Preliminary

WATER RUNS DOWN HILL AND EVAPORATES: HUMAN ORGANIZATION AND THE MANAGEMENT OF WATER ENVIRONMENTS

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Introduction: Getting Through This Paper

In the pursuit of agricultural production man rearranges his micro-environment to favor the growth of his cultigens and inhibit the growth of other plants and animals. On those parts of the earth's surface where rainfall is either scarce or poorly distributed an important re-arrangement is the creation of a suitable water environment for manipulating plant growth (favoring some and retarding others). Often, management of the water environment depends upon the coordinated action of two or more would-be water users. Impounding the water, conveying it to the desired location, disposing of the excess, are all activities that may require the assistance, or permission, of one's neighbors.

There is, therefore, in irrigated agriculture, a characteristic need for coordination of activities which, while not totally absent in other styles of agricultural production, is less critical. Unless each irrigator could somehow be given a completely independent source of water and an independent means of disposing of the excess, irrigated agriculture is a production style which assumes some degree of coordination and integration among the various water users.

A system of irrigated agriculture can be defined as a landscape to which is added by man physical structures which impound, divert, channel or otherwise move water from some source to some desired location, and which structures are operated by men in interaction with each other for the purpose of producing food or fiber.

Irrigation development is the task of creating such systems. Consequently, it is a task which is concerned with the development not only of landscapes and physical structures but also patterns of interaction. It is a task complicated by the fact that these components are interdependent--e.g., some patterns of interaction may not be matched well with some physical structures.

In developing irrigated agriculture, technology from the West has often been used to create the physical structures of the system. The design of these structures and the materials used in their construction are based on principles and experiences evolved in the West. Often, there is also a tendency to look elsewhere for appropriate patterns of interaction with which to operate the system: the irrigator's associations of Taiwan or the irrigation districts of California. Just as local technology has been judged as inadequate so local institutions and organizations are considered unsatisfactory--sometimes even nonexistant.

But any given pattern of behavior, for example allocating water, may be finely interwoven with other behaviors; some seemingly irrelevant to the focal action. Thus, the manner of distributing water may be related to hereditary rights, religious beliefs, land tenure laws, friendship arrangements, bureaucratic regulations, or a variety of other activities. It is this interdependence of an institution or organization that makes its creation, or replacement, a complex task--particularly if the strategy of change being used is noncoercive. Likewise, it is this feature of interdependence that makes the strategy of designing location-specific institutions and organizations an attractive and viable approach.

This paper is concerned with such an approach to the institutional and organizational requirements of irrigated agriculture. To deal with this concern, several related topics will be discussed. First, a brief look at some historical attempts at irrigation development are presented. Next, a more detailed discussion of the nature of institutions and organizations is presented as a prelude to briefly examining three traditional systems of irrigated agriculture. Finally, based on the discussion of the importance of understanding patterns of interaction in traditional irrigation systems it is proposed that a major research activity be undertaken in the Mekong Basin for the purpose of identifying and analyzing such institutions and organizations as a primary task for future irrigation development.

Historical Vignettes

Watson (1974) has described the agricultural revolution that took place in the seventh and eighth centuries as Islam spread through North Africa and into Europe. This agricultural revolution was dependent upon the spread of new crops and cropping patterns--many of which had high water requirements. Many of the areas that came under Arab domination at this time previously had extensive irrigation systems. However, their state of disrepair and the simple technology which they utilized made them unsuitable for the requirements of the new crops.

Thus, not unlike agricultural revolutions of the twentieth century, Watson notes the following:

> "With this legacy of irrigation systems and technology, therefore, the new agriculture could make little progress across the world the Arabs had conquered." (1974:12)

Consequently, irrigation development became an important component of the Arab agricultural revolution. The State took a major lead in this development and was instrumental in rehabilitating existing systems, constructing new ones and administering both. In addition, private resources were mobilized to construct and operate medium- and small-scale systems--"wealthy landowners, prosperous peasant proprietors, communities of irrigators or would-be irrigators, and associations of these communities" (Watson, 1974:27). Irrigation development also included the creation of a body of water laws based in part on principles found in the Islamic faith. In addition, tax incentives were provided to stimulate irrigation investment. One form these took was a lower tax imposed on land "watered by buckets" (or some other form of irrigation technology) than for non-improved land.

The result of these efforts with irrigation are summarized in the following sentence. "The Combined effect of all these advances was to create across the Islamic world a patchwork of heavily irrigated areas, great and small, into which the new agriculture could move, to transform an environment fundamentally hostile to many of the new crops into one which, for a time at least, they were grown with astonishing success" (Watson, 1974:13).

Thus there is some precedent for the tasks at hand--the further development of irrigated agriculture in the Mekong Basin. Hopefully, what is done in the Mekong will be successful for more than "a time at least."

What we do not have is very much detail about how irrigation development was actually accomplished in the Arab case. One interesting

report which provides considerable more detail on a strategy of irrigation development is found in the account by Roberts (1967). His report deals with the efforts of the British to improve irrigation in Ceylon (read Sri Lanka) in the last half of the nineteenth century.

Earlier in the nineteenth century, the British introduced two changes which subsequently modified existing social arrangements in a manner that directly affected the use and maintenance of existing irrigation systems. First, they abolished the custom of forced services (rajakariva). Second, they introduced the British institution of minor courts. These changes deprived the local community leaders of an effective form of sanction (forced labor) while introducing an alternative mechanism for settling disputes which was extremely cumbersome and ineffective. Since much forced labor was related to the maintenance of villages' tanks and canal systems and many disputes involved water, the combined effect of these changes on irrigation was extremely detrimental. As a solution to the deteriorating state of the existing irrigation systems, a set of policies embodied in the "Paddy Lands Irrigation Ordinance of 1856" was developed. This ordinance was aimed directly as the issue of restoring local initiative in the design and operation of irrigation institutions and organizations that would enable some requisite level of irrigator coordination and control to be established.

Rather than outlining an island-wide set of rules to be followed, the ordinance provided for local government officials and landowners to make their own rules and incorporate varying local practices for the operation and maintenance of irrigation facilities (Roberts, 1967:116).

In looking for a suitable person, or persons, to enforce these locally designed rules, the Administration turned to the traditional village council (gansabhawa). However, the council was to be used with some modifications; they would be under the nominal chairmanship of the (British) district officer, they would use fines as their sanctions, and they would come into action only when a rule had been broken.

Thus, irrigation development at this point in time was based on two important principles--1) the tolerance of local variation and the adaptation of rules; and 2) the use of existing institutional arrangements, somewhat modified. Tolerance for local variation was demonstrated again in a later version of the ordinance which provided:

> "With regard to the machinery for settling disputes and organizing the distribution of water, the proprietors of each irrigation division were provided with several options: that of gansabhawas only, that of village headmen only, or that of gansabhawas in combination with headmen" (Roberts, 1967:121).

The actual results of this policy of irrigation development seem to be mixed. On the one hand, it proved of value in "settling disputes; organizing agricultural activities; and in stimulating cooperation, enthusiasm and industry among the cultivators" (Roberts, 1967:125). However, this success was offset by the forces of Westernization being introduced into Ceylonese society. This Westernization emphasized individual values and actions over community actions and values. In such a changing setting, even though Government made some effort to utilize existing institutional arrangements, such arrangements became increasingly less appropriate.

What, then, do these glimpses of history suggest? First, the Arab glimpse shows that irrigation development and irrigation institutions were an integral part of an earlier and significant agricultural revolution. The Ceylonese case suggests that one strategy for such development is to utilize existing institutional forms. One requirement of such an approach is a tolerance for local variation and differences that usually is not found in national planning approaches. It also suggests that indigenous institutions, unchanged in a changing situation, can be as inappropriate as ill-fitted nonlocal institutions.

Irrigation Institutions and Organizations

The introductory pages of this paper have been liberally sprinkled with the words institution and organization. Since these ideas can be used very loosely, and sometimes confusingly, this section of the paper is an attempt to elaborate on their meaning.

Much of an irrigator's behavior is a consequence of restraints and limitations imposed upon him by the ecology of the situation, the engineering aspects of the system and the rules and procedures imposed by his fellow irrigators and the water authorities.[1] Within these constraints the irrigator uses water to achieve some set of goals: subsistance, commercial or mixed production, the minimization of risk, maximization of production or some desired middle position. Which of these goals he seeks and the situational context of his goal-seeking behavior provide important explanatory dimensions of his patterns of behavior on his farm, with other irrigators and with water authorities.

He may or may not: steal water from his neighbors, form a water user's association, minimize his total use of water, diversify his cropping pattern, cooperate with the water authorities, elaborate indigenous irrigation roles or develop specific norms and rules about the use of water. The choice-making of irrigators along these and other dimensions results in a changeable pattern of behavior that has an important impact on the total outputs of the irrigation system--economic production and others.

The behavior of men in using water for agricultural purposes is socially learned and can be understood with a perspective that combines learning principles and sociological principles. Recognition of these principles is an important prelude to understanding the human organization of irrigated agriculture.

Men's actions have consequences. From the actor's point of view these consequences may be either good, bad, inconsequential, or some combination of these. Behavior that results in desirable outcomes tends to be repeated--behavior with the opposite result is discontinued. Thus, behavior that we observed being repeated very likely is providing some positive outcome to those engaged in that behavior.

The same behavior may have different consequences, depending upon the situation in which it occurs. Stealing water when it is plentiful may have trivial consequences as compared to the effect of stealing water in times of scarcity. Thus, an important learning task for any individual is to identify the features of a given situation and select the behavior "appropriate" for that situation, i.e., the behavior that will provide the best mix of positive outcomes for him. Through personal experience

and the shared experience of others one comes to learn that a particular behavior has certain outcomes only when performed in the presence (or absence) of certain people, or when performed following some verbal behavior of another, or when performing some particular job or task. Taking water from the canal has different consequences depending upon whether or not that action was preceded by the ditchtender giving the verbal cue to do so by saying, "the water is now scheduled for delivery to your farm."

Whether consequences are considered by the actor as good or bad is dependent upon several things. First some behavior will result in satisfying basic physiological needs--obtaining water when thirsty, food when hungry or rest when tired. Second, some behavior will result in the actor obtaining something which he has learned to need--praise from his peers, a new set of clothing, greater authority in the village council, a higher yield of rice. Third, for some of these payoffs enough is enough; while for others, there seems to be no decreasing marginal utility. If a given behavior is going to result in more of something of which the actor already has enough--that consequence may provide little motivation for performing that behavior. Some consequences, such as prestige and wealth, are less easily satiated because they are convertible into a variety of more specific rewards.

One important result, emerging from the repitition of certain behavior in certain situations because of the positive results that are obtained, is the formation of institutions and organizations. The word "institutions" is used to refer to a variety of "miscellaneous" phenomenon

in the development literature. One important distinction that needs to be made in discussing the human organization of irrigation systems is that between institutions and organizations.

Institutions is a concept associated with ideal behavior and expectations and is a "generic concept for the variety of norms that govern social behavior: folkways, mores, customes, convention, fashion, ettiquette, law" (Chinoy, 1967). Institutions, then, are behavioral rules. They are "ideal" statements about the relationship between behavior and consequences in certain situations. As an example, the following behavioral rule exists in irrigation systems operated by the National Irrigation Administration in the Philippines:

If your fields need water (a certain situation) you must present your request to the ditchtender four days prior to your needed delivery (a specific behavior) so that water can be scheduled for delivery to your fields (a desired consequence).

Social organization refers to those actual patterns of interaction that occur among a plurality of people. Such patterns are sometimes formal purposive and enduring enough to be given names: the Nguyen family, the Royal Irrigation Department or the Nam Tan Irrigator's Association. Of course, social organization is also composed of less formal, purposive or enduring patterns such as a friendship clique, a rice-planting team, or a band of farmers along a common irrigation channel. Social organization, then, refers to the patterns of repeated behavior that occur when individuals find themselves in various specified situations.

It is important to recognize that there is often a poor fit between the institutional and organizational components of a human organization

such as an irrigation society. Behavior patterns and behavior rules are not always consistent--and, therein lies a degree of impetus for change. Referring back to the Philippine example, while the rule is that water requests are due four days prior to actual need, this rule is seldom followed and requests often are made, and accepted, with less notice time. Note that in this case the behavior that does not comply with the rule is repeated since it results in the desired outcome without also resulting in some negative consequence for the irrigator.

Institutions and organization bring to the irrigation system a certain degree of predictability about the use of water in that system. In an irrigation system the cluster of institutions (rules) around the function of water distribution, some water authority role, and the cluster of institutions (rules) around the function of water use, the irrigator's role, allow for each to anticipate the action and reaction of the other and for patterned relationships, or social organization, to emerge between irrigators and water authorities.

To manage a water environment for the purpose of agricultural production requires, in addition to physical structures, formal and informal rules (institutions) and regularized patterns of interaction (organization).

Among those concerned with irrigation development this idea is becoming increasingly recognized and accepted. The current need is for a better understanding of how to create new, or modify existing, irrigation institutions/organizations. These issues are of central concern to this discussion.

Within the Lower Mekong Basin there are, and will be, instances in which irrigated agriculture is introduced to cultivators who have no tradition of irrigated agriculture. One such example is the resettlement of Meo in the Nam Tan project in Sayaboury, Laos. In such instances the creation of new irrigation institutions/organizations are of critical importance. However, in much of the Mekong Basin, irrigation projects will improve water delivery to farmers already engaged in irrigated or rainfed agriculture--cultivators with existing rules and roles for handling water. In those situations, what may be required is the modification of existing patterns rather than the creation of entirely new ones.

One of the things that we have been rather ill informed about is the nature of the institutional and organizational patterns that have been developed in traditional irrigation systems. In part, this comes about because of the relatively little information that we have on such systems and in part because those with knowledge about traditional systems are not those who are involved in developing the modern systems. It is also related to our stereotyped image of the rice cultivator: he is irrational, he is not easily changed, and he is unorganized. As an attempt to sensitize our thinking to the possibilities of traditional irrigation organization, let us briefly examine several cases for which there is relatively detailed information available.

Indigenous Approaches to Water Management

Among the most fundamental processes to be organized in any irrigation system is the allocation and distribution of the system's water to

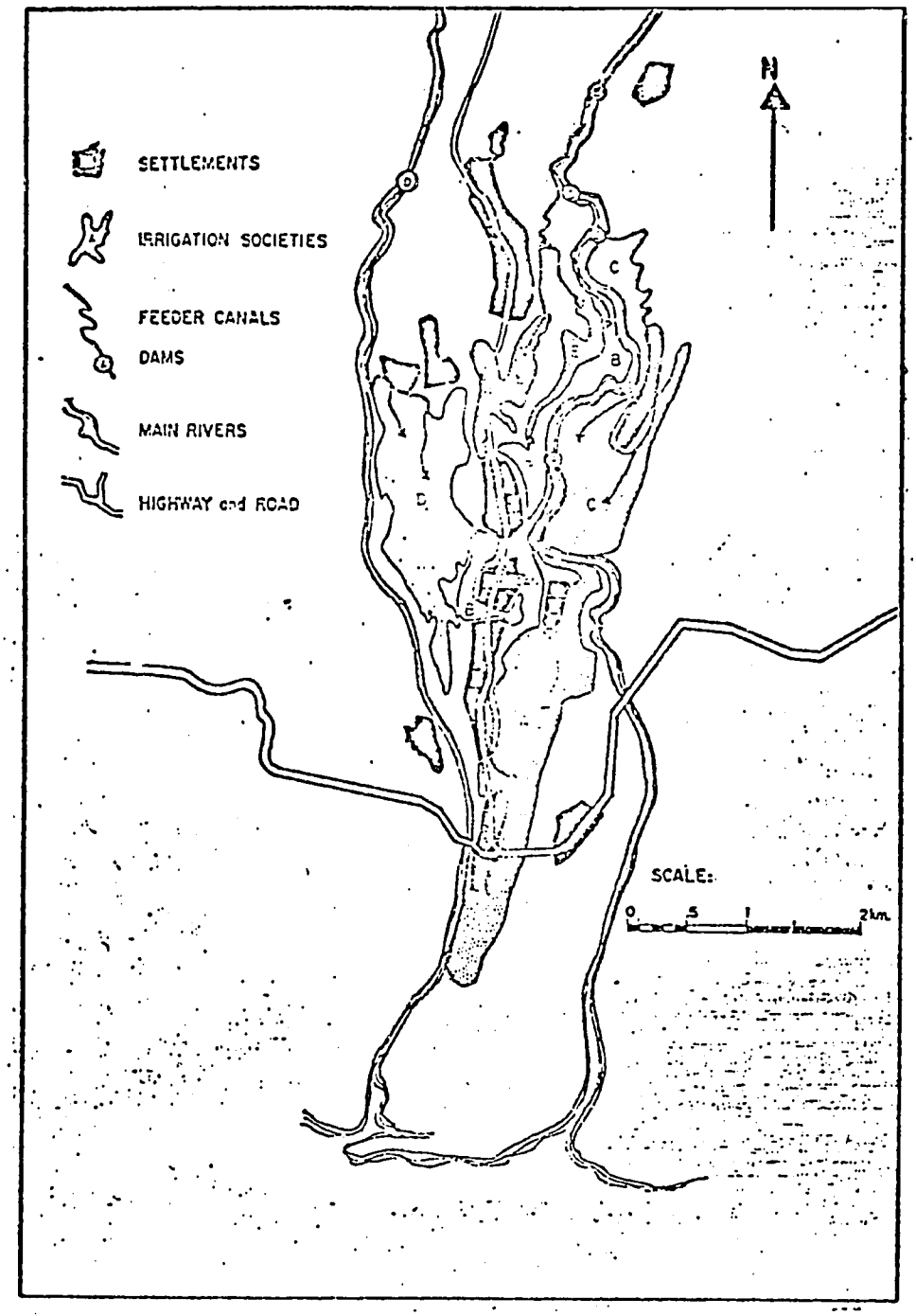
its users. Basically, alternative means for distributing water are a function of the physical components on the system and the institutions/organizations of the system. This section briefly describes three traditional systems in which the physical components for handling water are roughly equivalent, but in which significant institutional/organizational variation is found.

In Bali, the institutional/organizational arrangement created for each irrigation system is an irrigation association (or subak) whose membership is composed of all irrigators served by that particular system.[2] The subak is independent of the residential community (the bandjar) since the members of the subak may come from several different villages and the members of a village may belong to several different subaks (as may an individual irrigator). For a view of the relationships of villages and subaks, see Map 1.

Geertz (1967:230) provides a succinct overview of the subak:

> "A subak is defined as all the rice terraces irrigated from a single dam (empelan) and major canal (telabah gde). All individuals owning such land (with some major exceptions, it is all in freehold tenure) are citizens of the subak, or krama subak, just as all those living on the land of a bandjar are its citizens, or krama bandjar. As there are klian subak (subak headmen), as there are bandjar meetings, so there are subak meetings; and as there is a bandjar legal code, or constitutions, so also there is a subak one. Public obligations enforceable by fines, regulations concerning land use, legal transactions having to do with land transfer, collective ritual for group ends (such as fertility)--all these fall within the domain of the subak government as their counterparts fall within the domain of the bandjar government."

The subak is involved in more than just the maintenance of this system and the settling of disputes as they arise. It performs an active role in controlling and regulating critical on-farm decisions of



Map 1. Relationship of Subaks and Villages

SOURCE: Geertz, 1967:213

the irrigators--most importantly the time of planting. To stagger the peak demands for water within any one subak (as well as between subaks), the subak is subdivided into sections (tempek). Each section is then assigned a planting "time" and cultivators within that section are required to follow that assigned schedule. (See Table 1.)

The precise form of the subak organization may not be duplicable elsewhere--and that is not the point of this discussion. It does, however, have several features which need to be emphasized.

First, it represents one method of creating an association among irrigators sharing a common water source who do not at the same time share some other common association, such as village residence. Second, it demonstrates the possibility of having more than simply an ad hoc conflict-managing organization--it is also possible to have one whose control over agricultural decisions is more extensive, and presumably, of some degree of conflict.

All canal irrigation systems have heads and tails. The usual situation is that field location at the head end is more desirable than field location at the tail end. Much of the conflict that is manifested in irrigation systems has its genesis in the difficulties of distributing water over space--particularly if that space is interspersed with other water users. While seasonal conflict may arise, it is also possible that in the long run this inequity in water distribution will have important effects on the distribution of wealth among irrigators (see the discussion by Vander Velde, 1970). A Ceylonese system described by Leach (1961) provides an interesting and intriguing traditional solution to this ubiquitous problem. Basically, the solution is achieved through the patterns of land tenure enforced in the community.

Table 1

Distribution of Planting Schedule

by Irrigation Section

Mata system	Month 1	2	3	4	5	6	7	8	9	10	11	12
"Second"		plant rice					harvest rice	plant dry crops				harvest dry crops
"Fourth"		harvest dry crops		plant rice					harvest rice	plant dry crops		
"Sixth"				harvest dry crops		plant rice					harvest rice	plant dry crops
"Eighth"	harvest rice	plant dry crops				harvest dry crops		plant rice				

SOURCE: Geertz, 1967:234

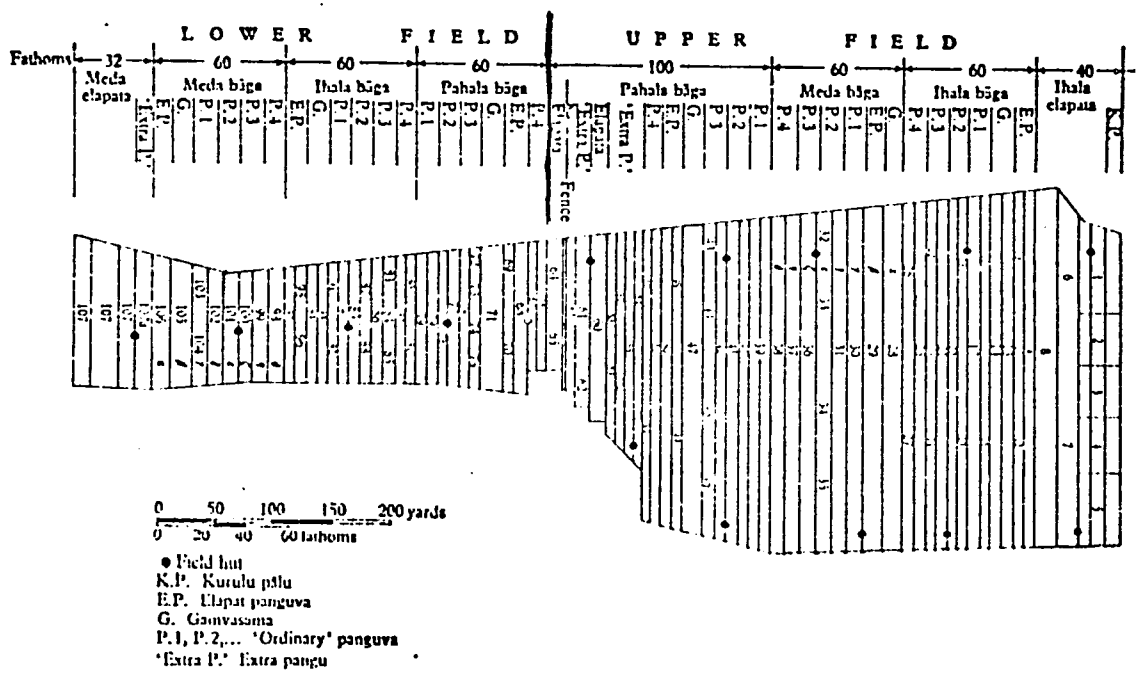
Unlike the Balinese system, this system is entirely associated with one village. The system irrigates about 150 acres of land and is supplied by a village-maintained tank of about the same size. Approximately 150 cultivators operate land in the system.

Within the command area of the village tank the land is divided in a manner designed to minimize the potential negative effects of field location for any given cultivator. This is accomplished in the following way. First, the total command area is divided into two parts, the Upper Field and the Lower Field (see Map 2). The fields are not of equal size--the Upper Field being about twice as large as the Lower Field.

Each of these Fields is further divided into three parts--an upper, middle and lower section.[3] These field-sections are then aggregated into units called baga. In the particular system described by Leach, the baga are composed of the parts of the command area as shown in Table 2.

Each cultivator "owns" rights to some share of water in one of these baga. The share is represented in the form of a strip of land of a designated size bordering the canal--thus, it is actually a share of water. The extent to which the strip is extended laterally is an option left with the cultivator. Each shareholder then has a strip of land in the Upper Field and a strip of land in the Lower Field according to the baga to which he belongs. "It is not possible to own land in the Upper Field without also owning a corresponding piece of land in the Lower Field" (Leach, 1961:158).

In a final effort to maximize equal access to water, the strips of land in the Lower Field are ordered in the reverse fashion of the strips in the Upper Field. Take the case of a cultivator owning shares in Baga 1.



Map 2. Division of Land in the Irrigation System

SOURCE: Leach, 1961:152

Table 2

Simplified Presentation of Baga Composition

by Field and Section

	UPPER FIELD			LOWER FIELD		
	UPPER SECTION	MIDDLE SECTION	LOWER SECTION	UPPER SECTION	MIDDLE SECTION	LOWER SECTION
Baga 1	X				X	
Baga 2		X				X
Baga 3			X	X		

If Baga 1 is subdivided into ten strips, then the cultivator who has strip one in the Upper Field will have strip ten in the Lower Field. That is, his "farm" will be composed of the best and the poorest field locations available to members of Baga 1.

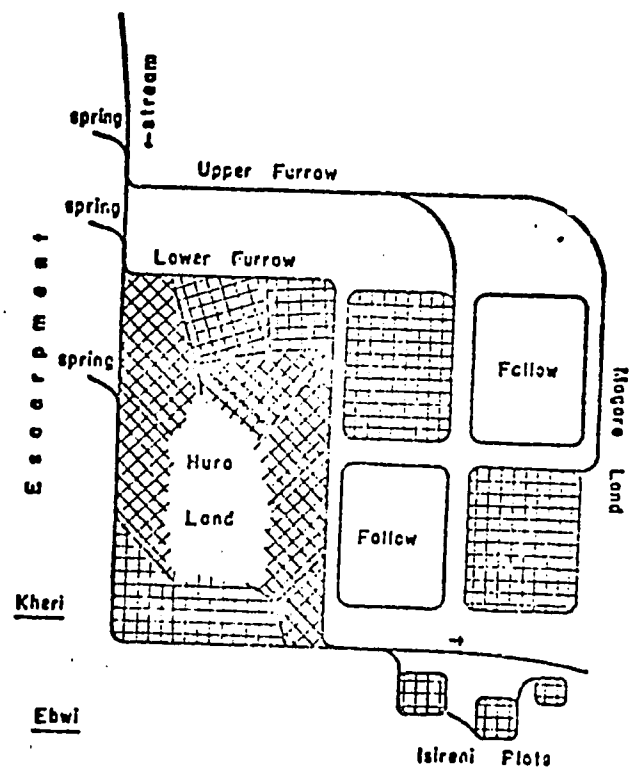
The intended effect of this elaborate assignment of location vis-a-vis access to water is as Leach suggests:

> "...that shareholders who own land in the lowest and least advantageous portion of the Upper Field also own land in the highest and most advantageous portion of the Lower Field" (1961:157).

Consequently, in any crop season of poor water supply each cultivator's production will be proportionally reduced rather than some suffering complete loss while others are able to maintain their production.

As with the subak system, the approach observed in Ceylon is designed to get at the "heart" of the matter of equitable water distribution and conflict resolution. If you have land at both the head and the tail of the system, there is some possibility that you will be more interested in equitable distribution of water throughout the system.

One more example. Let's look at the Sonjo of Tanzania, a tribal group of people participating in irrigated agriculture. Their system is described in the work of Robert Gray (1963). The system obtains its water by diverting a small stream as well as utilizing several small springs in the area. A series of main and secondary canals carry the water from the sources to the fields to be cultivated (see Map 3). The actual operation and maintenance of the irrigation system is the responsibility of a council of seventeen village elders who assume the duties through heredity.



Map 3. Diagram of the Sonjo Irrigation System.

SOURCE: Gray, 1963:49

The operation of the system is dependent upon two important rules. First, the twenty-four hours of the day are divided into four irrigation periods of approximately six hours each. For each of these irrigation periods some individual is assigned primary rights to the water. Usually, this is more time than is required to water his own fields so that the "extra" water can be assigned by him to others. The second rule deals with the assigning of water rights. The cultivators of the village are classified into four groups--each of which has different claims on the irrigation water. During an irrigation cycle of fourteen days, water is more or less distributed among these groups.

The irrigation cycle begins with the assignment of water rights to the village elders. It usually takes about four days to irrigate the fields of the seventeen village council members.

The next group of cultivators who have rights to irrigation water are what might be thought of as "minor" village elders: that is, individuals who have hereditary rights to water but who are not involved in the actual management of the irrigation system. The third group of water users are those wealthy members of the community who do not have hereditary rights to water but who are able to obtain "temporary rights" by making various payments to the village council. These three groups include only about one-half of the cultivators of the village.

Since a man with an assigned water right probably cannot use the water for the full six-hour period, there is an opportunity for cultivators without water rights to work out various arrangements whereby they can obtain the excess water from those with assigned rights.

From Gray's account, the system of water distribution appears to be extremely inequitable. However, it may well be that there exists in the society other mechanisms for redistributing the unequal wealth that would seem to arise from the stratified system of water distribution. Likewise, it may be possible that peculiar ecological factors gave rise to this system and continue to perpetuate it. The central fact that the system works suggests that, for most of the participants, it provides sufficient benefits to motivate them to continue the system and/or that there exist opportunities for those dissatisfied with the system to move from it and gain their livelihood in some other manner.

What can be seen in the Sonjo system is an alternative approach to organizing and controlling the practice of irrigated agriculture--in this case through the exercise of traditional political authority. Here, water is distributed not by allocating time, as is done in the subak system, or by assigning space, as is done in the Ceylonese system, but by distributing privilege.

The great variety found among this small (but selected) sample of traditional irrigation systems brings me to a central point. If one were designing a "modern" irrigation system to be introduced into each of these existing situations and if one were to design a system that would build upon these existing institutional/organizational arrangements--the design and operational requirements of the system would vary significantly. Not all irrigation technology or all irrigation designs would be "neutral" with regard to their social and political effect in these settings. Likewise, not all technology and designs would have equal change, or adjustment, "costs" attached to them.

The Mekong Basin is a place of several nation states and even more ethnic and cultural groups. Many of them are practicing irrigators. They operate in existing irrigation systems and these systems are characterized by institutional rules and organizational patterns--no matter how poorly perceived and understood by outsiders. Successful irrigation development is dependent, in part, upon increased knowledge of these irrigation institutions and organizations of the Mekong Basin and its contiguous areas.

A Dreamy Proposal: Project AIIM

There has been some preliminary work done on this topic. Frutchey (1969) has provided some interesting and useful detail on traditional irrigation systems in the Chieng Mai area of Thailand. Wijeyewardene (1965) and Bruneau (1969) have also written about systems in Northern Thailand. I have completed some work in Western Laos and anticipate further efforts in the near future (Coward, 1971). While it is likely that some preliminary work has been done in the Khmer Republic and in South Vietnam, I have been unable to locate any specific literature. Clearly, our knowledge for the Basin is fragmentary at best.

As is well understood, irrigated agriculture is a style of agricultural production which has special needs for institutional and organizational patterns that regulate, control and coordinate the water management behavior of some plurality of water users. The development of irrigation institutions and organizations is an integral part of irrigation development. While we can agree on this need, little has been said about how to do it. To that subject, let us turn our attention.[4] The basic

approach to be suggested involves three related tasks--identifying existing irrigation institutions/organizations; designing new or modified institutions/organizations and testing existing, modified or new institutions/organizations for their performance in actual development situations. Most of my comments will be with the identifying task since it logically needs to precede the other activities.

Many of the functions required to operate and maintain irrigation systems have been dealt with by people in the rural communities of the Basin for a long time. In dealing with them they have evolved a variety of institutional and organizational arrangements. Doubtless, not all of these arrangements are equally effective or desirable. Nonetheless, they do represent workable alternatives and, as such, deserve to be a part of our institutional/organizational "gene pool." While they may be an integral part of knowledge in a particular locality, they may be unknown to various planners and program implementors in the urban centers within, or outside, the Basin area. That condition suggests the need for a substantial effort designed to identify and analyze existing irrigation institutions/organizations in each of the riparian nations. How do villagers organize to perform irrigation activities in the Khmer Republic, Laos, South Vietnam or Thailand? Very little is presently known about these arrangements (at least by outsiders).[5]

The task of institutional/organizational identification and analysis is an important one and one which local scientists ought to be given support to undertake. The Mekong Development Committee could perform a useful function in identifying the need for this task, organizing potential participants, encouraging them to develop a comparable format for data collection and assisting them in obtaining the needed resources.

To give this proposal somewhat more concreteness, I would like to suggest that the Mekong Development Committee consider the value of Project AIIM (Analysis of Irrigation Institutions in the Mekong). The objectives of Project AIIM would be to conduct detailed analyses of selected systems of irrigated agriculture in the Basin nations--with special emphasis on existing traditional systems. To the extent possible, these analyses would be conducted by scientists of the riparian nations--both professionals and students. Collaboration with outside scholars and universities might be desirable and could also be considered.

It would be highly desirable to establish some type of coordination-information network, perhaps located in the Mekong Secretariat, that would allow participating researchers to come together in planning workshops, allow in-progress research experiences to be shared, and to facilitate the movement of information generated by the project to appropriate end-users.

No doubt, such a project would have to be a multi-year effort and in some cases would require a considerable amount of manpower preparation prior to the actual launching of research activities. In addition to actual graduate training in social science that might be required in some cases, Project AIIM might appropriately include a series of "training workshops" for project participants that could include review of the existing literature on traditional irrigation systems and guided fieldwork at irrigation sites to develop techniques of observation and data gathering.

The information that we presently have on traditional irrigation systems in the Basin is largely the result of a few scattered and disparate social scientists who devote some relatively small portion of their total

time to this problem. It seems unlikely that that process will generate the volume of information that we require within a reasonable time period. Just as water needs management, in this case at least, it appears that our research efforts need some management. Something like Project AIIM seems attractive.

Of course, identifying and analyzing existing institutions/organizations is but a part of the total task. As mentioned above, two corollary activities are designing and testing irrigation institutions and organizations. While I will not elaborate on this point herein (see Coward [1974] for more extended comments), I do want to mention one important point.

The recently initiated pioneer projects represent a significant opportunity for institutional/organizational designing and testing. As planned, the pioneer projects will provide actual settings of irrigated agriculture in which both the technical and institutional/organizational aspects of irrigated agriculture (and the important interactions between the two) can be observed, altered and evaluated. Of course, if such institutional/organizational testing is to be a part of the pioneer projects, this objective needs to be made a part of the policy regarding the operation of these projects; a plan of action needs to be outlined and professional skills and other resources mobilized to perform the task. Here, there is real complementarity with the proposed Project AIIM, since out of Project AIIM one would develop both a more comprehensive inventory of possible institutional/organizational arrangements and a group of professionals intimately acquainted with such forms. This professional manpower would be instrumental in these designing and testing activities.

A Last Word

Any human organization intended to manage a water environment must cope with two very simple principles: water runs down hill, and water evaporates. Beyond those basic principles of physical action is the added social dimension that water does so (runs down hill and evaporates) in social settings that we refer to as the Khmer Republic, Laos, Thailand or South Vietnam. We have seen from the examples above that water running downhill in Bali has been treated differently than water running downhill in Ceylon or Tanzania. Such variation may also exist between, and within, the riparian nations of the Lower Mekong. Information concerning the form and function of these water-related institutions and organizations is an important requisite for the further development of irrigated agriculture in the Basin.

Traditional irrigation institutions and organizations do not provide "the" key to success in the Mekong Basin. There is no *a priori* assumption that local is good and extralocal is bad. But, neither is the opposite assumption assumed to be useful. Local institutions and organizations may prove to be unsuitable to either the changing conditions of society (as was the situation, in part, in Ceylon) or to the changing demands of "modern" water management. But such ideas need to be examined and tested and that can be done only if we are able to enhance the present state of our knowledge.

It is to that issue that this discussion has been directed.

FOOTNOTES

[1]Additional discussion on these points is presented in Coward (1973 and forthcoming).

[2]Detailed description and analysis of the subak are found in Geertz (1967), Liefrinck (1969) and Birkelbach (1973).

[3]For purposes of this discussion, I am simplifying the division of the fields. In addition to the upper, middle and lower sections there are sections referred to as end pieces which are assigned to individuals performing specific functions in the system. For the complete discussion, see Leach (1961).

[4]This section is based on some earlier ideas which are included in my summary report of the Mekong Development Seminar held at Cornell in March 1974 (Coward, 1974).

[5]A sensitivity to traditional institutions and organizations can extend beyond looking only at existing irrigation institutions/organizations. It may include examining other forms of joint agricultural activity for their relevance to the management of water. An example is provided in the work of a Ghanaian graduate student in agricultural engineering who is examining irrigation planning in the Lower Volta River area and has suggested that a traditional social grouping called the huza might be an appropriate water management unit. The huza is "a group of individuals, not necessarily linked by kinship, who pooled their resources in order to acquire large tracts of land for agricultural settlement (Nunyuie, 1974).

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