

Sudan and the Exploitation of the Waters of the Nile

Patrick Conway
Department of Economics
Gardner Hall, CB 3305
University of North Carolina
Chapel Hill, NC 27599-3305
patrick_conway@unc.edu

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Summary:

This case study examines the existence of an externality and its implication for international trade, finance and resource use. It was written for use in an undergraduate course in international economics. I use it in concert with more theoretical readings on externalities and efforts to internalize externalities, as for example are found in the relevant chapters of Mishan (1976); my teaching approach presupposes that the students have studied microeconomics at the university level.

I have two goals in mind with this case. First, the water of the Nile is a scarce resource, but is not priced to its users: this creates an externality. To the extent that the agricultural products are competitive on world markets with this implicit subsidy, there is an impact on international trade. Second, Egypt and the Sudan remain fundamentally interdependent through their reliance on Nile waters, and this provides a window for examination of the Coase Theorem in action.

Contents:

Case study, 13 tables, 2 figures, 1 chart.
Appendix
Instructor's notes

Note from the author:

I am pleased to be able to distribute this case study on the Internet, and have no objection to faculty use of the case in educational settings. I ask two things: (1) that the cases not be resold to students, and (2) that you contact me at the above address with an evaluation of the case study and your success with it in the classroom.

The administrators and fellows of the Pew Faculty Fellowship in International Affairs have been a continuing source of inspiration to me as I have developed this and other cases. Thanks to all of them for their support.

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Introduction.

The Sudan is the largest country of Africa, with area of 2.5 million square kilometers but a population of only 18.5 million in mid-1980.¹ It is located just south of Egypt and to the west of Ethiopia; other neighbors include Libya, Chad, the Central African Republic, Zaire, Uganda and Kenya. It is a largely agricultural country, but arable land makes up only 14 percent of its area. Per capita output is valued at \$270, ranking the Sudan among the poorest of the world's nations.²

For all its troubles, the Sudan has one major economic asset: the Nile river runs through it. The Nile river system is the longest in the world (see Table 1), and its drainage and catchment area includes territory from nine African nations. It has two major tributaries -- the White and Blue Niles. The White Nile forms at Lake Victoria, on the Uganda/Zaire border. The Blue Nile begins at Lake Tana in Ethiopia. The two tributaries flow together and form the Nile at Khartoum, the capital of the Sudan. From there the Nile flows north into Egypt and through Egypt to the Mediterranean Sea. Precipitation in the upper reaches of the drainage basins of the two tributaries is quite high and roughly equal. The White Nile, however, contributes a minority of the waters flowing through Khartoum (Table 2); this is due to the existence of the Sudd, a large marshy area in the southern section of the Sudan through which the White Nile flows and into which a large volume of its water is leached. The water subsequently evaporates and never flows north.

The Nile has been a life-giving asset to the Sudan as well as to Egypt. The waters of the Nile have provided irrigation for agricultural activity in both countries, and its yearly peak flows (after flooding in the head-waters lakes, especially Tana) have deposited silt on the river banks that has greatly enhanced the productivity of the agricultural activities. Examination of the regional population densities of both countries indicates that the great majority of the populations live within the areas along each bank irrigated by the Nile and fertilized by these peak flows.

Although the Nile has provided what the populations have needed, it has not always provided what they wanted. The yearly flows of the Nile have been quite variable (Table 3). Over a period of five hundred years (from the 14th to the 18th centuries AD) Hamdan estimates that Egypt was ravaged by epidemics and plague every 11 years on average. The years in which Egypt enjoyed a "Sultanic" flood that guaranteed abundance

¹ By contrast, the United States has an area of 9.4 million square kilometers and a population of 210 million: a population density over 3 times as high.

² This calculation is made using the parallel exchange rate in 1980.

were relatively rare.³ The populations of both countries have searched for ways to regularize these flows. The Old Aswan Dam was erected at Aswan in Egypt in the 1920s, and raised to its maximum height in the 1930s. An additional dam was built at Nag Hammadi in Egypt. In 1926 the Sennar Dam was built on the Blue Nile in what is now the Sudan to provide catchment and irrigation water for the Gezira Cotton Scheme. In 1932 the Jebel Auliya reservoir south of Khartoum was begun. More recently, in 1966 two dams were built within the Sudan: Roseires on the Blue Nile and Khasm el Girba on the Atbara, a tributary of the White Nile. These were used to provide year-round irrigation of agricultural schemes. The final, and most ambitious, effort to regulate the Nile's flow was the Aswan High Dam. This was conceived in 1952 as the solution to Egypt's water needs; the Nile was dammed at this point in 1964, and final work on the High Dam was concluded in 1971.

Historical Relations between Egypt and the Sudan.

The Sudan has existed as a political territory for a relatively short period of time. In contrast to Egypt, whose pharaohs were among the first recorded political leaders, the territories to become the Sudan were known only as Nubia. Its people remained largely autonomous under the nominal authority of the Egyptian Khedive until the 1880s. In 1882 the Egyptian government was under ferocious pressure of foreign indebtedness, and threatened to close the Suez Canal unless concessions were made. Instead, the English under General Wolseley invaded Egypt, defeated the Khedive forces, and imposed English control.⁴ This control was extended southward to Khartoum, where General Charles Gordon became administrator. In 1885 a religiously motivated uprising, now known as the Mahdist revolt, defeated General Gordon and seized Khartoum -- Gordon was killed in the battle. After a decade of rule the Mahdist regime was destroyed by an English military force under General Kitchener in 1898. Five months later the Anglo-Egyptian condominium of 1899 was signed, which placed the Sudan under a governor-general "appointed by khedival decree on the recommendation of her Britannic Majesty's Government".⁵ Kitchener was named the first governor-general, but he was assured in no uncertain terms by Lord Cromer, governor of Egypt, that Cromer retained effective control:⁶

Generally what I want is to control the big questions, but to leave all the detail and execution to be managed locally. In the 'big' I of course include all such measures, for instance, as involve any serious interference with the water-supply of the Nile...

Two features governed interactions between the Sudan region and the Cairo government over the next half-century: a shared recognition of the need to expand the water flow of the Nile, and unilateral efforts by the Egyptian government to implement water control plans within the Sudan to produce that result. A prime example was the exploration and planning leading up to the proposal of the Jonglei Canal, a lined canal designed to bisect the Sudd region and ensure a larger and more direct flow of water through that marshy land. In 1938 the government in Cairo released a document outlining the plans for the Jonglei Canal. According to Angus Gillian, the civil secretary in Khartoum, "the Jonglei Canal was first brought to the attention of the

³ As reported in Waterbury, p. 38.

⁴ This angered the French, who had expected to participate in an Anglo-French joint occupation force. The French then invaded the Sudan from the south, and the ensuing confrontation with the British in 1898 became known as the Fashoda incident.

⁵ Reported in Collins (1990, p. 63).

⁶ Reported in Collins (1990), p. 64.

Sudan Irrigation Adviser when he happened to visit the Ministry of Public Works in Cairo on June 19, 1938 at which time he was handed a copy of [the] report which had already been released to the press."⁷ The Jonglei plan became linked to a group of other proposals in a comprehensive effort to increase and allocate the waters of the Nile; final action on these was not forthcoming until after independence 15 years later.

Egypt became independent with the Free Officer coup in 1952. Beginning in 1953, Egypt and Great Britain agreed on a three-year transition to sovereignty for the Sudan. The leaders of Egypt calculated that at the end of that period the Sudan would choose to merge with Egypt in a single nation espousing the Unity of the Nile Valley. Instead, the Sudan's leaders claimed independence, and on 1 January 1956 the national of the Sudan came into existence. The independence of the Sudan and the proposed high Aswan Dam necessitated a re-negotiation of water rights of the two countries -- this was formalized with the Agreement of Full Utilization of the Nile Waters in 1959 (Appendix 1).

The agreement formalized the allocation of waters of the Nile. The existing allocations of water (measured as billions of cubic meters of water passing Aswan) were 48 billion to Egypt and 4 billion to the Sudan. Hydrologists estimated that 84 billion passed Aswan in the average year, with the balance being unusable because it was overflow during flood season. The Aswan High Dam would allow capture of the entire amount in a large lake, but would lose roughly 10 billion annually through evaporation from that lake. Of the remaining 74 billion, the Sudan would receive rights to 18.5 billion and Egypt receive rights to 55.5 billion. Any increase above the 84 billion would be allocated equally between the two countries. The Sudan was entitled under the agreement to build dams on her territory to capture her share of the overflow: the Roseires dam was mentioned explicitly. The Sudan agreed as well to begin work on a Jonglei Canal through the Sudd; it would pay the costs, and Egypt would reimburse her for half the expenses. The Aswan High Dam flooded a large section of northern Sudan. Egypt promised to pay an indemnity of 15 million Egyptian pounds for that inconvenience. As a component of the agreement Egypt negotiated a "water loan" from the Sudan for the period up to 1977 to allow Egypt to go ahead with agricultural projects.

Political Difficulties within the Sudan.

The military first took power under Lieutenant General Ibrahim Abboud in 1958, and supervised a planned expansion of the economy based upon state investment (next section). He fell from power in 1964, followed by a civilian government led by Prime Minister Muhammed Mahgoub. Our present President, Major-General Gaafar Nimeiry, took power in a coup in 1969.

The defining political feature of the Sudan is the enmity between the populations of the north and the south. The southern regions of the Sudan are populated by tribes related to those of Kenya, Uganda and Sub-Saharan neighbors, while the northern regions most closely identify with their Egyptian neighbors. Independence movements have existed in the south since 1955, and Abboud's fall in 1958 was in part due to rioting in the southern provinces. Nimeiry quieted these movements for a time in 1972 by proposing and championing a Southern Provinces Regional Self-Government Act providing partial self-governance. He also created a national vice-presidency and a Southern command of the Sudanese Army to be filled by southerners cooperating with his policies. By 1978, however, more separatist elements had become dominant in the south, and Nimeiry's partners had lost influence in the southern movements.

Sudan's Current Economic Crisis.

⁷ Reported in Collins (1990), pp. 183-184.

From its inception, the modern sector of the Sudan has been under the direct guidance of the state. It began with the Gezira Scheme for cotton production inaugurated in 1925 with the completion of the Sennar Dam. By 1950 this was entirely government-owned and -operated. The first ten-year plan of 1961-1970 focused on agricultural production and infrastructural investment. The agricultural sectors encouraged were import substitutes: sugar and wheat in irrigated schemes, and tea and coffee in the south. Infrastructural investment focused on land reclamation and water management. The Roseires and Khasm-el-Girba dams provided water to irrigated agricultural schemes, and the Gezira project was expanded. In 1970 a number of private concerns, including banks, were nationalized; the five-year plan of 1971-75 forecast extensive growth as well in public agricultural and infrastructural investment.

This five-year plan proved to be quite pessimistic in terms of public investment. The expenditures of the state were revised upward in mid-plan after the rise in oil prices on world markets engineered by OPEC in 1973. The Sudan, an Islamic country with tremendous agricultural potential, was viewed by the countries of the Persian Gulf as a local and reliable source of foodgrains and other agricultural products: the bread-basket of the Middle East. Arab countries provided extensive loans and grants during these years to expand this production in the Sudan. The Sudanese did not discourage these notions, but rather built them into a development program. As Mansur Khalid, Minister of Foreign Affairs, told the UN General Assembly in 1974:⁸

What we are trying to do in the Sudan is to proffer this wealth of land to our friends: those who have the money, and those who have the technological knowhow, with a view to financing its utilization and cultivating it with the latest possible tools man has yet discovered. In other words, a tripartite venture between us who have the land and the water; the moneyed who are willing to invest in agriculture, and our friends with technological abilities we lack.

Indeed, the origins of the Sudan's current economic crisis lie in this overly ambitious public investment program. When combined with subsequent adverse developments in world markets, a decline in cotton production and inadequate domestic resource mobilization, this led to sharply rising government deficits. These in turn fuelled credit expansion, created inflationary pressures, and contributed to serious trade deficits. As a result, the Sudan now has international reserves adequate for only a few days of imports and its arrears on foreign debt service payments amount to over a year of export earnings.

The rapid increase in the public investment program was the result of a major effort by the government to lead the country out of the relative stagnation that had beset the country during the years of conflict between the north and the south. Public investment grew by nearly 50 percent in real terms between 1973 and 1974, and then more than doubling in real terms by the end of 1975. Although this effort did increase the Sudan's growth rate, it overtaxed the nation's physical, financial and human resources. Consequently, project completions were seriously delayed as were the benefits expected from the projects.

The investments for the most part ran counter to comparative advantage. The Sudan's traditional exports -- cotton, groundnuts, and other specialty crops -- were discriminated against in favor of wheat, rice and sugar cane. Cotton production, for example, declined from 4 million bales in 1971 to 1 million in 1981. This was due at least in part to the pricing policies of irrigated agricultural schemes like Gezira: water charges

⁸ Reported in Waterbury (1979, p. 175).

were levied on the output of cotton and traditional crops, but not on wheat production. Foreign investors, in particular the Lonrho Corporation of Great Britain, have fostered an ambitious expansion of sugar cane cultivation and sugar refining on the Kenana plantation: these first began production in the early 1970s and have great expectations for expansion of the sector despite relatively high operating costs.

Imports accelerated and exports declined during the period 1973-1981. This led to rapidly mounting deficits in the balance of payments and external borrowing on a scale massive for the Sudan. External debt commitments were manageable at less than \$100 million in 1972; by 1974 these reached \$700 million. Commercial debt is a minority of total, but represents 77 percent of the \$1.3 billion in arrears on principal outstanding. The Sudan has suffered from a severe shortage of foreign exchange over the last three years. This resulted in the accrual of arrears and a sharp reduction in import volumes. As these imports were for the most part necessary in production, real output has declined as well.

The excessive external borrowing was necessary in part because of weak domestic resource mobilization efforts. During most of the decade, domestic savings represented only five to 10 percent of GDP (compared to an average of 15 percent for all low-income countries in 1978). The government's current account (revenue minus non-investment expenditure) has been in deficit during the last years.

The government recognizes the need to expand exports, but cannot afford at this point to reduce production of foodstuffs. It proposes to increase output of traditional agricultural exports through more intensive use of the economy's natural resource: water in irrigated areas.

Projected Water Needs.

The Sudan has tremendous demands for increased water use in the coming years (Table 4). To fuel our development program we have targeted agricultural expansion. Expanding agriculture requires increased drawdowns of water from the Nile. We anticipate that our usage in the agricultural sector will double over this period, while we anticipate only a minor increase in the flow of water available to us through Jonglei conservation programs. By 1985-1986 we anticipate that our requirements for water will greatly exceed our supplies -- water will be the binding constraint on growth.

Egypt has provided us with its own projections for annual water use during the 1985-86 period (Table 5). It has ranges from the optimistic to the pessimistic -- if we take the cautious estimates as our base, we find that they too foresee a net excess demand for water by 1986.⁹

Our task.

We have been tasked to analyze the present water-use agreements between the Sudan and Egypt, and to propose policies that will best deal with our economic crisis within the context of these agreements. Should we find that the water-use agreements are too constraining, we should propose policies that allow us to rework these agreements to our best advantage given the political, military and economic constraints we operate within.

⁹ Note that their optimistic scenario is predicated upon a 9 billion cubic meter yield from the Upper Nile projects (in the Sudan), but we haven't gotten very far with that project.

Bibliography.

Collins, R.: The Waters of the Nile. Oxford: Oxford University Press, 1990.

Waterbury, J.: Hydropolitics of the Nile Valley. Syracuse, NY: Syracuse University Press, 1979.

Sources.

The discussion of this case study draws heavily upon the narrative and analysis provided in Collins (1990) and Waterbury (1979). It also draws upon the author's experience with a World Bank mission to the Sudan in 1981.

TABLE 1^a

The Nile in Comparison to Other Major River Systems

RIVER	LENGTH IN KM	DRAINAGE AREA km ²	ANNUAL DISCHARGE: BILLIONS OF m ³	ANNUAL SEDIMENT LOAD: MILLIONS OF TONS
1. Nile	6,825	3,100,000	84	110
2. Amazon	6,700	7,050,000	3,000	900
3. Congo	4,700	3,700,000	1,400	70
4. Hwang Ho	4,630	770,000	200	2,000
5. Mekong	4,200	795,000	400	800
6. Niger	4,100	1,890,000	180	40
7. Mississippi	3,970	3,220,000	600	600
8. Danube	2,900	1,165,000	200	80
9. Zambesi	2,700	1,300,000	500	100
10. Rhine	1,320	162,000	80	3

SOURCE: Democratic Republic of the Sudan, Ministry of Irrigation, *Control and Use of the Nile Waters in the Sudan*, Khartoum (June 1975), p. 7.

TABLE 2^a

Contribution of Main Nile Sources

	TRIBUTARY	12-MONTH WATER YEAR	FLOOD PERIOD
	Blue Nile	59%	68%
Ethiopian Sources	Sobat	14%	5%
	Atbara	13%	22%
Equatorial Lakes	Behr el-Jebel	14%	5%

SOURCE: Adapted from Michael Field, "Developing the Nile," *World Crops* (Jan.-Feb. 1973):13.

^aSource: Waterbury (1979).

TABLE 3^a

Annual Discharge of the Nile

NO. OF YEARS	PERIOD	MEAN IN BILLION m ³	STD. DEVIATION IN BILLION m ³
30	1870-99	110.0	17.1
60	1900-59	84.5	13.5
90	1870-1959	92.6	19.8

SOURCE: H. Hurst, R. Black, Y. Samaika, *Nile Basin* (Cairo: Ministry of Irrigation, 1965), X: 81. The table as presented above was taken from Yusuf Shibl, *The Aswan High Dam* (Beirut: Arab Institute for Research and Publishing, 1971), p. 22. The entire historic record, approximate though it may be, reflects a marked secular decline in lake and river volume and river discharge over a period of 7,000 years. See Karl W. Butzer, *Early Hydraulic Civilization in Egypt* (Chicago: University of Chicago Press, 1976), p. 31. See also Appendix.

TABLE 4^a

Water Supply and Demand in the Sudan,
1975-76 and 1985-86
(bill. m³)

SUPPLY	1975-76	1985-86
Acquired rights	20.5	20.5
Jonglei, Phase I	--	+2.4
Total	20.5	22.9
DEMAND		
Agriculture	13.692	27.151
Conveyance Loss 10%	1.369	2.715
Household & Industrial	275	550
STORAGE LOSSES		
Jebel Auliya	1.000	1.000
Sennar/Roseires	.700	1.000
		(after heightening of Roseires)
Khashm al-Girba	.190	.190
TOTAL	17.226	32.606
SURPLUS/DEFICIT	+3.274	-9.706

SOURCE: Figures compiled by the author.

^aSource: Waterbury (1979).

TABLE 5^a

Projections of Total Egyptian Water Supply
And Demand, 1986-90
(billions m³)

SUPPLY	OPTIMISTIC	CAUTIOUS	PESSIMISTIC
Released at Aswan	55.5	55.5	55.5
Yield from Upper Nile Projects	9.0	1.9	1.9
Reused Drainage Water	12.0	6.0	4.0
Groundwater	1.0	1.0	1.0
Total	77.5	64.4	62.4
DEMAND			
Crop Needs	51.4	54.4	55.8
Navigation and January Closing	2.5	3.0	3.0
Conveyance Losses	7.7	9.8	11.2
Industrial Use		2.0	3.0
Household Use	1.0	2.0	3.5
Total Demand	62.6	72.1	76.5
Surplus/Deficit	+14.9	-7.7	-14.1

One caveat is in order. Another "pessimistic" hypothesis not included here is that Egypt will fail to expand cultivated acreage or crop intensity. This possibility cannot be ruled out. The Plan for 1978-82 recommends that by that latter year a cropping pattern be established on *11 million cropped feddans* that would, according to our own calculations, require 43.1 billion m³ to 45.9 billion m³, according to the actual water duty for sugar cane. That is about 6 billion m³ short of our optimistic estimate above. The discrepancy can be explained by these factors: (1) the plan does not seem to allow for additional reclaimed land; (2) it is 3-5 years shy of the time period referred to here; and (3) the plan figures do not include all Egypt's crops (missing are *nili* maize, lupine, sesame, garlic, chickpeas, temporary berseem, barley, fennugrec). See ARE, Ministry of Planning, *The Five Year Plan, 1978-82*, Vol. IV: *The General Strategy for Agriculture, Irrigation, and Food Security* (Cairo: August 1977), p. 160. The inconsistencies in this document are rife. On p. 24 it is stated that the cropped surface must rise to 15,000,000 feddans, consistent with our assumption, and that that can be done with the addition of 2 million cultivated feddans.

^aSource: Waterbury (1979).

TABLE 6^a

Irrigated Crop-Water Needs of the Sudan, 1975-76 and 1985-86

CROP	IRRIG. SURFACE 1975-76 (feddans)	CROP-WATER REQ. m ³ PER FEDDAN	TOTAL WATER NEED, MILL. m ³	IRRIG. 1000 FEDDANS 1985-86	TOTAL WATER NEED MILL. m ³
Cotton	825	4,700	3,879	905 ^b	4,253
Sorghum	986	3,000	2,959	1,500	4,500
Wheat	707	2,100	1,484	1,010	2,121
Rice	16	9,000	147	100	900
Maize	9	3,300	3	20	660
Groundnuts	1,124	3,800	4,270	1,900	7,220
Sesame	4.5	2,440	11	6	14.0
Ful	35.8	1,600	57	50	80
Fruit & Veg.	28	4,620	129	60	282
Sugar Cane	42	17,800	753	400	7,120
Total	3,777.3		13,692	5,951	27,151.0

TABLE 7^a

Surface Proportion of Sudanese Sugar Cane

PROJECT	TOTAL SURFACE, ALL CROPS	NET SURFACE, SUGAR CANE
Guneid (in operation)	38,500 feds.	20,000 feds.
Khashm al-Girba (in operation)	360,000 feds.	20,000 feds.
Kenana (projected)	120,000 feds.	80,000 feds.
Sennar (projected)	35,000 feds.	30,000 feds.
Hajar Asalaya (projected)	35,000 feds.	30,000 feds.
Melut (projected)	45,000 feds.	30,000 feds.
Renk-Gelhek (projected)	400,000 feds.	120,000 feds.
Seteit (projected)	600,000 feds.	60,000 feds.
Mongolla (projected)	28,000 feds.	12,000 feds.
	1,661,500 feds.	402,000 feds.

^aSource: Waterbury (1979).

^bThis may be an underestimate as 450,000 feddans of cotton will be introduced at Rahad I and II alone, although wheat and rice may displace cotton acreage elsewhere. Part of the discrepancy may result from a shift from irrigated long-staple cotton to irrigated medium staple cotton. The figure of 905,000 refers only to long staple.

TABLE 8

Sudan: Summary Macro Indicators

ITEM	1972/73	1977/78	1980/81
<i>LS Millions</i>			
GDP	897	2883	4434
<i>Percent of GDP</i>			
Imports	18	17	22
Exports	17	8	11
Current Account Balance	-2	-7	-9
Current Revenues	20	16	16
Current Expenses	18	15	19
Development Expenditures	3	6	6
<i>Growth Rates^a</i>			
GDP	.	8	-1
Money Supply	.	29	31
Inflation	.	17	23

TABLE 9

Egypto-Sudanese Trade 1938-74
(selected years)

YEAR	EGYPTIAN EXPORTS TO THE SUDAN (in £E)	EGYPTIAN IMPORTS FROM THE SUDAN (in £E)	BALANCE FOR EGYPT (in £E)
1938	1,108,805	818,050	+ 290,755
1952	5,055,356	3,451,967	+1,603,389
1958	5,652,885	2,733,041	+2,919,844
1964	4,634,262	1,295,591	+3,338,671
1972	5,276,000	7,794,000	-2,518,000
1974	6,207,000	4,552,000	+1,655,000

^aGrowth rates cover the period since the year indicated in the previous column.

SOURCES: For figures of 1938-64 see Tareq Ismael, "The UAR and the Sudan," *Middle East Journal* 27 (1) (Winter 1969): 14-28; for the period 1972-74, DRS, National Planning Commission, *Economic Survey 1974* (Khartoum; July 1975), p. 123.

TABLE 10

Sudan: Balance of Payments Summary, 1972/73-1980/81
(US\$ Millions)

		1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
Exports GNFS	98	434.2	479.6	526.7	639.5	708.3	700.8	699.5	833.1	1045.2
Imports GNFS	99	456.4	762.6	1066.8	1256.9	1191.8	1436.9	1345.2	1611.7	1987.2
Res Balance	100	-22.2	-283.0	-540.1	-617.4	-483.5	-736.1	-645.7	-778.6	-942.0
C/A Balance	103	-39.1	-284.8	-517.1	-517.9	-351.2	-543.2	-457.7	-534.1	-768.0
Off Capital	225	50.6	270.9	464.0	414.1	267.2	143.2	347.9	455.0	683.0
ACC Arrears	118	0.0	0.0	3.0	125.0	345.0	325.0	309.0	93.0	0.0
ST/E&O C	31	-5.8	5.4	40.1	62.5	67.6	263.2	115.8	31.1	0.0
Change Resrv	65	1.2	21.6	76.2	71.5	4.7	75.4	-40.6	-30.8	0.0
Net Intl Res	66	61.3	124.3	36.4	23.6	23.2	21.9	27.4	32.8	32.8
Exch Rate	216	287.2	287.2	287.2	287.2	287.2	287.2	250.0	212.5	200.0
GDP	104	2575.6	3579.1	4339.0	5307.5	6719.6	8279.1	8050.0	8383.1	8868.0

Sudan: Foreign Trade Indexes
(1972/73=100)

ITEM	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	EST. 1980/81
Export Value	70.9	117.5	150.5	162.3	150.6	144.0	162.0	195.4
Export Volume	53.5	60.3	98.0	83.4	69.0	62.0	54.2	42.6
Export Price Index	132.5	194.8	153.5	194.8	218.3	232.3	298.7	458.7
Import Value	149.1	255.2	292.8	290.8	328.4	308.2	359.8	437.5
Import Volume	102.6	140.4	157.2	152.1	159.8	113.4	90.7	111.5
Import Price Index	145.4	181.7	186.2	191.1	205.5	271.7	396.6	392.4
Terms of Trade	91.2	107.2	82.4	101.9	106.2	85.5	75.3	116.9

Sudan: Summary of Major Crop Areas and Production

	AREA			PRODUCTION		
	`71-`75	`76-`80	`81e	`71-`75	`76-`80	`81e
	-----ths fd-----			-----ths mt-----		
Cotton	1,375	1,156	967	657	414	281
Groundnut	1,521	2,308	2,162	555	845	707
Sugarcane	34	52	103	1,024	1,420	2,848
Wheat	367	591	436	188	247	145
Sorghum	4,913	6,563	6,837	1,558	1,973	2,123
Sesame	2,194	2,162	2,011	281	227	211
Millet	2,321	2,764	2,604	381	438	492
Total	12,725	15,596	15,120	4,644	5,564	6,807

NOTE: Figures for `71-`75 and `76-`80 are period averages.

TABLE 11
Sudan: Gross Domestic Expenditure (Constant 1978 Prices)
(LS Million)

ITEM		1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
<i>Consumption</i>	21	1,729.3	1,959.8	1,943.5	1,713.8	1,864.4	2,130.8	2,135.5	2,440.6	2,725.3	2,559.7	2,566.7
Private	22	1,214.6	1,501.8	1,571.8	1,358.8	1,562.4	1,822.0	1,835.2	2,118.4	2,394.6	2,252.5	2,258.7
General Government	23	514.7	458.2	371.7	354.9	301.7	308.8	300.3	322.2	330.7	307.2	308.0
<i>Gross Domestic Investment</i>	24	278.0	257.5	198.4	230.7	398.8	407.8	589.7	487.5	413.7	426.8	342.0
Fixed	25	278.8	210.3	186.6	208.8	243.8	329.8	498.3	368.7	323.3	426.8	342.0
Private	28	184.2	117.5	128.5	158.8	171.1	172.3	343.3	183.8	137.5	282.4	186.2
Public	27	85.7	92.8	57.1	52.2	72.7	157.5	158.0	181.8	185.8	144.4	155.8
Changed in Stocks	28	-0.9	47.1	9.8	21.9	155.0	78.0	90.3	101.8	90.4	-	-
<i>Gross Domestic Exp. (GDX=C+I)</i>	39	2,008.3	2,217.3	2,138.9	1,944.5	2,283.2	2,538.8	2,725.2	2,908.1	3,139.0	2,986.5	2,908.7
Exports (Goods & NFS)	29	387.7	340.7	316.4	324.3	269.3	205.9	306.8	274.7	244.0	250.4	262.7
Terms of Trade Adj (TADJ)	41	-1.1	-1.6	-19.7	-36.9	-38.6	1.8	-81.0	-9.5	-	-38.5	-59.4
Exports (Import Capacity)	55	386.6	339.0	296.7	287.5	228.7	207.5	245.8	265.2	244.0	211.8	203.2
Imports (Goods & NFS)	30	350.8	370.9	316.5	302.1	365.2	420.1	483.0	448.2	500.3	407.3	393.2
Resource Balances												
Exports - Imports (RB)	53	38.8	-30.2	-0.1	22.2	-85.8	-214.3	-178.2	-171.6	-258.3	-157.0	-130.5
Net Factor Income (FSY)	31	-2.8	-11.0	-8.8	-18.4	-13.0	-18.8	-22.3	-18.7	-17.8	-23.0	-17.6
Net Current Transfers (NCT)	32	-	-	-	6.8	12.1	28.8	81.0	84.6	85.0	85.7	106.1
CUR A/C Bal = Ext Savings	33	33.0	-42.8	-28.4	-26.4	-138.4	-202.7	-198.5	-116.2	189.1	-132.8	-101.4
<i>Product</i>												
Gross Domestic (GDX+RB)	34	2,045.2	2,187.1	2,138.8	1,968.7	2,187.3	2,324.3	2,548.0	2,736.5	2,882.7	2,829.5	2,778.2
Gross National (GDP+FBY)	40	2,042.4	2,176.1	2,131.2	1,848.3	2,154.3	2,305.5	2,526.7	2,176.8	2,864.9	2,806.5	2,760.6
<i>Memo</i>												
Export Price Index (1978=100)	73	29.8	36.2	39.3	45.8	60.7	89.2	70.3	89.2	100.0	106.4	136.8
Import Price Index (1978=100)	74	29.9	36.4	42.4	48.7	70.7	88.4	90.6	93.0	100.0	132.2	193.0
Terms of Trade Index (1978=1)	76	-	-	-	-	-	-	-	-	-	-	-

SOURCE: Bank of Sudan.

TABLE 12

Sudan: Export Products
(Value: `000 US\$; Volume: `000 MT; Price: US\$/MT)

ITEM		1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
<i>Cotton</i>									
Value	65	194,032	164,112	159,545	300,368	285,689	295,891	320,815	328,803
Volume	66	230	140	107	219	151	143	168	185
Price	67	843	1,170	1,493	1,375	1,893	2,075	1,905	1,782
<i>Gum Arabic</i>									
Value	74	25,345	7,341	41,288	30,541	32,795	33,780	38,265	43,342
Volume	75	37	10	17	24	26	27	58	36
Price	76	691	727	2,414	1,289	1,247	1,261	656	1,221
<i>Sesame</i>									
Value	77	31,296	10,038	55,117	32,939	62,050	55,487	27,643	41,888
Volume	78	99	33	93	60	109	93	37	40
Price	79	317	305	595	545	571	594	741	1,045
<i>Groundnut</i>									
Value	80	32,999	17,324	82,369	115,520	103,363	80,155	25,598	12,912
Volume	81	135	63	147	279	224	135	40	19
Price	82	244	274	561	414	462	593	640	666
<i>Oil</i>									
Value	83	10,158	4,900	15,865	2,858	5,474	8,593	26,603	8,600
Volume	84	26	9	19	6	16	19	41	22
Price	85	385	557	818	493	351	443	644	396
<i>Oil Cake</i>									
Value	92	11,479	19,294	5,152	16,215	26,264	8,803	21,075	18,599
Volume	93	146	129	56	224	210	79	186	155
Price	94	79	150	92	72	125	111	113	120
<i>Dura</i>									
Value	104	5,408	4,633	11,046	5,141	12,933	8,590	8,788	70,308
Volume	105	66	47	75	39	109	58	56	341
Price	106	82	98	148	132	119	148	158	206
<i>Other</i>									
Value	107	52,595	28,645	39,349	32,847	46,150	40,673	43,828	57,216
<i>Exports</i>									
Value	115	363,314	256,286	409,731	536,429	574,719	531,972	512,613	581,668
<i>Reexports</i>									
Value	116	2,628	3,108	20,104	14,145	19,340	19,257	14,295	12,295
<i>Total Exports</i>									
Value	117	365,942	259,393	429,835	550,574	594,059	551,229	526,908	593,963
<i>BOP Adjustment</i>									
Value	123	9,458	158,807	23,065	-374	-559	-229	93	37
<i>Exports, BOP</i>									
Value	124	375,400	418,200	452,900	550,200	593,500	551,000	527,000	594,000

TABLE 13

Sudan: Export Market Composition
(Percentages)

ITEM		1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
<i>Western Europe</i>	1	32.3	33.4	39.4	38.3	43.7	49.7	44.7	41.6	32.6	31.9
<i>Eastern Europe & China</i>	17	32.7	24.7	15.0	19.1	16.0	18.2	20.3	18.8	34.0	31.5
<i>Western Hemisphere</i>	29	4.0	4.1	3.1	2.1	8.1	4.2	2.8	2.6	2.4	2.4
<i>Africa and Asia</i>	35	19.1	23.1	23.9	21.8	17.4	20.3	23.2	25.4	16.5	12.7
<i>Arab Countries</i>	43	11.8	14.7	18.5	18.7	14.8	7.5	9.0	11.6	14.5	21.5
Egypt	45	4.3	5.7	7.0	2.1	5.9	3.4	2.3	3.4	5.5	2.0
Saudi Arabia	47	2.2	3.2	3.1	3.7	4.1	1.9	4.0	4.8	6.4	15.2
Others	49	5.3	5.9	8.5	12.8	4.9	2.2	2.7	3.4	2.6	4.3
<i>TOTAL</i>	51	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
<i>B/P Adjustment</i>	59	-0.7	-1.5	2.6	-	-	-0.7	-0.1	-	-	-0.1
<i>Exports (bal. of payments)</i>	61	99.3	98.5	102.6	100.0	100.0	99.3	99.9	100.0	100.0	99.9

SOURCE: Bank of Sudan.

FIGURE 1

Nations of the Middle East

FIGURE 2

Provincial Boundaries of the Sudan, 1976

CHART 1

SUDAN: Schematic Model of Nile Irrigation Schemes

The Sudan and the Exploitation of the Waters of the Nile

Instructor's Notes: Patrick Conway

This case study examines the existence of an externality and its implication for international trade, finance and resource use. I use it in concert with more theoretical readings on externalities and efforts to internalize externalities, as for example are found in the relevant chapters of Mishan (1976).

The Vision Thing.

I have two goals in mind with this case. First, the water of the Nile is a scarce resource, but is not priced to its users: this creates an externality. To the extent that the agricultural products are competitive on world markets with this implicit subsidy, there is an impact on international trade. Second, Egypt and the Sudan remain fundamentally interdependent through their reliance on Nile waters, and this provides a window for examination of the Coase Theorem in action.

Organization of discussion.

I begin the class period preceding the case study by asking one student to take the Egyptian perspective for the case. This entails some outside reading: there is a chapter in Waterbury (1979) that is appropriate background for that student.

The case day began with an enumeration of the goals of the Sudan and the problems faced.

- (1) The goal we wish to achieve: faster economic growth.
- (2) Process to achieve this: increase agricultural output in irrigated areas.
- (3) Constraint: availability of Nile River water.

We then spent some time on the details of the Nile River flow.

- (1) Notion of "over-year" storage capacity.
- (2) Existing agreements on water allocation.
- (3) Forecasts for Nile River water use in 1986.

The "Egyptian" provided a nice contrast and tension in this discussion.

I nudged the students as quickly as possible to recognize the excess demand for water, and to consider how this would be dealt with in other economic contexts. The concept of a market for water was explored, as well as incentives to increase supply and reduce demand.

The students then derived a negotiation strategy with three parts.

- (1) Egypt-Sudan: how to allocate water between the countries efficiently?
 - (a) auction off water, with users in both countries participating.
 - (b) analyze the returns to various agricultural schemes in the two countries in terms

of exports.

(2) Sudan-environmentalists: save protection of the Sudd for assistance from environmental groups. Debt-nature swap?

(3) Sudan-other Arab countries: the value of having an Arab "breadbasket". Favorable trade agreements in exchange for continued use of irrigated land to produce "breadbasket" crops.

Conclusion.

The case as it stands has only limited information about the Egyptian position in all this, and that must be provided to turn this into a full-blown negotiation vehicle. The chapter from Waterbury was sufficient for this.

It is useful for analysis of an externality, especially since it minimizes the "public good" nature of the externality. (The notion did come up in the discussion of the market for water, as we talked about the propensity of farmers to dip into the river without paying.)

The instructor will have to push a bit to ensure that all international aspects of the problem come out. For example, is the Sudan's comparative advantage in cotton due to non-internalization of the cost for water? That traditional exports might lose their opportunity-cost advantage is evaluated by including the opportunity cost of water.