

Irrigation in Contemporary Egypt

NICHOLAS S. HOPKINS

PRESSURE TO ADAPT EGYPT'S agriculture to world economic conditions, and to an increased population, have led to major changes during the nineteenth and twentieth centuries. The changes have included the transition from 'basin' (annual flood) to 'perennial' (year-round) irrigation, the growth of a market economy in agriculture, the development of a bureaucratic structure to oversee agriculture, the disappearance of a sharp division between rural and urban, and the shift in the social organisation of rural Egypt. Irrigation policy is a useful site for the examination of these changes, especially in the current period marked by pressure for 'structural adjustment' and privatisation. Irrigation policy also is made in an atmosphere of concern for an imminent water shortage in the Nile Valley.

Irrigation and the Water Crisis in Contemporary Egypt

The overwhelming fact in contemporary Egyptian irrigation is the threat of a water crisis in the near future. By virtue of its 1959 accord with the Sudan, Egypt is entitled to 55.5 billion cubic meters (bcm) of Nile water, out of a total of 84.0 bcm theoretically available, calculated from the flow at Aswan.¹ Ten bcm is counted as lost to evaporation, and the share of the Sudan is 18.5 bcm. Egypt has some additional sources of water, notably the deep aquifer, and it has the possibility of reusing some drainage water, so that the actual water consumption in Egypt is estimated at 59.2 bcm, slightly higher than 55.5 bcm but still close to the maximum of water available in the country. Rainfall is not a factor in the Nile Valley. Approximately 84 per cent of Egypt's water is used in

¹ Abu-Zeid (1993), 72.

agriculture (this is fairly typical for a country with substantial irrigated agriculture); about 35 per cent of this is used for sugar cane and rice, which also have the lowest returns per unit of water.² Non-agricultural water is divided between industry and household consumption. Population growth and the rising standard of living, together with industrial growth and the effort to expand agriculture into the new land, all put additional demands on this limited supply of water. There is not now a shortfall, but all indications are that one is coming soon, hence 'the need for rationalising the different uses of water'.³

The solution to the crisis is, firstly, more efficient use of water and less waste. Since agriculture is the major user of water, any change that increases the efficiency of water in agriculture has substantial impact. Hence most of the contemporary concern with improvements in irrigation revolves around the question of efficiency. This in turn implies changes in the way in which the Ministry of Public Works and Water Resources (MPWWR, i.e., the Ministry of Irrigation) operates, and changes in the way in which farmers irrigate. Changes in water availability and use lead to changes in agriculture—methods, crop selection, work organisation, and the like. Among the changes currently under discussion and to some extent being enacted by the Egyptian government and its financing partners (World Bank, USAID, African Bank, Netherlands, Canada, Japan, FAO, Arab League, etc.) are more accurate measurement of water levels in the Nile basin to allow for more efficient use of water, rebuilding of the barrages and the dams in Egypt to increase efficiency in water control, a modest amount of decentralisation of control over water allocation from the Ministry to local user groups; agricultural extension efforts to ensure that farmers use the water efficiently, and efforts to limit the degradation of canal water by human, agricultural, and industrial waste, so that the water can be reused.

At the same time, liberalisation (structural adjustment) in agriculture is increasing the freedom of farmers to choose their crops, including freely choosing water-demanding ones like rice. It also implies a freer market in land. The Egyptian state is loosening (but not abandoning) its control over agriculture and over farmer choice. Farmer use of water has to be understood in this context.

A second solution to the crisis would of course be to find more water, or to manage the water in the upstream Nile basin better. From the time of Garstin's 'Century Scheme' based on water control in Lake Victoria and the Sudd area of the Sudan, this has been an element in the equation.⁴ At the moment, it does not look as if there is much relief coming from this direction. Even the Jonglei Canal scheme in the Sudd has been halted because of the Sudanese civil war. It is worth mentioning that there are no comprehensive international agreements on

² World Bank (1993), 28.

³ Abu-Zeid (1993), 71.

⁴ Collins (1990).

water use in the Nile Valley, only the 1959 agreement between Egypt and the Sudan. The absence of Ethiopia is particularly striking since about 85 per cent of the Nile water entering Egypt derives from Ethiopia. Thus even the current levels of water in the Nile entering Egypt are potentially threatened by the actions of the upstream countries. For instance, the Ethiopians may one day develop a use for their water that diminishes downstream flow. Water-sharing between the two countries is the subject of discussion, sometimes marked by aggressive statements. On the other hand, two high MPWWR officials, Abu-Zeid and Radi, are optimistic that the amount of water coming to Egypt in the Nile can be increased by 50 per cent to 124 bcm, but do not explain how.⁵ The best guess at present is that the water allocated to Egypt will neither increase nor decline in the foreseeable future, but a shift in either direction is still a theoretical possibility in the short to medium run, and a better possibility in the long run.

Agriculture and Villages

Egyptian agriculture at the end of the twentieth century is primarily, as it perhaps always has been, an agriculture of smallholders. The average holding is around 2.5 *feddans* (one hectare), and there are many villages where there is no one farming more than ten *feddans*, and where the average farm is about one *feddan*. Interspersed among the myriad of smallholders are a few large farms. Land in the valley is all privately owned, and much of it is cultivated by the owner. The so-called 'traditional' crops dominate: wheat, bersim, broad beans, etc. in the winter, and cotton, rice, maize, etc., in the summer. The areas around sugar factories in Upper Egypt are heavily planted in sugar cane. Considerable land is cultivated in fruits and vegetables. Much of the work on the farm is done by family members, but even smallholders hire labour at peak periods. Agricultural work has been mechanised, or at least tractorised, as tasks formerly done with animal power are now done with tractors. Water-lifting is also increasingly mechanised. Many hand tasks remain, however, including planting, weeding, harvesting, etc. Farmers are likely to grow many crops for the market, though for certain crops like wheat or maize a subsistence orientation remains. The market is primarily domestic though some crops (citrus, fruits, potatoes, cotton) are exported. Financing for farming comes from crop loans made by banks, and repaid at the harvest. The state was formerly a silent partner (through subsidies and loans) with each farmer, but in recent years has withdrawn. Overall, perhaps half the income generated in rural areas comes from agriculture, while the remainder comes from government jobs, from factory jobs or entrepreneurial activity, or from trade.⁶

⁵ Abu-Zeid and Radi (1991), 92.

⁶ Hopkins (1993).

The settlement pattern in the rural areas is predominantly one of villages. Average village size is around 7,000 inhabitants. Some villages are dominated by big families, big in number and in landholdings. Others are characterised by the equalising effects of agrarian reform land. Still others are in areas like Qena in Upper Egypt where 'tribalism' holds sway: a tribe (*qabila*) such as the Hawwara is an important regional grouping. Sufi brotherhoods, marketing networks, and educational systems are also regional in nature. There is tension between hierarchy and egalitarianism, with hierarchy usually predominating—villages have a political and economic élite that plays an important role in running the village and linking it to the outside.

Irrigation canals and command areas are designed on a completely different basis than the village. They must follow engineering specifications, such as slope and distance from the source. Even the distributary canals may cut across village boundaries, and village lands are watered by several distributaries. This suggests that there may be some difficulty in transposing village leadership institutions to the politics of canal management.

Overview of the Irrigation System in Egypt

Currently the irrigation technology in place allows for centralised control of the water delivery system in Egypt. The centrepiece, since the 1960s, is the Aswan High Dam. The construction of this dam allowed for the inter-year storage of water within Egypt (and thus was intended in part to free Egypt from difficult dealings with upstream countries), but it also allows the irrigation authorities to release water systematically to respond to all downstream needs—agricultural, industrial, household, and other. The 'other' includes tourism needs: the MPWWR would prefer to let the water-level drop in the Nile in January to allow for canal cleaning and other maintenance, but January is a peak period for tourist cruises on the Nile, so enough water has to be released to allow the boats to travel between Aswan and Qena/Naga Hammadi. Anyone who has watched these cruise boats manoeuvre over a sandbar knows how close the calculation of water levels is.

The central role and major forms of government activity and responsibility for irrigation were established during the British period, at the end of which Hurst summed up the situation: 'The provision of water and its distribution until it arrives at the *misqa* [tertiary canal] is the business of the Government, which has therefore to construct and maintain in good order dams, barrages, regulators and canals, as well as to organize the programme of distribution . . . There is no water rate and irrigation is paid for out of the land tax, which is levied on all cultivated land, at a rate which varies with the value of the land, and is reassessed at fairly long intervals of time.'⁷ In Hurst's time and before, the usual

⁷ Hurst (1952), 65.

justification for the expense of irrigation construction was that it raised the value of the crops.

Water for agriculture is diverted from the main Nile channel by a series of barrages into main canals, from them into secondary canals, and from them into tertiary canals (referred to as *misqas* in the development literature) from which the farmers draw water. The canals from which the farmers draw are 'below grade' (except in the Fayyum and a few other areas), which means that the water-level is from 50 to 75 cm below the level of the fields. The farmers must then lift the water from the canals for their use. The lifting technology and the related social organisation have always been a matter for the farmers rather than the government. Farmers are also charged with maintenance of the *misqa* but do not have direct control over the flow of water into it. The raising of water to field level is done through the scoop water-wheel or through pumps, mostly small, movable, diesel-powered pumps. The lifting points, the field ditches, and often the lifting mechanism are shared by groups of farmers. Once the water is lifted it then flows through a network of ditches until it reaches the field where the irrigation is taking place. Depending on the crop there may then be a further network of ditches inside the field, or the field may simply be flooded. And so the final step is reached—how to ensure that water reaches the root zone of the plants in a timely fashion and in the right quantity.

Farmers and the Local Organisation of Irrigation

Now let us see how the irrigation system looks from the farmers' viewpoint. This analysis focuses around the question of the 'lifting point', where the water is lifted from the *misqa* to the field ditches. These lifting points are shared, and consequently require a form of social organisation. The other form of social organisation required is at the *misqa* level since farmers are collectively responsible for cleaning the *misqa*. There is considerable variation in Egypt, and the present sketches can do no more than suggest that variation. They are not meant as a comprehensive classification.

The Saqia Type and the Shift to Pumps

The most recent description of the *saqia*/pump type is provided in the study of Mehanna, Huntington and Antonius, based on sites in the Delta.⁸ For example, near the village of Aghur al-Kubra, Qalyubiyya, there is a 3-km long tertiary canal (*misqa*) known as Um Yaddak. The Um Yaddak receives its water from the state-run secondary canal. As soon as water passes from the secondary canal to the tertiary canal, it is controlled by the farmers. But the state fixes the

⁸ Mehanna, Huntington and Antonius (1984), 18–65.

rotation of water in the secondary canal: five days on, ten days off in winter, a week on and a week off in summer, but with the possibility of changing the rotation if there are pressing needs here — or elsewhere. The state also fixes the size of the intake that links the two canals, and it builds and maintains any engineering works on the tertiary canal. In other words, the state approximately fixes the amount of water available to the farmers along the tertiary canal.

The farmers then divide the water among themselves. This they do with the help of lifting devices (animal-powered water-wheels such as the modern version of the 'Persian' water-wheel, the saqia, or small diesel pumps). The saqia or the pump then supplies a cluster of fields which belong to different farmers. The farmers thus grouped together form what is called a 'saqia ring', those who must co-operate to make a single water-wheel or diesel pump work. On the Um Yaddak, there are 28 lifting points, which can be divided into 20 with saqias and 8 with pumps, though in some both are used. Each lifting point is linked to a field ditch network. The command area of the lifting points ranges from 4 to 26 feddans (12 is the average), and the number of users of each lifting point ranges from 2 to 37 (14 on average). Co-operation among farmers is needed on two levels: at the level of the saqia ring and at the level of the entire misqa.

Generally, each saqia ring has a leader who oversees the use of the water-wheel. Each farmer must provide his own draft animal (cow or buffalo), and has the right to an agreed-upon period. Turns must be taken when the misqa is full, and thus must follow the rotation. Since the misqa does not 'flow' there is no night-time irrigation; the water waits for dawn. If there is a peak of demand, some farmers may turn to diesel pumps, with a larger flow, to supplement the animal-drawn water-wheel. Saqia rings thus group neighbouring farmers (often also linked through kinship), but at the same time, farmers are likely to belong to as many saqia rings as they have fields, probably around three or four on average. Pumps are in some ways more individualistic, and can be moved from point to point, but the pump-users must nonetheless share the field ditches that link the lifting points to the fields.

Co-operation among farmers is also necessary to manage the misqa canal. The users of this distributary canal are supposed to take care of the annual cleaning or dredging. They collect money and rent a mechanical shovel, or use paid or volunteer hand labour. Hand labour is generally preferred because there is less damage to trees and paths; where paths are narrow the mechanical shovel is out of the question.

Water shortages come about because of allocation of scarce water to other areas, because of engineering and management shortcomings on the part of the state, or because the farmers are growing crops that require more water than the state has allocated to them. When there is not enough water in the canal, farmers work together to alleviate the shortage — by hiring a pump to move additional water from the secondary canal to the tertiary canal. As individuals, they

may also seek to secure water from a nearby canal or drainage ditch. In general, farmers do not blame their neighbours for water shortages, but instead find fault with the state. This at least helps to maintain good relations among the neighbouring farmers. In sum, there are two levels of organisation, the saqia ring at the lifting point, and the more loosely organised association of users of a single misqa.

Farmers often waver between the animal-powered saqia and the diesel pump. Some switch back and forth according to circumstances. Some crops, such as maize, prefer slowly flowing water which the saqia provides better, while at other times—such as when the ground is dry right after the harvest—the pump's rapidity helps prepare the land for the next crop. Whether farmers use a pump or a saqia to raise water, they must still take turns since they use the same network of field ditches.

In 1982 researchers surveyed 1,000 farmers, 100 in each of ten villages in Beheira, Gharbiyya, Qalyubiyya, and Minya.⁹ Of these farmers, 496 reported using a pump to lift irrigation water to their fields, while another 152 reported that they switched back and forth between a pump and an animal-powered wheel, the saqia. The total of pump-users was thus 648, or 65%. The actual percentage in the Delta villages was probably somewhat higher since in two of the Minya villages a number of farmers were able to irrigate by gravity flow, without lifting water at all (96 by gravity, and another 57 only needed to use the Archimedes screw). The number of farmers who used only the water-wheel was 199, plus the 152 who used both, for a total of 351 saqia-users.

The number of farmers who said they preferred pumps was even higher than the number who used them (75 per cent); most of them preferred electrical pumps, which are not widely available, to diesel pumps. Farmers are willing to accept the higher cost of the pump because they feel it saves time and effort. Farmers also prefer pumps in order to free the animal (cow or water-buffalo) from the task of turning the water-wheel so that it will produce more milk and perhaps grow faster.

Most of the pumps recorded in the 1982 survey were small, mobile pumps, mounted on a frame with wheels so they could easily be pulled by tractor or donkey. The pumps were mostly of Indian manufacture, had a hp of 7.5, and at that time cost about LE1000.¹⁰ An Indian anthropologist recounts how he was called on to authenticate a new Indian pump motor in a Beheira village in about 1980.¹¹ Like tractors, the pumps are likely to be owned by bigger farmers. While farmers of more than 5 feddans were 6.4 per cent of the farmers' sample, they were 44 per cent of the pump-owners.¹² About two-thirds of the pumps in the

⁹ Hopkins *et al.* (1982).

¹⁰ Hopkins *et al.* (1982), 160.

¹¹ Ghosh (1992), 70–4.

¹² Hopkins *et al.* (1982), 169.

sample were owned by a single individual. When the pump is rented out, it is most common for the owner (or his agent) to run it, and payment is in cash on the spot in 78 per cent of the cases.

Stationary Pumps

This description is based on a field study I carried out in the village of Musha, near Asyut, 400 km south of Cairo.¹³ The Nile continued to flood in this area until the Aswan High Dam began filling in 1964, but the farmers had devised a way to farm year-round as early as the 1930s.¹⁴ Certain large farmers installed stationary diesel pumps to draw water from wells during the 'dry' time of year from January to August. (The flood season was September to October.) After the High Dam was completed, the state built a network of distributary canals which, in effect, linked these existing pumps. The state provides water to large stationary pumps in these canals every other week, and the owners and operators of the pumps lift the water about 75 cm to the level of the fields. Here the water flows through a private network of field ditches until it reaches the field of the individual farmer, who then uses his own network of furrows to distribute the water among the plants. The average area commanded by a pump is 70 feddans, and the range is from 25 feddans to 280 feddans. The average number of 'clients' is around 60, but varies with the command area of the pump and the amount of land held in large blocks, for Musha has a high degree of land concentration.

The pumps and motors were installed in the 1930s, and thus at the time of fieldwork in 1980 were 40 to 50 years old. Each pump and motor was inside a mud-brick shelter, sometimes with annexes, and drew its water from a state canal. Most motors ranged from 25 to 42 hp. Like the saqias in the Delta, each motorised pump was considered to have 24 shares (qirats). There were usually a number of owners, each of whom was said to have a certain number of qirats. Pump shares were owned separately from land. The smallest share I came across was 1/3 qirat, or 1/72 of the pump, but it was the larger farmers who dominated the overall picture. The seven biggest farm enterprises in the village controlled nearly half (46 per cent) of the pumps. In general, shareholders in a pump also farmed land in its command area, but there were exceptions. Shares in the pumps could be sold or inherited, and clearly most smallholders did not own any.

Around each pump cluster certain roles. There are the owners, generally several for each pump. Pump-ownership is concentrated in the hands of the richer farmers, but most individual pumps have multiple owners. Secondly, there is the mechanic (*usta*) who runs the pump, and is paid by the owners. The third role is the pump guard (*ghafir*), who also guards the fields associated with the pump,

¹³ Hopkins (1987), 98–105.

¹⁴ Hurst (1952), 41; Hopkins (1987), 99.

for a fee paid by the farmers. The fee is calculated according to the land farmed. The pump guard also organises the distribution of water among the users, and maintains the channels. Fourth, there is the farmer, who most often (fifth) hires a worker to perform the actual task of irrigating. Obviously one person may occupy two or more of these roles, or those who occupy them may be relatives.

The farmer must pay the pump for the water. The pump-operators are responsible for the maintenance of the pump and the network of field ditches, and for purchasing the heavily subsidised fuel. They also direct the water into one or another of the field ditches, and serve to co-ordinate the work of individual farmers. The ordinary farmer is less responsible than in the case of the saqia rings, but must learn to deal with this centre of power. A farmer is likely to have fields in the command areas of several pumps so that his risks are scattered. He must, however, keep track of the times when water will be available in each of his fields. Thus the farmer here does not share responsibility for the system, but instead is a client of sorts of the owner-manager.

While in the Delta there is a certain co-operation among relatives and neighbours, this part of Upper Egypt is instead characterised by concentration of ownership and control. There is no pattern of co-operation among the 'users' except the co-ordination by the pump-operators. Any 'irrigation association' is thus hierarchically organised. Musha is dominated by large farmers, who have been able to place themselves between the state and the farmers. The control of water can lead to surplus income, and also to political control. Conversely, the farmers are paying for their water. But the state has no more influence on the local distribution of water than in the Delta.

Gravity Irrigation in the Fayyum

The gravity flow irrigation system in the Fayyum is unique in Egypt. The water enters into the Fayyum at 20 metres above sea level, and ends up 70 metres lower in Lake Fayyum, 50 metres below sea level and without an outlet. While the farmers here are not required to lift water, there is a strict limitation on the quantity of water allowed to enter the Fayyum in order to prevent excess water from causing the lake to overflow.

Fieldwork was carried out near the village of Naqalifa along an irrigation channel named 'Um Moussa'.¹⁵ The 'Um Moussa' is 4 km long and irrigates 354 feddans, mostly farmed by farmers from Naqalifa village. As throughout the Fayyum, water runs continuously by gravity. Each farmer has a time-share in the flow. The Ministry of Irrigation fixes the amount of water that enters the channel according to the size of the command area. The actual flow is modified by further understandings, such as the rule that areas in orchard receive a double

¹⁵ Mehanna, Huntington and Antonius (1984), 92-133.

allotment. The 10,080 minutes each week are divided by the number of feddans to determine the period of time to which each farmer is entitled each week. Each field has a weekly turn. Each farmer belongs to an irrigation unit which collects the combined turns of adjoining fields, and then redivides the water among them. This allows, among other things, farmers to give up their turn one week in exchange for a double turn the following week. This is the only example in the literature on Egypt of exchange of water rights. The units are thus small solidarity groups, almost factions, which ensure the rights of each member.

The irrigation cycle begins at the dusk prayer each Friday eve (sunset Thursday) considered to be 12 o'clock. Everyone sets his watch and the week starts. The rotation among the users of the channel is supervised by a chief, usually an elderly and rich farmer, who informs each user of his time-share and his turn. But more than the first two systems described, this one produces disputes among farmers. Because the control point for the water (where it splits off from the larger canal) is distant from most fields, the water must flow for some distance before it reaches a farmer ready to irrigate. There is an opportunity here to cheat by diverting one's water early, or by drawing water from a flowing channel while the irrigator is busy in his field. Irrigators thus prefer to work at least in pairs—one in the field and the other to supervise the water. But disputes along a canal are mitigated by the fact that most farmers possess fields elsewhere where the conditions may be quite different.

Farmers complain that the state lets the water level in the distributary canals drop too low, and if the state of affairs is serious, they will complain in a body to the government. In the meantime, co-operation is required among all farmers along the Um Moussa channel, and among those who are members of the same irrigation unit. At both levels, but especially at the higher level, the system is controlled by older, rich, and powerful farmers. These farmers generally extract a small part of the water share of their smaller neighbours in return for their leadership.

Sprinkler Irrigation in the New Lands

Sprinkler irrigation is practised in various places in Egypt, including the Tahaddi area of South Tahrir, west of the Delta. This former desert area of sandy soil was made available for cultivation by resettled farmers after 1970.¹⁶ The water is pumped up from the Nile Valley by powerful electrical pumps, and then flows by gravity until it is adjacent to the farmers' fields. Here there is a second electrical booster pump station that draws the water from the open canals and pumps it through pipes with sufficient pressure to activate the sprinkler system. The command area of each of these pump stations is 320 feddans, divided into units

¹⁶ Meyer (1978); Gotsch and Dyer (1982); Hopkins *et al.* (1988).

of 20 feddans each. Each 20-feddan unit has a separate set of pipes, with a variable number of offtakes. In Tahaddi, where the owners are smallholders, the pipe network is shared by 6 to 12 farmers who must take turns in order to maintain maximum water pressure. In other areas, the farmers are medium holders—8 to 12 feddans—and so fewer people have to co-operate. Drip irrigation is also practised in this area.

As usual, most of the complaints focus on the role of the state, which has to maintain a complicated infrastructure of electrical pumps and booster pump stations, canals, and so on. The most common complaint is that neither the pumps nor the pump-operators are reliable. Due to mechanical or human error, the pump may not provide water at sufficient pressure to run all the sprinklers, or may not work at all. When one of the pumps breaks down, the state is in theory responsible for repairing it. In fact, the farmers who are affected often collect money to speed up the repair process, so they will not be without water for long. They also sometimes collect money to pay a bonus to the pump-operators to ensure that he will do his job.

Thus there are two levels of co-operation—those associated with one booster station, and those in the 20-feddan units. As in the case of Musha, the emphasis is on dependency on the pump-operators. Here the state, and not local big farmers provides the water directly to the farmers. However, despite heavy state investment and involvement, including determination of the quantity of water allocated to each farmer, local irrigation communities participate in the final determination of the use and sharing of water. Various techniques are developed by pump-operators and farmers to modify the state's allocation plan. This is a system which is still not firm because the farmers are recent settlers from a variety of different rural Egyptian backgrounds. Each farmer has received the same allotment of land from the state, so all are 'equal', and because of their varied backgrounds, no firm village or local community has yet emerged.

These four examples illustrate the diversity of local irrigation situations in Egypt within which the new forms of irrigation based on a more individualistic philosophy and the policies of 'structural adjustment' and the market economy are being encouraged.

Current Issues in Egyptian Irrigation

Engineering

Several issues stand out in contemporary Egyptian irrigation. One, governed by the threat of scarcity, is the need to improve the efficiency of the system, to ensure that the water that enters Egypt's Nile Valley at Aswan is used effectively in agriculture or elsewhere. The solution here lies in engineering works that minimise water loss—improving barrages and regulators, redesigning canals,

effective dewatering — all so that water will flow smoothly. Part of the problem lies in the delivery system, the network of canals and barrages that supplies water to the doorstep of the Egyptian farmer. The efficiency of the delivery system is lower than that of the farmer; thus the Utah State University report noted: 'While farm application efficiencies are reasonably good, the delivery system is quite inefficient. This could be improved by better control. Up to 50 per cent of the water delivered to the main system is thought to be wasted to drains'.¹⁷ The perennial issue of gravity flow versus lift irrigation appears here again, but is still resolved in favour of lift. Sprinkler and drip irrigation have been put aside as offering no particular advantages and some disadvantages; it is argued that they are more advantageous on sandy soils, not the clay soils of the Delta and the Valley. An enduring issue is the diversion of water to the new lands, to extend agricultural lands horizontally. Often this diversion is at the expense of an adequate supply in the old lands, which causes periodic water shortages, especially at the tail ends of canals. Whether this diversion pays off in extra production in the new lands is unproved.

Water User Associations

In addition to the engineering problems of efficient delivery, there are two social problems: Water User Associations and cost recovery.

The package currently being put forward by the United States Agency for International Development (USAID) requires the creation of Water User Associations (sing. *rabita mustakhdamin al-maia*) on the improved misqas. This model is part of a plan that includes a shift to continuous flow rather than rotation in secondary canals, and that assumes that the farmer will be free to take the water he needs for the crop he chooses to grow, keeping in mind his micro-economy, rather than having to adapt his crop choice to the availability of water. Since this would probably increase water demand, it becomes crucial to limit water losses.¹⁸ Nearly six hundred Associations had been created in a number of USAID/World Bank pilot zones by the end of 1995. The Water User Associations are organised and supported by a recently created service within the MPWWR, the Irrigation Advisory Service, whose personnel is seconded both from the MPWWR and the Ministry of Agriculture.¹⁹

The improved misqas are now organised around a single lifting point, with all farmers receiving their water by gravity from there. The Water User Associations (WUAs) are composed of all the farmers on a misqa. The zones managed by the Irrigation Advisory Service average around 60 feddans, mean-

¹⁷ Utah State University (1986), 29.

¹⁸ Utah State University (1985).

¹⁹ Abdel-Aziz (1995).

ing presumably that they have from 30 to 60 members. The WUAs elect their officers, deal with the irrigation authorities, and concern themselves with water allocation and maintenance (canal clearing). It should be noted that farmers on a *misqa* were already theoretically responsible for canal cleaning, and thus had at least a rudimentary organisation. Recently passed laws are intended to provide the legal support that would legitimate the existing associations (Law 12/1984 and Law 213/1994, followed by MPWWR decree no. 14900/1995).

The model of the associations has led to further proposals. There are some suggestions that the WUAs should be used to collect taxes and water-user fees. Associations could also transmit information on cropping patterns upwards and on water supply downwards so that available water could be better adjusted to needs, and thus avoid waste.²⁰ Another notion is that federations of WUAs to correspond to higher-level canals could be formed, and could negotiate with the MPWWR over their collective water supply.²¹ In the extreme form, the association becomes a private company, and experts speak of the privatisation of the lower levels of the irrigation system.²² The issue here is the accountability of the water-suppliers to the water-users, through the decentralisation of decision-making over water allocation.²³

Water User Associations have been instituted only in a few locales in Egypt. In addition to the sites under the Irrigation Improvement Project, the Dutch are experimenting with them in the Fayyum, and the experts cite as the main advantage that the MPWWR engineers now deal with fewer people (i.e., the leaders of the associations rather than angry crowds). Water User Associations are also part of the Canadian irrigation project in Mansoura.²⁴ One Egyptian official expressed a preference for associations that only deal with water issues,²⁵ while a review of experience in several countries suggests that associations work best when they group all the farmers' concerns into a multipurpose association.²⁶

The effort to create Water User Associations is still too new to judge. The technocrats appear not to appreciate the social patterns among farmers at the local level. The literature I was able to consult basically treats 'farmers' as a uniform category, yet all we know about rural Egypt argues against this. Factors of stratification and differentiation, if not class, emerge commonly,²⁷ and even where that is not a problem, farmers still anticipate problems in co-operating with one another.²⁸ Another problem is the contentious relationship between the

²⁰ IIMI (1995b), 36.

²¹ IIMI (1995b), 10.

²² IIMI (1995b), 39.

²³ IIMI (1995b), 33, 48.

²⁴ Ibrahim (1991).

²⁵ Abdel-Aziz (1994), 11.

²⁶ ISPAN (1994).

²⁷ Mohieddin (1995a).

²⁸ Knop *et al.* (1982), 9; Skold *et al.* (1984).

MPWWR and the Ministry of Agriculture,²⁹ and perhaps inadequate co-ordination between the different projects.

Cost Recovery

Several foreign donors (USAID; World Bank) are pushing the Egyptian government to institute water-user fees or service charges in order to recover maintenance and some capital costs. The theory is that the water remains free, but the service of providing it requires payment. It is important to distinguish this project from the earlier Egyptian concern to force the farmers to conserve water by raising its cost, hence the below grade system and the need imposed on the farmers to lift water. 'The traditional policy of delivering water below field level was implemented in Egypt as an incentive to not overirrigate'.³⁰

The Egyptian authorities are ambivalent about cost recovery.³¹ However, two top irrigation officials, Abu-Zeid and Radi,³² note in a paper written for the World Bank, that 'while complexities of implementing a functional water pricing and cost recovering system in Egypt should not be underestimated, in the longer term the country has no other feasible alternative but to go along this route'. Abu-Zeid and Radi, as well as many US analysts, have noted many of these complexities. One complexity is the feeling that under Islam water should be free to the user; thus only the service of providing it can be charged to the user. Abu-Zeid and Radi conclude that the issue is ultimately a political one, though issues of equity among farmers and accountability of government to farmers enter in. The World Bank's position³³ is less equivocal: 'cost recovery of the O&M [operation and maintenance] costs of the irrigation network, leading eventually to price incentives for more efficient use of water, also have to be introduced'. The World Bank is also interested in trying to recover a contribution towards investment costs.³⁴

This concern for cost recovery has led to some intricate calculations, designed on the one hand to gauge whether the amount farmers would have to pay is feasible, and on the other hand to calculate what the costs of running the Egyptian irrigation system are, so that they can be recovered.³⁵ In this latter task, the calculations have to take into account the varied uses of water (urban, industrial, tourism, etc.).³⁶ The conclusion to these studies seems to be that 'full cost recov-

²⁹ ISPAN (1990).

³⁰ Utah State University (1986), 68.

³¹ ISPAN (1990), 79 speaks of their 'evident reluctance'.

³² Abu-Zeid and Radi (1991), 78-9.

³³ World Bank (1993), 29, 72.

³⁴ World Bank (1993), 27.

³⁵ ISPAN (1993); IIMI (1995a).

³⁶ Cestti (1995).

ery of water services in agriculture would reduce farm incomes by about 4.5 per cent on average' and so would be bearable.³⁷ However, a further pair of problems is recognised: how would a fee be collected, given the inability of the bureaucracy to collect the land tax effectively,³⁸ and could the fees each misqa pays be earmarked for improvements in that association instead of simply paid into a central treasury as is the custom in Egypt.³⁹ In other words, could such a fee be used to finance and encourage decentralisation of decision-making in irrigation? Finally, the question of the impact of water pricing on crop choice comes up. If water were priced at its economic value, then farmers would in theory choose crops that would make the most effective use of water. The World Bank report points out⁴⁰ that 'while market signals provide the required incentives to increase production of the competitive products, incentives also remain high to produce non-competitive crops since the real value of water is not taken into account in making cropping decisions'. Thus it is a matter of, as the saying goes, 'getting the prices (or incentives) right'. Some foreign experts have also speculated that a market in water could be created, so that farmers could sell some of their rights in water to others who need it more.⁴¹

This advocacy of the market as the guide to all decisions is a long way from Hurst's simple statement of government responsibility to provide water.

Conclusion

The major change in the Egyptian irrigation system came with the British effort between 1882 and 1914, which established the network of barrages and canals, the beginnings of a drainage system, and centralised bureaucratic control. The British effort built on and perfected an Egyptian effort, to which French engineers provided technical assistance. Since then, the goal has been to perfect the system by incremental changes rather than an entire reorganisation. From the point of view of agriculture, even the Aswan High Dam is only an improved version of its predecessors. The current effort is directed at modifying the organisational rather than the technical dimension of Egyptian irrigation.

One enduring phenomenon is the pattern of social organisation among local groups of users. There was a time, in the nineteenth century and earlier, when this was the major feature of Egyptian irrigation and the state played little role.⁴² But now the local social organisation of irrigation has become a poorly known

³⁷ IIMI (1995a), 9.

³⁸ Mohieddin (1995b).

³⁹ Abu-Zeid and Radi (1991), 76 speak of a 'revolving fund' for this.

⁴⁰ World Bank (1993), 40.

⁴¹ ISPAN (1993), 74; Löfgren (1995), 13.

⁴² Alleaume (1992); Maury (1987).

feature of a larger system.⁴³ It represents the element of decentralisation and local participation in what is otherwise a highly centralised system. There are, however, two versions of this local social organisation: the traditional version and the one advocated by the development agencies, and the relationship between them is still evolving.

How the farmers get their water is central to their agriculture. Currently Egyptian farmers have largely changed their way of doing agriculture to accommodate the shift from the socialised agriculture of the 1960s to the free-market system now being constructed. The socialist pattern involved substantial government subsidies (on inputs, credit, etc., but also, arguably, on water), rules that strengthened the access to land of the small farmers, and official marketing channels where the prices reflected bureaucratic decisions rather than market forces. For some crops, such as cotton, the official price was below the world market price, and the difference became the government's revenue from agriculture. All this is now changing. Government subsidies on inputs and artificially depressed prices are in principle a thing of the past. In 1992, the Egyptian parliament passed new amendments to the land reform bill that removed the guarantees that a legal renter had to the land he was farming; this is intended to be a step towards a freer market in land (see Saad, this volume). Although arguably even under socialism the Egyptian farmers were part of the capitalist system, and calculated their advantages and disadvantages as petty capitalists,⁴⁴ this has now been accentuated. One clear area where the changes in irrigation can have their effect is in the farmers' choice of crops: water costs do not at the moment influence the choice of crops, but certain ways of charging for water could change that. Also, farmers' choice of crops that are water-demanding or not will determine whether a system built on unlimited farmer access to water can survive if Egypt enters into a situation of water scarcity. At a national level, the question is whether Egypt can continue to encourage cultivation of rice and sugar cane, which together use between 30 per cent and 35 per cent of agricultural water, under conditions of water scarcity.

We can now see how the changes in irrigation fit into this process of change. For the moment, the major improvements are in the area of canal construction and upgrading, or in improved flow of information about water levels. There are pilot projects (financed by Canada through the Integrated Soil and Water Improvement Project, by USAID, and by the Netherlands) which experiment with some of these engineering innovations. At the same time there is considerable attention given to organisational issues: the establishment of Water User Associations on *misqas* and perhaps then federations of these for higher level canals; cost recovery for irrigation improvements and for operations and main-

⁴³ Mehanna *et al.* (1984).

⁴⁴ Hopkins (1987).

tenance; efforts to improve the flexibility and responsiveness of the ministries involved. Some of these organisational changes are of immediate consequence to farmers, and are tied to the engineering changes; others will have a more indirect influence.

The effect on the farmers will be to introduce a further element of entrepreneurial uncertainty into farm life, as farmers have to organise locally and may also have to make individual calculations based on the availability and price of water. The introduction of such notions as formal associations, accountability of water-suppliers to water-users, revolving funds, transferable water rights and the like into irrigation would have the effect (explicitly mentioned if not desired in some consultants' reports) of decentralising control over irrigation to the local level, perhaps the level of the irrigation district or the federation of misqas. From a development philosophy perspective, two notions are intermingled here: the positive role that participation in governance can play in development,⁴⁵ and the desirability of applying the free market logic to the limit.⁴⁶ One can wonder whether this will not re-establish the situation of rulelessness to the advantage of the powerful farmers described by Barois and Willcocks.

The overall water balance of Egypt remains the overriding factor. Abu-Zeid and Radi placed their 1991 analysis in the framework of coping with water scarcity. A number of irrigation specialists⁴⁸ agreed in 1995 that 'Egypt must do more with less water', and since agriculture is the biggest water-user by far, most of the changes will probably also come in agriculture. Currently the goal is to increase the efficiency of water-use in Egypt (less waste); definite steps are being taken in that direction. The next question is whether social organizational factors enter into this equation. If water-use decisions are decentralised, handled by farmer-users, and subject to market considerations, will that mean that water efficiency will be enhanced or diminished? Will it help individual farmers as well as the country cope with scarcity?

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⁴⁵ Richards (1993).

⁴⁶ World Bank (1993).

⁴⁷ Barois (1887), 124; Willcocks (1889), 288.

⁴⁸ IIMI (1995b), 30.

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