difficult to resist. The possibility of credible unilateral investments and rising populations means that time is not necessarily on the side of the riparian countries and the donor agencies as they embark on a process of consensus building and dialogue. It may be easier to negotiate a revised Nile Waters Agreement sooner rather than later.

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