Performance Measures of Irrigating River Nile Islands (Gezirahs)

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ABSTRACT

THE RIVER NILE is the main source of irrigation water in Egypt. Before construction of the High Aswan Dam (HAD) and during the flood season, the Nile waters used to carry soil minerals which led to the formation of many small islands in the stream of water. The location and area of these islands used to change from year to year and flood waters would cover them. After construction of HAD, flood waters no longer reached the levels of the past. The farmers on the islands were pleased with this change. The soil of the islands became very rich, the Nile water is now available all year-round and a unique micro climate exists during both the hot summers and the cold winters.

Farmers of farmer-managed irrigation systems (FMIS) in these islands have developed their own surface irrigation systems, cropping patterns and water delivery and distribution systems. A natural drainage system exists and care is being taken in applying and distributing water within the farmers' fields and throughout the islands.

The performance of these FMIS is unique since their outputs reflect their management practices in terms of soil, irrigation, drainage, cropping pattern and their impact on the economy of the islands. Their performance also reflects the use of farmer-produced inputs which tends to increase their expected profits by minimizing the transaction costs.

Questionnaires as well as field visits and observations were used to gather information on irrigation-related activities of these islands. Farmers' views of different systems such as the Centrally Managed Irrigation Systems (CMIS) were studied to gain insights and for purposes of comparison between FMIS and CMIS. After examining farmers' views on CMIS and FMIS, performance indicators are described.

Gezirah is an Arabic word meaning island. Gezirahs have an appealing significance in Arabic tradition due to expectations of what may be found on them. This paper covers some studies on selected islands in the River Nile. It describes the area cultivated, location, water lifting devices, surface irrigation systems, cropping patterns, returns and suggested plans for improvement of the FMIS. The paper also describes the technical and economic parameters used to evaluate the case studies, and relates these to performance indicators.

Technical and economic efficiencies are compared to show how the management of these systems makes compromises in their decision-making process. The social structures and the internal organization structures are described, analyzed and evaluated.

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FARMERS' VIEWS OF THEIR SYSTEMS

Two groups of farmers were met. The first was a group of elderly farmers who had experienced both the conditions prior to the construction of the HAD and after it came into operation; the second group consisted of young farmers who were children at the time of construction.

Before the construction of the HAD, irrigation activities were the most costly and time-consuming of all farming operations and involved very hard work. After the HAD came into operation, the rate of introduction of water pumps to the islands was very high in comparison with that of the Centrally Managed Irrigation Systems (CMIS). Irrigation is the main activity which farmers have to perform. 30 percent of their decisions deal with irrigation. Other decisions deal with fertilization, blowing, picking and marketing. The drainage system is natural due to the soil formation and the care taken in applying water to the crops. Maintenance of the water delivery system is done routinely. It is done every two to three weeks. At that time all farmers using the irrigation channel share in maintaining the headworks. There is no other water source except the intake from the Nile.

Vermillion (1991) states that "the ability to recover operation and maintenance costs from beneficiaries is directly related to the productivity of irrigated agriculture. The users have a personal interest in ensuring the long-term productivity of their irrigated agriculture. This is ensured through good operation and maintenance management performance."

The interval between irrigations is five to six days with no constraints on the availability of water. This permits raising crops such as vegetables which are sensitive to water stress and have high cash value. Because the production of the islands is not subject to government regulations, production is more consumer- and market-oriented.

THE ISLANDS IN THE RIVER NILE OF EGYPT

Table 1 gives the number of islands and their total areas (in feddans) along the different reaches of the River Nile from Aswan to Cairo. The zero location is the Rodda water level near Cairo. Table 2 classifies the islands according to size in order to highlight the number of islands in each size group and their distribution along the six reaches of the River Nile.

Table 1. Number of islands and their total areas in the different reaches of the River Nile from Aswan to Cairo.

Reach No.	Extent of the area	Location from Rodda Water Level near Cairo in km	Length of the reach in km	No. of islands	Total area in feddans
1	From Aswan to upstream of Esna Barrages	921.00 to 760.40	160.60	29	4,956.47
2	From downstream Esna Barrages to upstream Naga Hammadi Barrages	760.40 to 567.50	192.90	52	5,457.40
3	From downstream Naga Hammadi Barrages to upstream Assiut Barrages	567.50 to 382.20	185.30	89	10,748.00
4	From downstream Assiut Barrages to the City of Minya	382.20 to 242.00	140.20	46	7,022.14
5	From the City of Minya to the City of Beni Suef	242.00 to 117.00	125.00	85	5,411.98
6	From the City of Beni Suef to upstream Delta Barrages (North of Cairo)	242.00 to 117.00	142.90	55	6,039.82

Table 2. Classification of the detailed areas of the islands in feddans (F) and their numbers.

Reach No.	Extent of the area	No. of Islands	Area of the islands					
			Less than 50 F	from 50 to 100 F	from 100 to 200 F	from 200 to 500 F	from 500 to 1,000 F	more than 1,000 F
1	From Aswan to upstream of Esna Barrages	29	10	6	6	6	–	1
2	From Downstream Esna Barrages to upstream Naga Hammadi Barrages	52	28	5	9	8	2	–
3	From Downstream Naga Hammadi Barrages to upstream Assiut Barrages	89	60	9	3	11	4	2
4	From Downstream Assiut Barrages to the City of Minya	46	29	4	6	4	1	2
5	From the City of Minya to the City of Beni Suef	85	68	7	5	2	3	–
6	From the City of Beni Suef to upstream Delta Barrages (North of Cairo)	55	34	9	5	3	3	1
Total		356	229	40	34	34	13	6

The Tables show that the largest number of islands (89) is in the reach from downstream Naga Hammadi Barrages to upstream of Assiut Barrages. The total area of the islands in this reach is 10,748 feddans (1 feddan=0.42 ha). The smallest number of islands (29) is in the reach from

Aswan to upstream of Esna Barrages. These have a total area of 4,956.47 feddans. Classified by area, the largest group contains 68 islands each with an area of less than 50 feddans. This group is located between the city of Minya and the city of Beni Suef. Only six islands exceed one thousand feddans. The largest island is Shebha, with an area of 2292.66 feddans, length 4.9 km and maximum width 2.50 km. Its location is 277.00 km south of Rodda or south of Cairo.

The information in Tables 1 and 2 was gathered by the High Aswan Dam Side Effects Research Institute (HADRI) of the Water Research Center, Ministry of Public Works and Water Resources (Shalash, S. 1986). The survey was done following an aerial survey of the River Nile made to monitor the erosion of the banks of the Nile as well as the stability of the islands. The location of the islands relative to the stream is to the right, to the left or in midstream. Some of the islands have submerged sections on the River Nile. The degree of submergence is relative to the water level of the River Nile which varies from season to season according to the water requirements of the different sectors such as agriculture, industry, navigation and hydropower generation.

There are many other islands in the Rossetta and Damietta branches of the River Nile. There are, in addition, two other types of islands. The first is not a complete island, as it is connected on one side to one of the banks of the Nile; the second type is cultivated only three months a year during the winter closure period and the winter season when water requirements are minimal. Farmers cultivate these islands only during that short period.

ECONOMIC PERFORMANCE OF GEZIRAH FMIS

Since the farmers develop their own surface irrigation systems, cropping patterns, farm management practices in terms of soil, irrigation and drainage, the economics of these practices merit study as a measure of their performance.

Barghouti and Le Moigne (1990) report that in various parts of Africa, there are signs that privately managed irrigation systems perform better than government-managed systems, especially in small-scale irrigation.

Farmers of Gezirahs were found to have their own economic concepts in managing their irrigation systems. The concepts focus on maximizing their returns and increasing irrigation water use efficiency, physically and economically. The application of this concept manifests itself in the cultivation of short-season case crops (SSCC) which have a rapid flow of returns. The flow of returns helps finance other operations and the cultivation of crops already planted as well as others still planned.

Gezirah FMIS cultivated parsley, lettuce, cucumbers, tomatoes, Egyptian leak and garden rocket, in addition to maize and occasionally Berseem. Other farmers cultivated flowers, trees and orchards. These crops can be cultivated three to five times a year (almost nine months for Gezirahs) and their returns are very high since they can be used fresh and thus sold at high prices.

The survey indicated that crop yields of El Gezirah FMIS were very high compared to those of CMIS farmers. Crop intensity in the Gezirahs was three times that of CMIS. Cost per feddan was also three times that of CMIS. Gross returns were four times that of CMIS. Irrigation efficiency for El Gezirah FMIS was high since irrigation water requirements were less than those of CMIS. The average estimated water requirements for one feddan cultivated at El Gezirah FMIS were 5,400–5,500 m^3 compared to 6,000 m^3 for an efficient CMIS.

Stegman E.C. et al. (1980) described the management models and procedures which have been used in applied irrigation scheduling as well as the arguments for those models and procedures. These are summarized as follows:

* Economics of near-maximum seasonal yield (relatively low cost of water application).
* Maximizing yield per unit area.
* Maximizing yield per unit water applied.

Table 3 summarizes the differences in economic benefits between El Gezirah FMIS and CMIS.

Table 3. Economics of FMIS at Gezirahs compared to CMIS.

Item	CMIS	FMIS
Type of crop patterns	CCP[35]	SSCC[36]
Crop Intensity (%)	200	300–50
Average cost/feddan (L.E.)	997	2015
Average gross returns/feddan (L.E.)	1511	4397
Average net return/feddan (L.E.)	514	2382
% of net return to gross return	34	54
Irrigation water requirements (m^3)	6000	5400
Return to one m^3 (L.E.)	0.086	0.44

Note: L.E. = Egyptian Pound

The following conclusions may be drawn from this Table:

* El Gezirah FMIS are technically efficient.
* Investments in FMIS at Gezirahs will yield acceptable economic returns.
* Returns to irrigation water per m^3 for Gezirah FMIS were Egyptian Pound (L.E.) 0.44 which is economically desirable compared to L.E. 0.086 for CMIS.

35 CCP: Centralized crop patterns managed by the Ministry of Agriculture; there are six to seven crop patterns:
Short berseem followed by cotton
Long berseem followed by maize
Long berseem followed by rice
Broad bean followed by maize.
Broad bean followed by rice
Wheat followed by maize
Wheat followed by rice
Also, winter crops followed by summer vegetables or winter vegetables followed by summer crops.

36 SSCC: Short-season cash crops, mainly vegetable crops. Parsley, garden rocket, Egyptian leak, lettuce can be cultivated 3–4 times a year. Tomatoes and cucumber can be cultivated only twice a year.

* Gezirah FMIS may be seen as a model for encouraging a shift in irrigated cropping patterns from basic crops to high value crops.

* Economic indicators can be seen to be good measures of the performance of Gezirahs FMIS. The data presented provide public and private managers and planners with some general results on the economic value added from managed irrigation systems. These data may be applied for better water allocation between competing demands or uses and also for better decisions on investment in irrigation.

The technical conclusions from the data in Table 3 may be summarized as follows:

* Natural drainage from the FMIS of the Gezirahs helped the farmers to irrigate their crops frequently and efficiently.

* Management of the soil is done frequently: either each season or during the high water level stages of the Nile.

* The microclimate of the islands has positive effects on the maturity stages as well as on the quality of the products resulting in high market prices as compared to the CMIS products.

* The small size of the holdings as well as the large number of water lifting devices have served to develop self-management capacities and the ability to coordinate irrigation, agriculture and marketing activities. All these aspects have had positive effects on yield as well as on net returns of FMIS of El Gezirahs.

* The farmers of FMIS are more successful than those in the CMIS. There are many signs of this in the neighboring areas on the banks of the Nile.

* The decision to liberalize the FMIS created a strong movement towards irrigation improvement in terms of efficient water use and improved management practices.

The data in Table 3 are drawn from two sources. Data on FMIS of the Gezirahs were collected through a questionnaire which was designed to elicit farmers' responses (farmers' responses and interviews). Data on CMIS of the old lands in Egypt were obtained from the Irrigation Improvement Project (IIP) which was designed to improve the water management of both on-farm and water delivery and distribution networks (IIP 1990).

While the IIP is working to improve the CMIS, it is already clear that the FMIS of the Gezirahs are performing very well. Their management has resulted in high returns per unit of water and per unit of land, as may be seen from the data in Table 3.

FUTURE DEVELOPMENT

Due to the continuing settlement of the islands since the construction of the HAD and to the variable flows associated with changing water levels, the Mechanical and Electrical Department of the

Ministry of Public Works and Water Resources in Egypt has undertaken a new project denominated "37 Pumping Stations Project." Work on this project started one year ago. The pumping stations of the islands are of the floating type.

The location of the islands makes them subject to high risks such as contamination of the water by wastes, erosion of the shores and flooding in the event of high releases for the safety of the dam. The recent development of the islands as well as their future development needs necessitate research to protect the successful examples of performance and to alleviate or minimize the high risks.

It is reasonable to assume that farmers who own their own land and manage their own systems have a lifelong interest in the sustainability of their schemes and the surrounding lands. Prevention of environmental hazards and the dissemination of sound practices could enhance the ability of individual farmers and farmer groups to sustain their systems. Many studies have found a high correlation between security of land tenure and the motivation to make long-term investments in soil conservation by such means as terracing. Where centrally managed systems subsidize farmer landowners, it is politically difficult to withdraw support for the irrigation service. Historic analysis of existing schemes including economic and sociological factors could provide valuable insights for future development strategies (Chancellor 1991).

CONCLUSIONS

Analysis of the data on the FMIS of the Gezirahs in Egypt has shown that the settings of water availability, workability of the soil, natural drainage, absence of regulations on cropping patterns and the existence of a market-oriented economy, have made it possible to achieve high yield per unit of water and per unit of land and to achieve technical and economic efficiency. The Gezirah System may be taken as a model in matters of routine maintenance, the performance of irrigation and agricultural practices, high rates of adoption of new advances in technology, achievement of high yields, satisfaction of consumer demand, production under the high risk of environmental change and achievement of technical and economic efficiency. All the conditions and the working environment described in this paper must exist to reach the objectives of the model described.

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