

Village, Technology, and Bureaucracy: Patterns of Irrigation Organization in Comilla District, Bangladesh

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Throughout much of the Asian region the development of new and the rehabilitation of existing irrigation systems is viewed as a major aspect of agricultural development. As with many other strategies of agricultural development, irrigation development is dependent upon a combination of appropriate technology and organizational arrangements for utilizing that technology. In most contemporary programs of irrigation development some government agency has control over significant components of the irrigation technology (the weir, the reservoir, the pump, etc.). Often, these same agencies are interested in assigning responsibility for some aspects of the maintenance and operation of the irrigation system to the water users themselves (this may include functions such as cleaning canals, settling minor disputes, coordinating water use, etc.).

This simple separation of powers and responsibilities creates the need for some pattern of articulation between the irrigation bureaucracy and the local water users.¹ Not infrequently, the mode of articulation utilized has contributed directly to the limited success of irrigation systems. To help increase our understanding of possible articulation modes this paper discusses arrangements that have developed

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The fieldwork for this study was done by Mr. Ahmed and reported in his M.S. thesis, "Local Organization for Irrigation Management: A Case in Bangladesh" (Department of Rural Sociology, Cornell University, 1977). Support for his fieldwork in Bangladesh and academic studies at Cornell was provided through a grant from the Ford Foundation to the Bangladesh Academy for Rural Development. Both authors collaborated in the interpretation of the case materials as related to the more general issues of irrigation development. Useful comments on an earlier draft were provided by Barbara Lynch and Mark Svendsen.

¹For a discussion of alternative modes of articulation in irrigation systems, see E. Walter Coward, Jr., "Irrigation Management Alternatives: Themes from Indigenous Organizations," *Agricultural Administration* 4 (1977): 223-37. This issue is also related to a general problem in Bangladesh's rural development that Bertocci identifies as the contrast between indigenous rural organization characterized as diffuse and the centrally managed agencies of government. See Peter J. Bertocci, "Rural Development in Bangladesh: An Introduction," in *Rural Development in Bangladesh and Pakistan*, ed. Robert D. Stevens et al. (Honolulu: University Press of Hawaii, 1976), pp. 2-8.

in Bangladesh as part of the Thana Irrigation Program (TIP). As will be detailed below, the TIP links village cooperative societies with an agency of the government (Bangladesh Agricultural Development Corporation [BADC]) so as to achieve the distribution, operation, and maintenance of irrigation pumps used for the production of a winter (dry-season) crop. Details of this articulation are provided through a case study of a single village in Comilla district.

The area devoted to an irrigated winter crop (*boro*) in Bangladesh has increased dramatically in the last decade. As Thomas has noted, "Irrigated agriculture is now an established part of agriculture in Bangladesh."² Now, and during this period of expansion, several alternative irrigation technologies and their related organizational arrangements have been available to government policymakers.³ These alternatives have offered choices with regard to the source of water to be used (surface water or water from shallow or deep wells), the capital intensity of the construction and operation phases, and the scale of operational organization.

In the next few pages we will examine the operation of the deep tubewell irrigation system in one village in Comilla with special focus on the arrangements that have been elaborated within the village to operate and maintain the system.⁴ In doing so, we also will be in a position to examine the patterns of locality-bureaucracy articulation that are central to irrigation development.

Nabagram: Habitat and Agricultural Organization

The village of Nabagram is located approximately four miles to the west of Comilla town and about two miles to the east of the Bangladesh Academy for Rural Development. The village is situated on a relatively flat plain about 30 feet above sea level; there is a slight slope from north to south in the village. Soils are generally alluvial but more clayey in the north and more loamy in the south. The eastern side of the village is bordered by a small stream, and the three remaining sides are bordered by other villages.

The Comilla region receives an average annual rainfall of 94 inches. However, rainfall is unevenly distributed across the year; actual rainfall during the period of field work—December 1975 through mid-May 1976—amounted to 11.8 inches. In addition to the variation that occurs within the year, it is important to note that enormous variations may occur for the same month from one year to the next.

Nabagram incorporates 113 acres of cultivated land; another 40-50 acres is devoted to residential uses. There are 50 family units in the village and a total of 291 individuals. These 50 families own a total of 96.2 acres of land distributed as shown in table 1.⁵ While every family in the village owns at least some small portion of

²John W. Thomas, *The Thana Irrigation Program and Notes on Local Rural Planning for Bangladesh* (Dacca: Ford Foundation, 1976).

³John W. Thomas, "The Choice of Technology for Irrigation Tubewells in East Pakistan: Analysis of a Development Policy Decision," in *The Choice of Technology in Developing Countries*, ed. C. Peter Timmer et al. (Cambridge, MA: Harvard University, Center for International Affairs, 1975), pp. 33-67.

⁴The following field methods were used in this study: participant observation by Mr. Ahmed from mid-January to mid-June 1976; a questionnaire administered to all heads of households in the village; a sample survey of ten farms to obtain physical measures of total amount of land cultivated and amount of land irrigated; and a review of records available from the village cooperative society and *thana* offices such as BADC, TCCA, and others.

⁵Six of the village families have a total of 2.4 acres of land located in neighboring villages. Furthermore, 11 families from villages other than Nabagram have a total of 12.1 acres of land within Nabagram. The study village roughly corresponds with the "average" Comilla village that Peter J. Bertocci

cultivated land, some farms are so small. While two types of renting arrangements (*barga*) and cash leasing (*lagith*), the latter conditions of reduced risk through greater use of modern rice varieties the preferred cash leasing.

TAB
LAND HOLDINGS OF FAMILIES L

HOLDING SIZE (ACRES)	FAMILIES Number
Less than 1	10
1-2	21
2-3	10
3-4	8
4 or more	1
Total	50

It is also useful to note the labor conditions of the small size of farm units, most farm critical periods of transplanting and harvesting are situated with the three-crop system, and the village from the surrounding areas to a proximity of the village to urban centers employment. Approximately 28 percent of off-farm employment.

Wet rice is the main crop grown in the the main crop of rice (*amon*) was grown at the end of the monsoon season. This water was abundant and to be harvested in addition to this main crop some farmers w (*aus*), particularly on higher lands less like ated with the early part of the monsoon s mits cultivation of a third crop (*boro*), wh is harvested (preferably January but often beginning of the rainy season, sometime i

The movement to this three-crop patter ber of individual and group adjustments a schedule of agricultural activities. A criti ating the operation of the pump so as to al If the initiation of irrigation is not timely t by the ensuing monsoons increases signifi of the two subsequent crops is precluded. sions, the timely operation of the irrigati both village and bureaucracy, separately.

describes in "Social Organization and Agricultural ment, ed. Stevens et al., pp. 157-84. The average vill 10 homesteads (Nabagram has 13) and occupying 13

cultivated land, some farms are so small as to require the leasing of additional land. While two types of renting arrangements exist in the village, sharecropping (*barga*) and cash leasing (*lagith*), the latter is increasingly being used. Under conditions of reduced risk through greater water certainty and higher returns with the use of modern rice varieties the preferred leasing arrangement has shifted toward cash leasing.

TABLE 1
LAND HOLDINGS OF FAMILIES DISTRIBUTED ACCORDING TO SIZE

HOLDING SIZE (ACRES)	FAMILIES		LAND	
	Number	Percentage	Number	Percentage
Less than 1	10	20	5.94	6.2
1-2	21	42	33.28	34.6
2-3	10	20	25.20	26.2
3-4	8	16	27.36	28.4
4 or more	1	2	4.40	4.6
Total	50	100	96.18	100.00

It is also useful to note the labor conditions that exist in Nabagram. Even with the small size of farm units, most farm operators face a shortage of labor at the critical periods of transplanting and harvesting. These periods are further accentuated with the three-crop system, and consequently hired laborers come to the village from the surrounding areas to assist with these tasks. Furthermore, the proximity of the village to urban centers provides opportunities for nonfarm employment. Approximately 28 percent of the heads of households report regular off-farm employment.

Wet rice is the main crop grown in the village. Under pre-irrigation conditions the main crop of rice (*amon*) was grown during the September-December period: at the end of the monsoon season. This allowed rice to be planted at a time when water was abundant and to be harvested at a time when the rains had stopped. In addition to this main crop some farmers were able to grow an earlier summer crop (*aus*), particularly on higher lands less likely to be damaged by the floods associated with the early part of the monsoon season. The availability of irrigation permits cultivation of a third crop (*boro*), which is planted soon after the main crop is harvested (preferably January but often February) and harvested just before the beginning of the rainy season, sometime in May.

The movement to this three-crop pattern currently is not completed and a number of individual and group adjustments are in process to accommodate this new schedule of agricultural activities. A critical activity in this new calendar is initiating the operation of the pump so as to allow the timely planting of the *boro* crop. If the initiation of irrigation is not timely the risk of the *boro* crop's being damaged by the ensuing monsoons increases significantly; in addition, the timely planting of the two subsequent crops is precluded. As will be seen in the following discussions, the timely operation of the irrigation pump is dependent upon action by both village and bureaucracy, separately and in coordination.

describes in "Social Organization and Agricultural Development in Bangladesh," in *Rural Development*, ed. Stevens et al., pp. 157-84. The average village has a population of 340 persons living in 8 to 10 homesteads (Nabagram has 13) and occupying 135 acres of residential and cultivated land.

Approximately 54 percent of the land irrigated by the pump is farmed by members of the cooperative.

In addition to these elected officials, two persons are appointed by the membership to act as full-time staff during the irrigation period: a pump operator and a water distributor. Both of these persons are paid a fixed sum for the irrigation season. The need for a pump operator was anticipated in the original development of the TIP, and provisions were made for cooperatives to select men to be trained in pump operation by BADC. Several men from Nabagram received this training. Thus, when the pump operator of the previous year announced that he did not want the job in the 1976 season, the cooperative was able to replace him with another trained individual. The water distributor is a second critical staff position and is discussed below.

Adaptations: Local Inventiveness and Bureaucratic Tolerance. In the operation of their irrigation system the water users of Nabagram have evolved three important and locality-specific organizational adaptations. These three adaptations, the role of the water distributor (*panichalak*; literally, the man who drives water from one channel to another), the creation of differential water-user categories, and the use of private mechanics are each discussed below.

Creation of the water distributor role is not a required part of the TIP. During the first years of system operation in Nabagram this role was not established and responsibility for the actual distribution of water within the command area fell on the managing committee. That arrangement proved unsatisfactory, and in the 1971 season it was decided to create a water distributor who would have the sole right to distribute water to the individual fields following a system of rotation developed in collaboration with the managing committee and the general assembly in its weekly meetings. Some detail on the procedures for distributing water in the command area may help to illustrate the role of the *panichalak*.

The irrigated area in Nabagram has been divided into eight blocks, each served by a secondary branch of the main canal and a number of intrablock field channels. The blocks vary in size from 4.1 to 15.2 acres; most also contain a variation of soil types.

Water is supplied successively from one block to another in a prearranged rotational pattern. When water is supplied to any particular block, the mouths of all other secondary channels are closed and no water is provided to other blocks. There is no fixed period for the supply of water to a particular block. When the *panichalak* judges that adequate water has been supplied to all the fields within the receiving block, he discontinues water in that location and moves it to another block.

Within the receiving block similar procedures are used to supply water to the individual fields. The *panichalak* acts alone to open and close field channels supplying water to individual plots; the adequacy of water in the individual plots is a judgment made by the water distributor.

The procedures just described apply in the post-transplanting period. During the period of land preparation and transplanting, when there is a peak demand on the system's water supply, water is supplied according to the sequence of requests received from the individual water users. To receive this initial water one must have paid the irrigation fees in advance. Water is supplied in the order that requests are made with the provision that several requests from water users within one locality will be filled before moving to a completely different area of the system.

The utility of the *panichalak* role, in part, seems related to its similarity to the generalized accountability model of irrigation leadership.¹⁰ This model suggests that irrigation leaders will be successful when they are accountable to the water users with whom they interact. Three elements of accountability have been identified: accountable leaders serve relatively small groups of water users; they are selected by the water users and subject to replacement by them; and, they receive direct compensation from the users of their services.

The *panichalak* position in the Nabagram irrigation system closely approximates the accountability model. First, he is responsible for serving a relatively small command area (72.1 acres) and a small number of water users (61), 80 percent of whom live in the same village. Second, the *panichalak* is selected by the water users (in this case by a subset of the total water users, the 52.5 percent who are members of the cooperative), and his performance is subject to their review. His appointment is for the irrigation season, and poor performance could lead to his replacement. Third, the *panichalak* is paid for his services by the water users through the village cooperative. He is an employee of the village irrigation system and not an employee of a government agency. These three elements of the role appear to contribute to its suitability as a means for implementing the complex, and sometimes controversial, procedures of water distribution.

A second important adaptation in Nabagram's system is the creation of differential categories of water users and differential rates of water charges.¹¹ Three points regarding irrigation costs are important to note. First, the cooperative society must pay a rental fee to the BADC to obtain its pump each year. Second, all costs of operation are borne by the village cooperative: fuel costs, salaries for the pump operator and water distributor, and costs and repair.¹² Third, not all farmers who receive water are members of the village cooperative; in fact, not all water users are members of Nabagram village.

Two aspects of this situation, the need to generate funds locally and the existence of different categories of water users, have been combined into a policy of differential water charges. In 1976, as in past irrigation seasons, discussions regarding the appropriate water charges were held in the weekly discussions of the cooperative. A bargaining process was activated in which the proposals of the officers and individual water users and the situation in nearby villages were all offered for consideration.

From these discussions a three-level rate structure emerged: (1) cooperative members were charged approximately US\$10 (Tk150) per acre; (2) village members not belonging to the cooperative were charged approximately \$20 (Tk300) per acre; and (3) water users from other villages were charged approximately \$25 (Tk375) per acre. Using these water rates and the number of acres irrigated by each category of water user, we can calculate the contribution of each category to the cash income of the cooperative's irrigation program (see table 2).

¹⁰E. Walter Coward, Jr., "Indigenous Organization, Bureaucracy and Development: The Case of Irrigation," *Journal of Development Studies* 13 (1976): 92-105.

¹¹A similar pattern of differential membership categories has been reported for a system in the northern Philippines in Coward, "Irrigation Management Alternatives." One might hypothesize that this is a generalized pattern that occurs in irrigation systems that are multivillage in coverage.

¹²Alternatives for handling repair costs are discussed shortly. Presently, village cooperatives are not being given clear guidelines on the need to accumulate funds to purchase replacement pumps, a point made by Thomas in *Thana Irrigation Program*.

WATER USER CATEGORIES: LA

CATEGORY OF WATER USERS	WATER USERS	
	Number	Percentage of Total
Cooperative members	32	52.5
Village nonmembers	18	29.5
Outside villagers	11	18.0
Total	61	100.0

As shown in table 2, outside villagers, who live outside the command area, are contributing nearly one-half of the total water charges. Likewise, Nabagram villagers who are not members of the cooperative are contributing nearly one-half of the total water charges. Only about 36 percent of the command area is contributing to the water charges.

However, this seemingly inequitable distribution of water charges must be considered in view of the other contributions to the management of the system. First, the *panichalak* meets in weekly sessions to discuss a range of matters (and other matters); they are required to contribute to the management of the system. While they clearly may benefit from the system, they are also responsible for indicating dissatisfactions, pleading special cases, and associated with allocating their time to the management of the system. The responsibility for management of the system is shared by the cooperative members as compared to the outsiders.

The differential rate between nonmembers and members is related to a third resource: labor. From time to time the canals of the system must be repaired when this work is required *all* the families in the command area (cooperative members and nonmembers) must accomplish these tasks. Water users are called upon to contribute in this manner. At this point, it may be that the difficulties of the system, the contribution of labor from outside the command area, and the option to the system managers. A more equitable option is increasing the monetary costs to the outsiders. The total contributions made by different categories of water users and water charges may be considered more equitably.

A third form of adaptation in the Nabagram system is the procedures for repairing the irrigation pumps. The BADC is to provide to the village cooperative the pumps. To do this the BADC must maintain the pumps. In 1976, the co-ops were asked to pay a fixed fee for repair coverage; this fixed fee would cover the cost of the pumps.

¹³Viewed in these terms it would appear that the cost of capital invested through their savings program is offset by the charge to the members and the charge to the outsiders. Maintenance is judged to be \$5 (the difference between the charge to the members and the charge to the outsiders).

TABLE 2
WATER USER CATEGORIES: LAND IRRIGATED AND PAYMENTS MADE

CATEGORY OF WATER USERS	WATER USERS		LAND IRRIGATED		PAYMENTS MADE	
	Number	Percentage of Total	Acres	Percentage of Total	\$	Percentage of Total
Cooperative members	32	52.5	39.0	54.1	390	35.9
Village nonmembers	18	29.5	26.2	36.3	524	48.3
Outside villagers	11	18.0	6.9	9.6	172	15.8
Total	61	100.0	72.1	100.0	1,086	100.0

As shown in table 2, outside villagers, while irrigating less than 10 percent of the command area, are contributing nearly 16 percent of the total water charges paid. Likewise, Nabagram villagers who have not joined the cooperative pay nearly one-half of the total water charges collected by the cooperative but irrigate only about 36 percent of the command area.

However, this seemingly inequitable burden of operational costs must be considered in view of the other contributions that cooperative members make toward the management of the system. First, as mentioned above, the co-op members meet in weekly sessions to discuss a range of topics related to the irrigation system (and other matters); they are required to do so to remain members in good standing. While they clearly may benefit from this participation (through being able to indicate dissatisfactions, plead special cases, etc.), there is also an opportunity cost associated with allocating their time to these meetings. Presumably, this collective responsibility for management of the system is reflected in the lower rate for cooperative members as compared to the other two categories of water users.

The differential rate between nonmembers who are villagers and those who are outsiders is related to a third resource needed to operate the irrigation system: labor. From time to time the canals of the system need cleaning and repair, and when this work is required *all* the families in the village with land under irrigation (cooperative members and nonmembers) are expected to contribute labor to accomplish these tasks. Water users residing in other villages, however, are not called upon to contribute in this manner. While our data are not clear on this point, it may be that the difficulties of informing, organizing, and enforcing the contribution of labor from outside the village simply makes this an undesirable option to the system managers. A more easily implemented procedure is that of increasing the monetary costs to the outsiders.¹³ Thus, when viewed in terms of the total contributions made by different categories of water users, the variable water charges may be considered more equitable.

A third form of adaptation in the Nabagram system occurs with respect to procedures for repairing the irrigation pump. As one of its services the *thana* office of the BADC is to provide to the village co-ops assistance in the repair of the irrigation pumps. To do this the BADC maintains a staff of trained mechanics. In 1976, the co-ops were asked to pay a fee of approximately \$33 (Tk500) for their repair coverage; this fixed fee would cover the labor costs of BADC mechanics as

¹³Viewed in these terms it would appear that the management time of the members and the return to capital invested through their savings program is judged to have a value of US\$10 (the difference between the charge to the members and the charge to village nonmembers) and the value of labor for maintenance is judged to be \$5 (the difference between the charge to village nonmembers and that to outside villagers).

bureaucracy. First, the villages enter into only a limited dependency relationship with an outside agency; they are able to preserve a considerable degree of local integrity while benefiting from an externally provided resource. Though limited, the dependency does create difficulties. One of the most obvious is the difficulty associated with the timely operation of the pump for initiating the irrigation season. As mentioned previously, the timeliness of this operation is critical not only to the success of the irrigated crop but to the two successive crops. Initiating the irrigation season depends upon action by both the BADC and the village cooperative. In the 1976 season the national-level decision regarding the annual rental fee was not known by the villagers until the second week of January. Furthermore, after this information was available, the cooperative society took more than two additional weeks to decide on water rates, clear the irrigation channels, appoint the pump operator and *panichalak*, collect sufficient funds for the pump rental, repay other loans made to the cooperative, and purchase fuel. Delays by both parties resulted in a less-than-optimal initiation of the irrigation season.¹⁶ Second, the bureaucracy, and the larger society, benefits from the mobilization of the scarce resources of management and capital from within the immediately benefited unit; no large amounts of agency resources are required to distribute water, repair facilities, or manage conflict within each command area. These tasks are performed either by the water users themselves or by a local staff whom the water users select, supervise, and pay.

Nabagram and Irrigation Development. Many people concerned with irrigation development recognize the importance of organizational arrangements for utilizing irrigation and other technologies. For example, Takase and Wickham, writing about the Asian region, have noted that "the major weakness in the irrigation sector is not lack of technology nor lack of financial resources but a shortage of institutional organization by which human talent and skills can be matched optimally with other inputs. . . . The most serious of these problems now appears to be the operation and maintenance capabilities . . . and their integration with local engineering, agronomic, economic and social aspects."¹⁷

The TIP is a "large" irrigation program that provides an organizational pattern for overcoming several of these difficulties. By dividing responsibilities between the *thana*-units of the BADC and the village cooperative societies, a great deal of irrigation management in Comilla District is in the hands of individuals intimately familiar with local engineering, agronomic, and socioeconomic conditions. This local management unit does have incentives to use water efficiently and can do so through flexible rules that allow differential water charges and the modification of rules and roles as seen in the creation of a locally accountable water distributor.

Finally, we should note that we are in basic agreement with the observation of Takase and Wickham that "there is a tendency, especially among those interested in social organization, to overlook the many unproductive village systems and to

¹⁶Ahmed, "Local Organization for Irrigation Management," p. 53, reports that the results of this late start were seen in subsequent parts of the agricultural year: "Farmers in Nabagram could grow their *aus* crop only in *boro* plots where the comparatively low yielding but short duration paddy known as China I and Chandina were grown. In *boro* plots where the high yielding, but longer duration, International Rice Research Institute (IRRI) varieties were grown there was insufficient time for production of the *aus* crop. Those families who grew IRRI varieties of paddy in the irrigated *boro* season lost a significant amount of yield and almost the entire straw because of the early rains . . ."

¹⁷Kunio Takase and Thomas Wickham, *Irrigation Management as a Pivot of Agricultural Development in Asia* (Manila: Asian Development Bank, 1976), p. 5.

overestimate their actual operating performance."¹⁸ By focusing on one Comilla village that participates in the TIP it is not our intention to suggest that all participating villages have been as inventive as Nabagram nor that all BADC *thana* offices have been as tolerant as this office in Comilla.

It can be suggested, however, that any consideration of institutional and organizational arrangements for achieving irrigation development should consider the experiences of Nabagram. These experiences suggest that the effective articulation of irrigation programs can occur when village groups are given a large amount of responsibility for managing irrigation and if a variety of village-developed or -originated organizational arrangements for this management are permitted. Furthermore, this village capacity for innovativeness was matched by a bureaucratic style that was flexible and tolerated local responses and variations. An important result was that Nabagram was able to modify its technological base while developing only limited dependency on a government agency. It achieved this modification in technology and enhancement of productivity, to a large extent, through the mobilization of locally provided and locally controlled resources.

Public Policy and The First Five Year

The analysis of authoritarian regimes in structural, ideological, and situational power. Far less attention has been devoted to how regimes consolidate their power and attain a theoretical problem, the consolidation of the consolidation of revolutionary regime types of regimes confront issues of legitimization (or demobilization). In the analyses followed by an authoritarian or revolutionary regimes, explanations of regime dynamics tend to focus within the preconditions for the seizure of power events.

The lack of research on the consolidation of authoritarianism is particularly striking in the case of Chile. An examination of the three years of the Popular Unity government reveals a relative dearth of scholarly material on this period. This gap is surprising not only because of the rapid rise to power, but also because the emergence of a new real departure from Chile's previous political

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¹⁸Book length studies include Alain Touraine, *Vie et mort* (Paris: Editions du Seuil, 1973); Pedro Vuscovic et al., *La cultura chilena* (Santiago: Editorial de Cultura Economica, 1975); Joan E. Garcés, *Allende* (Santiago: Editorial del Financiero, 1976); Alain Labrousse, *L'Experience chilienne* (Paris: Editions du Seuil, 1975); Ildemaro Torres, *Chile, de Allende a la actualidad* (Santiago: Editorial del Financiero, 1975); Manuel Vasquez Montalban, *La via chilena al golpe* (Santiago: Editorial del Financiero, 1974); Genaro Arriagada Herrera, *De la via chilena a la via actual* (Santiago: Editorial del Financiero, 1974); Pio Garcia, ed., *Las fuerzas armadas y el golpe* (Santiago: Editorial del Financiero, 1974); Pablo Piacentini et al., *Chile: Una tragedia* (Santiago: Editorial del Financiero, 1974); James Petras and Morris Morley, *The United States and Chile* (New York: Oxford University Press, 1974).

¹⁸Takase and Wickham, *Irrigation Management*, p. 22.