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ORGANIZATIONAL ASPECTS OF IMPROVED IRRIGATION MANAGEMENT: AN EXPERIMENT IN DEWAHUWA TANK, SRI LANKA

by

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FOREWORD

This report is one of several IIMI publications addressing the issue of irrigation management to promote diversified crops during the *dry* season. As Sri Lanka approaches self-sufficiency in rice production, a target already achieved by some other countries in the region, there is little logic in growing rice using land and water resources which could support higher- value non-rice crops, using less water. Thus, one of the incentives in improving irrigation management is to find ways of stretching water further during the dry season in water-deficit systems, when rice is relatively more expensive to grow than during the wet season, and when other crops which *can* be grown only during the *dry* season (when there is less danger of water-logging) offer the farmer and the country a comparative advantage.

IIMI's research interest in Dewahuwa Tank was prompted by the existing widespread adoption of non-rice crops during the yala season. By studying a case of diversified cropping "success," IIMI hoped to better understand the irrigation-management factors underlying that success, and if possible, to improve on them. After three seasons of research (yala 1985, maha 1985/86, and yala 1986) to document existing practices, a decision was taken, along with the two agencies concerned (the Irrigation Department and the Irrigation Management Division) to attempt an operational intervention during the 1987 yala, aimed at improving the efficient use of water in the system. This report presents one important component of the 1987 experiment: the organizational aspects of the new rotational plan which was introduced.

The basic management principle underlying the yala 1987 operational research in Dewahuwa was information feedback to farmers and project officials, and between farmers and project officials. The information included measurements of water flow and duration, deviations from the intended pattern, and the attitudes and reactions of farmers and farmer representatives. The fora introduced to allow feedback and discussion of this information on irrigation-management performance were post-issue meetings involving farmer representatives, the project manager, the technical assistant, and IIMI research assistants to discuss the previous issue, and plan the next issue. These meetings were supplementary to Tract Committee and Project Committee meetings which also brought together farmer representatives and the project management on a regular basis.

The innovation of regular meetings, while a minor step in itself, has significant implications for the way in which irrigation systems are managed, and in particular, the management participation of farmers. The report documents the experience of the 1987 yala season and draws some preliminary conclusions as to the management role which farmers could play in the future.

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This report documents part of an operational experiment in Dewahuwa Tank during the 1987 yala (dry season). The experiment, or "action research," was conducted by IIMI in cooperation with the Irrigation Department and the Irrigation Management Division. The experiment was the outgrowth of studies which focused on constraints to cultivation of non-rice crops during the *dry* season. Careful monitoring of irrigation and cropping patterns in selected areas of the system conducted from yala 1985 had documented three important constraints to diversified cropping:
1) inadequate water control at the secondary and tertiary levels of the system, 2) lack of organization for water sharing from the secondary level downwards, and 3) poor communication between farmers and agency staff regarding water-delivery schedules (Miranda 1989; Panabokke 1989).

Rationale and Objectives

The research carried out during the 1987 yala was an "action study," designed to influence and monitor a new pattern of water rotations which farmers and agency staff jointly decided on, prior to each issue. The objective of introducing a new rotational plan was to pilot-test possible improvements in irrigation management that can save water, increase total cropped area, and improve the overall productivity of non-rice crops.

The more specific objective of this report is to present the organizational aspects of the new rotational plan. Documentation of water use and the physical performance of the system will be presented in a later report outlining the experiment as a whole. Moragoda and Groenfeldt (1990) provide a comparable analysis of a nearby irrigation system during yala 1987.

Background

The ancient tank of Dewahuwa, which dates back to the 3rd century A.D. had been abandoned for centuries. It was reconstructed in the 1950s and farmers from the reservoir area, from surrounding villages, and from more distant regions were allotted 2-hectare (ha) parcels of irrigated land and 1.2-ha "highland" plots near the command area. By 1970, the new system had fallen into a state of disrepair and was rehabilitated under a Japanese aid project. Today the designed command area of 944 ha has expanded to 1215 ha through unauthorized encroachments. The original families who were allotted land have subdivided and many of the second and third generations rely on rain-fed agriculture outside the scheme supplemented by off-farm employment. Land tenure is fluid, with more than half the operators farming land which they do not *own.* Some non-owners are family members who may someday inherit the land they now lease; others who are classified as owners have taken mortgages and are actually tenants on their own land. Hidden tenancies are common, because land transfers through either lease or sale are prohibited by law.

The scheme comprises a large tank with a single main *canal* from which distributary channels take off on one side to serve the command area. The highland residential area extends along the right side of the canal. At each take-off point from the main channel to a distributary, or from a distributary to a field channel is a turnout gate. It is the responsibility of the Irrigation Department to open or close the turnout gates. Distribution of water below the turnout which may serve between 1 and 15 allotments (or up to *50* operators) is the responsibility of the farmers themselves. The system is divided hydrologically into 9 tracts which correspond roughly to the major distributaries (see Map 1).

The nine tracts are represented in three "tract committee" organizations: tracts 1-4, tracts 5-7[1] and tracts 8-9. Farmer representatives play important roles in irrigation management at the tract level primarily because the project manager supervises them quite closely. Below the level of these multi-tract committees, however, there is no formal organization other than that of the farmer representatives who number 28 in the scheme. While the farmers who cultivate within the area of one farmer representative are said to constitute a "turnout group" there is no practical organization within this "group," Indeed, using the term "group" is a source of confusion in understanding how water management is actually carried out. Farmers do not normally practice formal rotations within the area of one farmer representative.[2] An exception is field channel F1 of tract 3 the capacity of which is not sufficient to provide water for all the allotments at a time. The management value of the farmer representative was in passing information up the line from farmers to project management (at tract-committee and project-committee meetings) and vice versa.

In the operational experiment introduced during yala 1987 both the role of the farmer representative and the management practices of farmers within a "turnout group" changed significantly. For the first time farmer representatives were given responsibility for the turnout gates within their area (whether direct issues from the distributary or turnouts to field channels). In some cases they were also given responsibility for carrying out rotations within the field channel.

Research Methodology

The research "methodology" which might be more accurately termed a "strategy" involved: 1) collecting specific data from a sample of farmers, their fields, and the channels serving them; 2) identifying problems of water distribution at the secondary and tertiary levels; 3) formulating a new rotational plan to overcome these problems; 4) monitoring water use and the

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[1] Although Tracts 1-7 officially comprise two "tract committees" (tracts 1-4 and tracts 5-7) the two hold joint meetings and for all practical purposes comprise a single tract committee.

[2] Farmers' water-distribution practices during the 1986 yala season are documented in Ekanayake and Groenfeldt (1987).

reactions of farmers, farmer representatives, and agency staff; and 5) analyzing the results.

Because the 1987 yala was an unusually water-scarce season only 20 percent of the command area was slated for irrigation on a bethma[3] basis. The upper three tracts (tracts 1-3, but not all of tract 3) were included in the bethma. All bethma partners were allocated 1-acre (0.4-hectare) plots within these tracts, if they owned a full 5-acre (2-hectare) allotment. If their legal holding was less than the full allotment (which is now possible, since land divisions among offspring are being recognized) their bethma portion would also be correspondingly less.

Sample selection. Because of the complexity of tract 3, which is served by two long secondaries with equally long tertiaries it was decided to focus the study on this area. Although tract 3 comprised 73 of the 96 allotments in the bethma, this did not narrow down the sample very far. Of the 73 allotments in tract 3, 9 were used as a control (served by the same tertiary) where data were collected but no intervention was made in terms of irrigation management. The remaining 64 allotments were sampled on the basis of every second or every third allotment, depending upon the judgement of the technical scientists on the team who were concerned with micro-variations in canal, soil, and crop conditions. In each sample allotment, the first and second farmers to begin cultivation were selected for the sample. In six of the selected allotments, all cultivators were included in the sample in order to study intra-allotment water distribution. The sample consisted of 107 farmers and 112 plots.

[3]Under bethma, the portions of the command area which are irrigated (generally a contiguous block) are divided equally among all farmers in the system, for that season only.

SEASONAL PLAN FOR IRRIGATION MANAGEMENT

A kanna (season of rice cultivation) meeting was held on 9 April 1987 when the tank capacity was only 22 percent of full supply level (FSL), with the water level at 13.5 feet (4.1 meters). Farmers were dubious of cultivating a yala with such a limited water supply, but they could cultivate a small extent as they did the previous yala. Some owners who had mortgaged their lands were able to recover them by cultivating during yala.[4] Tail enders were interested in cultivating a yala, since some of them could sell their bethma right for up to Rs 1000 (US$32.50) per *acre* (0.4 ha).

Apart from the anticipated income from a yala cultivation, farmers were also responding to newly introduced credit sources, such as the Regional Branch of the Central Bank, Red Barna, and the Co-operative Credit Relief Society. The loan utilization from formal sources was significantly higher during the 1987 yala than during the previous yala season, and this credit availability prompted some farmers to cultivate rather than avoiding the risk altogether and renting out. However, to minimize the risks most farmers selected low-input crops such as soya and green gram.

Bethma Area

The Irrigation Department anticipated that an area of only 500 acres (202 ha) could be cultivated with the existing water storage capacity of the tank. At the kanna meeting tracts 1, 2, and 3 were recommended for cultivation. Tract 3 covers an area of more than 500 acres (202 ha) and includes several long field channels that have difficulty in obtaining water. The final selection excluded certain parts of tract 3 from bethma cultivation. This particular issue was discussed with the farmer representatives during tract-committee meetings before it was presented at the kanna meeting.

Farmers in the tail-end tracts were reluctant to cultivate in tract 3; they preferred to cultivate their *own* tracts or adjacent tracts such as tract 4, 5, and 6. Others preferred the area close to or along the main channel where water could be obtained relatively easily. However, farmers who intended to cultivate with drainage water preferred that their respective allotments not be included in the bethma.

The area initially selected for bethma in tract 3 was D1 (head end), FC1, FC4, FC5 and D2.[5] At the committee meeting the farmers suggested omitting the FC4 area and including the FC3 area, as they considered this latter area more

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[4] In Dewahuwa, land is mortgaged for the maha (wet season) only; the yala is not considered in the contract.

[5] "D1" refers to distributary number one; "FC" means field channel. See Map 1.

suitable for non-rice crops. The suggestion was accepted and implemented. Only three allotments and two direct issues were selected from the FC5 area in order to adjust the total bethma extent.

No attempt was made to avoid the heavy, poorly drained soils of D1 head end and FC1, although this area was known to he unsuitable for non-rice crops. It was anticipated that even if these areas were omitted from the bethma area, illicit cultivation would take place *anyway,* since water would pass by the fields and could be stolen easily. Furthermore, the upper portions of some of the allotments contain well-drained soils.

The bethma area is divided according to the "bethma list" with one 5-acre (2-ha) allotment shared by five farmers. The bethma command area was also defined on the basis of soil type, and in some cases allotments were split between a bethma and non-bethma portion. In addition, certain 4-acre (1.6-ha) allotments were shared by 4 farmers. Farmer representatives in the bethma area received one extra bethma division (i.e., a second acre) in lieu of any other payment for their services. Division of the bethma area was expected to be made cooperatively among the "guest" and "host" farmers with assistance from the farmer representatives, cultivation officer, and the oolonization officer. Land not included in the "bethma list" would have no rights to irrigation water.

Cultivation Plans and Water Issues

The agricultural extension officers promoted the cultivation of soya, green gram, cowpea, black gram, and groundnut. For fields adjacent to drainage channels, onion was recommended, since additional water could be extracted by pumping. Chili was implicitly discouraged by the short duration of the irrigation season. At the kanna meeting, the agricultural officers asked farmers to grow non-rice crops even in the poorly drained land by preparing the land carefully. But from the farmers' point of view, waterlogging cannot be avoided in *some* areas where excess water flows from higher land and from seepage. In these areas rice is the only feasible crop.

The decision of the kanna meeting was to give the first water issue on 1 May. Land preparation was expected to be completed by 10 May, with water rotations. The last date of the water issue was scheduled for 31 July. Rotational issues would be 2 days of water flow on a 10-day cycle, with a total of 10 such rotations. An extra water issue could only be made when more than 25 percent of the farmers in the command area requested it. A charge of Rs 60 (US$1.95) per acre (0.4 ha) would be levied.

Operation and Maintenance Plans

Channel cleaning. The kanna-meeting decision was for farmers to clean their field channels twice during the season. The last dates for cleaning were 20 April and 10 June. Cleaning would be carried out cooperatively on a day agreed to by the farmers from each field channel. Farmers who failed to come on the designated day would be fined Rs 30 (US$0.97), with the payment going towards

hired labor. If more than 75 percent of a field channel is not cleaned, water would not be issued to that turnout.

Water taming. Taking water directly from the channel other than through the pipe outlet would be punishable by a fine of Rs 150 (US$4.87). The pattern of water rotation would be announced by the farmer representatives, and those disregarding the rotation would be fined Rs 100 (US$3.25) per turn.

PLAN IMPLEMENTATION

Bethma division, by definition, entails a division of land and water, and by implication, crops. Thus, the usual arrangements for sharing a common resource (water) are further strained, as land enters the calculation. This was the case during the 1987 yala because a very small portion of the land was included in the bethma area (although this created a situation of theoretical water surplus for that area). This section outlines some of the basic features of land and water sharing and crop decisions.

Land

Land tenure, The 112 sample farm plots were cultivated by 107 operators during yala 1987, Many of the operators were lessees; only 62 owned irrigated land in Dewahuwa. Bethma portions were given to original allottees only during the 1987 yala, although provision had been made to grant legal access to a maximum of three family members of original allottees, In practice, the number of family members sharing one allotment during the maha season may go up to eight. The same practice also occurred in the bethma divisions, but since these were limited to one acre (0.4 ha) each, farmers resorted to various methods to divide the land: 1) the entire acre was cultivated by one family meinber with the agreement of the others (some payment was often involved); 2) the one-acre portion was shared by the legal owners (a legal maximum of three); 3) the one-acre portion was cultivated by all family members together (the maximum number observed was 5); 4) one family member cultivates the bethma portion while others cultivate the non-bethma area or lease a second bethma portion; or 5) the bethma portion is leased to a non-family member.

The size of bethma farm plots ranged from 0.25 to 2.0 acres (0.1 to 0.8 ha), with one exception. About 71 percent of the Sample plots were one acre (0.4 ha) each; 18 percent were less than one acre each and 11 percent were more than one acre each. Cases of cultivating more than one bethma-acre occurred when an owner farmer leased an adjoining bethma portion from the bethma partner. Another situation was that a single lessee cultivator rented more than one bethma portion, or one full portion plus half of another, as a unit. A third situation occurred where an Owner farmer claimed the right to cultivate not only his one-acre portion, but also any additional encroached land by which his five-acre allotment exceeded the standard size, sometimes by one or one and a half acres.

The size of a cultivated plot is partly determined by the tenure status of the farmer, as is seen in Table 1. In general, family tenure is associated with smaller plots, since there is a tendency for a nwnber of family members to share a single plot.

Table 1. Distribution of the land extent by tenurial arrangements.

	Less than 1 acre	Greater than 1 acre
Original Owners	07	18
Leased	01	39
Ande (share tenancy)	01	03
Partnership with the owner	-	03
Partnership with the lessee	-	03
Ande to lessee	-	02
Family tenure	11	23
As salary for a farmer representative	-	01
Total	20	92

Only seven sample households had access to irrigated land outside the Dewahuwa scheme. The maximum owned was 3.0 acres (1.2 ha). The 107 sample households cultivated a total of 110 acres (44.5 'ha) in the 112 plots. The maximum area cultivated by a single household, including land outside the scheme and irrigated non-bethma area was 10 acres (4 ha). Irrigated land cultivated by a sample household outside the bethma area included 4.5 acres (1.8 ha) within Dewahuwa, and 3 acres (1.2 ha) outside the scheme. Sixty percent of the irrigated area cultivated by sample households comprise non-owner cultivation rented under various tenure terms including family tenure. The total irrigated area cultivated by the 107 householders was 191 acres (77 ha) including land outside the scheme.

One of the major constraints to adhering to the water-management plan was cultivation outside the prescribed bethma area. With unplanned fields (and farmers) seeking water changes in water deliveries were inevitable. In addition to the official bethma area of 500 acres (202 ha) there were another 140 acres (56.6 ha) cultivatedby farmers outside the bethma area, particularly in tracts 3 (10 acres) and 4 (70 acres). Water distribution within the official bethma area in tract 3 was affected, since farmers allowed water to flow into the drainage in order to pump it out into these extra areas. Some locks on the field-channel gates were also broken by these farmers, so they could irrigate at night. The farmers asked their relatives within the bethma area to allow the water into the drainage channels by keeping their respective outlets open longer than necessary for the bethma area. This practice caused problems for tail enders along the affected field channels within the bethma area. In at least one instance, a farmer representative within the bethma area deliberately sent water into the non-bethma area where his relatives were cultivating.

A land market existed within the non-bethma area; land was leased at prices ranging from Rs 200 to 300 (US$6.5 to 9.5), or about one-half to one-third the rate for leasing irrigated bethma lands. Some farmers leased their bethma lands at a higher price in order to cultivate their *own* non-bethma lands. Rain-fed cultivation was also practiced in these areas. Tobacco, a favored crop requiring little water was prohibited within the bethma area. Other rain-fed crops included soya, green gram, black gram and chili.

In general, the non-bethma areas were cultivated by families who had access to bethma lands. However, the bethma allocation for each farmer (one acre [0.4 ha]) was so small that in those cases where the legally *owned* land was already divided among two or three family members, one member was sometimes given cultivation rights to the entire acre while the other members cultivated in the non-bethma area.

In response to the widespread illegal cultivation in non-bethma areas, the project manager decided to destroy the crops. The rationale for this action was that the non-bethma farmers interrupted the water-distribution schedules and took water intended for the bethma area. Because of political intervention, however, the project manager only threatened to fine the illegal cultivators. In the end, however, no fines were ever collected.

Problems in bethma division. The colonization officer who was responsible for allotting bethma land reported that 35 disputes were presented to him during the course of this season. The most common type of complaint lodged by bethma farmers was the owner attempting to cultivate a larger section than authorized. In some cases owners had leased a portion greater than the single *acre* they were legally entitled to cultivate. In general, however, bethma division was handled smoothly. An unwritten rule permits the Owner farmer to have first choice in selecting a section of land. Usually, the preferred land plot was defined both by the soil type (light soils are preferred for growing other field crop) and the location of the water inlet.

The official procedure followed in allotting bethma land was to divide it according to a list of bethma allotments and partner numbers in what is called the "bethma list." At the kanna meeting dates were fixed to divide each allotment and the respective partners were requested to be present. In practice a few were present on the prescribed date, In some cases the rightful bethma partner was represented by a lessee, If the division had not been made by the time the owner was *ready* for his cultivation activities, he demarcated a section for himself and left the rest for others to share. Some farmers who started cultivation late in the season were unaware of how the land had been divided, This category of bethma farmers included those who replaced the ones who quit cultivation after having prepared their fields. Division of the land perpendicular to the channel was encouraged by the officers so that different types of soils in the allotment would also be shared.

Of the 112 sample farm plots 28 were in the owner section and 79 in the bethma section. The remaining five plots were made up of parts from both sections. This happened when Owner farmers rented the bethma section by paying for the bethma right. The following table summarizes the responses of farmers to questions on how bethma land was divided.

Table 2. How bethma land was divided (based on farmer responses).

	%
The owner	25
The owner and bethma partner.	10
The owner and other cultivators	46
The owner and other cultivators A third party (or cultivation officer)	5
Do not know	14
Total	100

Water

Maintenance, The Irrigation Department normally undertakes maintenance work before the start of each cultivation season.. This work includes cleaning of the main canal and structural repairs in the distributaries and field channels, At the project-committee meeting on the day prior to the first water issue (*May* 9), farmer representatives criticized the Irrigation Department for not carrying out necessary repairs. The senior technical assistant (TA) had not been available during much of the pre-season period, as he had been called off for other duties and the junior TA who had been appointed as a temporary replacement had not been able to complete the repairs. The senior TA who was present at the project-committee meeting promised to make some temporary arrangements. Rather than using departmental maintenance funds, the TA suggested carrying out necessary maintenance with the labor available from among the Irrigation Department field staff attached to this scheme (e.g., irrigation laborers). For small structural repairs such as turnout gate locks, the TA suggested employing local blacksmiths.

Under this arrangement the repairs were implemented over a period of one month. In the meantime many of the gates had to be operated without locks. At the request of the International Irrigation Management Institute (IIMI), extra finances were allocated from the Irrigation Management Division (IMD) budget to carry out some of the major repairs such as replacing broken turnout gates. This work did not commence until after the start of the season and was completed by the end of June, A total of Rs 27,000 (US$877) was allocated from the IMD budget from which two field channel (FC) gates, 3 pipe outlets and some bend-filling work were done. A number of other minor repairs were also made utilizing the Operation and Management (O&M) funds (farmers' O&M fees).

During the course of the season farmers removed some of these gates and damaged others. In the tail-end area (in FC5 and 4) two padlocks were removed. In addition, some of the cement allocated for maintenance work appears to have been diverted to private use with the connivance of farmers. According to the farmer representative of FC3 he did not have control over the irrigation work although he was responsible for this area.

O&M functions of farmers. At the kanna meeting a decision was taken to clean all irrigation channels twice during the season and 20 April and 10 June were set as deadlines. By the time of the first water issue on 10 May, only about 5 percent of the channels had been cleaned. At a meeting on 19 May, the project manager threatened to stop water issues until the channels were cleaned and following this farmer representatives met individually with farmers and encouraged them to clean their channels. Because it was difficult to locate the bethma partners, the farmer representatives interacted primarily with the owner farmers. By the time of the second water issue about 60 percent of field channels had been cleaned. In some cases, farmer representatives themselves cleaned portions of the field channel that no farmer had attended to, on the understanding of the project manager that they would receive payment for the cleaning work upon collection of fines from the defaulting farmers.

Cooperative channel cleaning. Although cooperative (shramadana) channel cleaning was specified in the kanna meeting agreement, in practice, all field channel cleaning was done individually. At the level of the distributary, however, cooperative cleaning was carried out through arrangements made at tract-committee meetings. On the specified day, about 100 farmers, including a number of bethma farmers from tail-end tracts, turned up. However, they arrived at various times during the morning and some left before others arrived, Thus the total number was not present at any given time. On instructions from the project manager, 14-foot sections of the distributary were marked out by the farmer representatives. Some farmers cleaned their respective sections within half an hour; others returned to their homes without doing *any* cleaning, because most of the time was spent on discussing how to proceed with the work.

Fines. Although the kanna meeting set a fine of Rs 150 (US$4.87) for any farmer taking water from a source other than the prescribed outlet (e.g., by breaking the channel), no fines were actually imposed inspite of the rule being breached in a number of occasions. In some cases, fanner representatives or irrigation officers or both closed breaches in the channel only to have fanners reopen them shortly thereafter.

The kanna meeting also set fines for taking water from the correct source but at the wrong time, i.e., for not following the planned rotational schedule, The fine was set at Rs 100 (US$3.25) per turn. No fines were actually imposed, although many violations of the rule were observed. Some cases were also discussed at the tract-committee meetings, The only fine recorded for the yala 1987 season other than for uncleaned channels was a single instance of a Rs 125- (US$4.06) fine imposed on a farmer for damaging an irrigation structure. This occurred in the middle of the season when a lessee farmer in tract 3 broke the gate lock on the turnout gate for FC1. Similar incidents were also observed in FC4, T2 and FC5 but no fines were collected.

Extra water issue. At the kanna meeting, provision was made for an extra water issue at the *end* of this season upon payment from requesting farmers. The fee was set at Rs 60 (US$1.95) per acre (0.4 ha). An extra water issue (Issue No. 10) was made from 3rd to 6th September, but the fee was reduced to Rs 40 (US$1.30). The farmers requesting the extra issue were not in a contiguous area, but scattered throughout the entire command area. Since there was no mechanism for limiting water distribution to those who had requested it, the entire area

was irrigated, though only a few farmers paid for it. Water was requested for 82 acres (33.2 ha), but the payment was collected for only 58 acres (23.5 ha).

Crops

The selection of crops was an evolving process beginning prior to the allocation of bethma lands and continuing into the season. Of the 112 sample farmers 62 percent decided on their crop only after the bethma divisions were made. Another 7 percent had decided before this time and 18 percent waited until they had actually seen the bethma plots allotted to them before making their decision. The remainder (12 percent) selected their crops sometime after the start of the season.

The timing of the decision itself influenced the outcome as those who decided very early, prior to the start of the season, had already committed financing to the selected crop. For instance, chili cultivators needed to begin land and nursery preparations quite early. Farmers who leased land tended to select a particular crop first and then try to find land suitable for the cultivation of that crop. However, the market for well-drained land was rather tight, since these are the most suitable to cultivate other field crops (OFCs). Thus, some lessee farmers were forced to grow rice, even though they had intended to grow OFCs.

Another factor that influenced crop selection among Owner cultivators was the land that they were allocated under the bethma arrangements. If the land was not suitable for the crop they had intended to grow, they were forced to switch to another crop. For example, if their bethma plot was waterlogged, as happened in several cases, they had no choice but to cultivate rice. Other factors which influenced crop selection by farmers included the distance from their homes to the bethma field, availability of household labor, promotion of the crop by agricultural officers, experience in cultivating OFCs during the previous yala seasons, and anticipated chena cultivation for the following maha.

From the farmers' point of view, the easiest OFC to cultivate is soya, which needs few inputs, little care, and little water, and is harvested only once. Both soya and black gram are grown in chena areas during maha. Some farmers cultivate these crops under irrigated yala conditions in order to provide seeds for maha rain-fed cultivation. One reason Dewahuwa farmers have often cultivated soya is market reliability both from private traders and from the Oil and Fats Corporation. In addition, loan facilities were available for soya (e.g., credit schemes of the regional branch of the Central Bank).

Some farmers who had decided to grow soya changed their decision in favor of green gram which is not as sensitive to excess rain in the early stages of the crop. Black gram is just as easy to cultivate as soya but the market is not as reliable. Green gram is preferred by many farmers because of its relative profitabilityandshort-growth duration. However it is also relatively expensive to grow, both because of the cost of chemical pesticides, and because it requires two or three different harvests.

Chili is the most expensive of the crops cultivated in Dewahuwa, but it is also the most profitable. In general it is largely cultivated by relatively well-off farmers. Others cultivate small patches. Those who intended to grow chili began their cultivation early in the season. Cultivation of onion was done primarily by a few wealthy farmers who had ties with the extension officers.

A new crop which became popular during the yala season was a variety of pumpkin called batana, This is a short-duration crop requiring little water and producing a good yield. Many farmers grew batana as a supplementary crop, and farmers in the non-bethma area adjacent to tract 3 showed a particular liking for this crop as they could irrigate from the drainage channel. Irrigation was done both by pump and by bucket, using water either from the drains during the water rotation or from the main canal after the sluice was closed. A one-acre plot of pumpkin cultivated at a cost about
Rs 2000 (US$65.00) yielded a profit of about Rs 15,000 (US$487.50).

The weather pattern was a major factor influencing farmers' crop decisions. Early rains at the start of the season damaged some of the soya crop, and induced farmers to sow a new crop of green gram or black gram. Other farmers elected to replant the soya, in some cases replanting three times, rather than switch to another crop. A few farmers gave up their attempts to cultivate soya and abandoned their fields, while still other farmers planted pumpkin at a later stage in the season. Six sample farmers abandoned their cultivation (6 acres [2.4 ha]) entirely.

Some green gram cultivations *came* under a virus attack in the middle of the season. Because of the short duration of pumpkin, some farmers switched to pumpkin from green *gram;* others turned to black *gram.* Cases of crop abandonment are not reflected in the sample, as questions were asked only about the crop currently being grown. Most farmers (77 percent) cultivated only one crop. A minority (23percent) cultivated two crops, and only one sample farmer cultivated three crops, Farmers' reasons for selecting a particular crop are given in Table 3.

Table 3. Cropping pattern of sample farmers, Dewahuwa, yala 1987.

Table 3 (a). Reasons for selecting the first crop.

	BG	BO	CH	CW	GG	RC	SQ	SY	Total
Requires little cash outlay								7	7
Requires little attention					1			18	19
Yields high income		2	7		6			3	18
Tolerant of excessive rain	2				1				3
Heavy soils						13			13
Easy to harvest					1			2	3
Promoted by agri. officers								3	3
Short duration				1	10		1	3	15
Low water requirement	1								1
Prior experience with crop	4				5			8	17
Bethma partner growing same crop					2			2	4
Needs seeds for chena								3	3
Pest/disease resistance								6	6
Total	7	2	7	1	26	13	1	55	112

Table 3 (b). Reasons for selecting the second crop.

	BG	BO	CH	GG	RC	SQ	SY	Total
Requires little cash outlay	-	-	-	-	-	-	-	0
Requires little attention	-	-	-	-	-	1	2	3
Yields high income	-	1	2	1	-	2	-	6
Tolerant of excessive rain	-	4	-	1	-	-	-	5
Heavy soils	1	-	-	1	-	-	-	1
Easy to harvest	-	-	-	-	-	3	-	4
Promoted by agri. officers	-	-	-	-	-	1	-	1
Short duration	-	-	-	1	-	-	-	1
Low water requirement	-	-	-	1	-	-	-	1
Prior experience with crop	-	-	-	-	-	-	3	3
Bethma partner growing same crop	1	-	-	-	-	-	-	1
Needs seeds for chena	-	-	-	-	-	-	-	0
Pest/disease resistance	-	-	-	-	-	-	-	0
Total	2	5	2	5	-	7	5	26

Note: BG : Black gram
BO : B Onion
CH : Chili
CW = Cowpea
GG : Green gram
RC : Rice
SQ = Square pumking variety
SY = soya

Changes in the Cultivation Calendar

The first water issue of the season on 10 May was intended to be the start of land preparation, with water delivered on a continuous basis for a ten-day period. Because of early rains however, irrigation water was not needed, and the first water issue was stopped after only two days. Farmers could not be informed of this decision immediately. Farmer representatives were informed of the changed schedule at the tract-committee meetings.

The early rains washed out some of the newly planted crops, and in some cases farmers replanted two or even three times. Some farmers changed their crops at this point; for example, a switch from soya to green gram was relatively common. Other farmers retained their original crop but delayed the second planting for some time, thus adding to the total length of their growing season.

In addition to the early rains, other factors also influenced farmers' starting dates, Of the sample farmers, 39 percent began land preparation only after the first water issue, in spite of the fact that most sample farmers (78 percent) were growing crops other than rice. Table 4 summarizes the reasons for postponing land preparation until after the first water issue.

Table 4. Reasons for delaying land preparation for the major crops grown.*

	BG	BO	CH	CW	GG	RC	SQ	SY	TOTAL
Leased the land at a late date	1		1		3			6	11
Rain	1		2	1	3	1	2	6	16
Cultivating other plots					1			1	2
Financial problems					1				1
Family disputes			1		1			2	4
Other occupations								1	1
Insufficient water to plough						6		3	9
Total	2		4	1	9	7	2	19	44

* Table refers to the 44 sample farmers of the total 107, who delayed cultivation, See Note of Table 3 for crops,

Late leasing of land occurred because *many* lessee farmers were looking for land suitable for cultivating OFCs (food crops other than rice). The lengthy process of negotiating with the owner(s) resulted in delayed cultivation. In other cases, bethma farmers gave up cultivation following a loss of crop with the heavy rains, and then decided to lease the land, A few farmers leased the land after having planted a successful crop. All rice cultivators waited until the first water issue before preparing their land. This is a common practice, although not a necessary one. In addition, a few farmers who cultivated OFCs, also preferred to wait until water issues began before preparing their land.

For other farmers the problem was too much water. Since most farmers preferred to cultivate OFCs, and since many of the soils were poorly drained, they were forced to wait until the soils dried up sufficiently for planting.

Although the last water issue was scheduled for 31 July (Issue 8), an additional water issue was made in mid-August (Issue 9). An optional water issue (Issue 10) was then provided during the first week of September, upon payment from the farmers requesting it. Thus, the cultivation season was extended by more than a month beyond the original plan.

NEW PLAN FOR WATER ROTATION

Water rotations within D1 began with the second water issue, and followed a pattern of giving water to the head *end* of the distributary first, and the tail-end turnouts second. This continued until the fourth issue when widespread disregard of 'the rotational pattern by head enders was reported. Some direct-issue allotments remained open throughout the water issue, while others were opened and closed regularly. At the suggestion of IIMI staff, the rotational pattern was changed from the 5th issue onwards to give water to the tail-end area of D1 first, and the head end second. This new pattern continued till the *end* of the season with the exception of the last (10th) rotation when water was issued on request to particular groups of farmers.

In preparation for active involvement in water management during the yala season, IIMI had asked the Irrigation Management Division to repair and replace certain structures in the sample distributary (D1) at the beginning of the season. "his was to ensure that the physical operation of the system would provide a valid test of the management plan to be introduced. During the kanna meeting and the first issues of the season, IIMI staff played an observational role, while the project manager and the technical assistant took their normal irrigation decisions without direct IIMI influence.

With the start of the 4th water issue IIMI staff sought to influence the management of the system by presenting feedback data on actual water deliveries following each rotation. "he information was discussed in meetings of project officers, IIMI research officers, and farmer representatives and the plan for the upcoming water issue was decided.

Feedback on Water Measurements

The set of water measurements in the sample distributary included twice-daily readings at the distributary gate, twice-daily readings at each turnout, and readings at 33 sample allotments. *Of* these measurements, the readings from the distributary gates and the turnout gates were analyzed within a few days following each water issue, and then presented to the project officers (project manager and technical assistant) and at group meetings with farmer representatives (either special meetings or regularly scheduled tract- or project-camnittee meetings).

Since the measurements were presented in terms of total water depth delivered over each turnout area comparisons between turnouts was simply a matter of comparing numbers. In this way, turnouts receiving more or less water than planned could be quickly identified and discussion stimulated regarding the cause for the discrepancy. Farmer representatives who were present at all these meetings could then explain the water use.

The water measurements showed consistent oversupply in D2 and FC2 in D1. The oversupply in D2 prompted the technical assistant to make a night- time

investigation in the area where he found that farmers were deliberately allowing water to flow into the drainage channel so that farmers downstream cultivating non-bethma areas of tract 4 could have access to water intended for the bethma area of tract 3. In D1, FC2, the project manager identified the reason for oversupply as an ineffective farmer representative. The turnout gate under the responsibility of the farmer representative was being opened at night by farmers in violation of the rotational schedule.

At the same time several other turnouts were consistently under-supplied. The head end of D1, Fcl, which irrigates predominantly heavy soils was found to be using very little water and the tail-end field channel (FC3), although receiving an adequate supply at the turnout gate, was not delivering adequate supplies to the turnout allotments. The supplies were being interrupted by head-end farmers within the field channel.

Observations on Water Use

In addition to feedback on water measurements IIMI research officers also reported on problems voiced by farmers or observed in the field, One particular set of problems which was somewhat unique to this season was the lack of personal relationships among the farmers within a turnout area. Because of the unusually small proportion of command area irrigated during the 1987 yala there were *many* more farmers cultivating a given land unit than was the case in most other bethma seasons. Some of these farmers were bethma partners from outside tracts and others were lessees from outside the scheme *(see* discussion above).

To build cooperation among this diverse group of farmers the project manager attempted to introduce turnout-level meetings. Two such meetings were held, one for FC3, and the other for the head-end allotments of D1. Participation was poor, with 15 farmers attending from Fc3 and 10 from D1 (head). The project manager was the only officer present.

At the allotment level cooperation among farmers was problematic with an average of 5.4 farmers per allotment. The normal yala average is about three farmers per allotment. For water distribution within the allotment the project manager had suggested six-hour rotations to be implemented with the help of the farmer representative. However, in no case was this actually implemented. Farmer representatives pointed out that the water requirements of each allotment, and often within allotments were different, and furthermore, a water rotation within the allotment would require too much attention from the farmer representative.

Although the project manager had hoped that the tract-committee president (whowas the farmer representative within D1, FC2) would play a coordinating role among the other farmer representatives this role did not emerge. With the exception of one dynamic farmer representative from FC3, others for the most part did not serve as leaders for their turnouts although they were generally effective in controlling their respective turnout gates. One technical constraint to the coordinating role of the farmer representative was the lack of locks for the turnout gates. In two turnouts (T2 and T4) water flowed almost continuously because of broken locks.

Special Meetings

In addition to the regularly scheduled tract-committee and project-committee meetings several other meetings took place during the 1987 yala season, Foremost among these were the pre-water-issue meetings called by the project manager. Participants normally included the technical assistants from the bethma area, and later in the season, IIMI research officers. The first of these meetings held under a tree near the offtake to the D1, tract 3 distributary, was called on 9 May to discuss maintenance needs before the water issue (see below). Because of the success of this first meeting the project manager decided to organize such meetings on a regular basis, between water issues. IIMI staff also encouraged him in this regard, as these meetings provided a useful forum to discuss the water measurements recorded from the previous issue. These meetings were not normally held if a tract- committee or a project-committee meeting was scheduled at about the same time. A total of eight such meetings "under the tree" were held during the season,

The first meeting, held on May 9, one day prior to the first water issue, concerned maintenance needs for the channels and structures and the *new* responsibilities given to farmer representatives in water distribution including responsibility for the turnout gate and overseeing rotations within some of the field channels (e.g., FC1). The project manager encouraged the farmer representatives to reduce flows to those field channels where farmers had not yet cleaned their sections. Details of the rotation system within FC1 were outlined at this meeting and all six farmer representatives present (from tract 1-2, D1 head, FC1, FC2, FC3, and D2) contributed to the discussion. The group decided to divide the 11 outlets of FC1 into two sections in order to rotate water: six right side outlets and five left side outlets, with the rotation split between these two groups. Unfortunately, the farmer representative responsible for carrying out the rotation was unable to enforce it effectively,

The second meeting "under the tree" was held on 3 June, just after the second water issue. Discussion turned to a review of the first water issue (which was cut short to two days because of rain), and this established a feature of these meetings that continued throughout the season: they became a review of the previous water issue, as well as a time for planning the next issue. For example, at the second meeting, the technical assistant discussed with the farmer representatives the adequacy of water released in the first issue and the project manager suggested that farmer representatives take over certain functions from the Irrigation Department irrigator, such as operating turnout gates and overseeing water distribution within the field channel.

The third meeting took place on 10 June, a day before the third water issue. The fourth meeting was held on 19 June, two days before the fourth water issue, A project-committee meeting was also held on this day at which the dates of the next water issue were advanced and a decision was taken to issue water on 10-day cycles tilk the end of July. Farmer representatives were asked to publicize the new water-issue dates. Problems of operating the new turnout gates that had been fixed by the technical assistant were also discussed. It was decided to make any repairs or adjustments to these gates using funds from the O&M fee collection. Farmer representatives from the tail-end turnouts (turnouts FC2 and FC3) asked that water be issued to the tail end first and the head end second.

However, no action could be taken as the technical assistant was not present. The IIMI research officers who were present explained what their research involved, and discussed the need for cooperation among farmers and between farmers and farmer representatives.

The next "under the tree" meeting took place on 1 July, one day prior to the 5th water issue. At this meeting, IIMI research officers presented the results of their water measurements for the previous water issue. This followed a suggestion by IIMI staff that the water rotation plan within the distributary be modified somewhat to give water to the tail-end field channels first. These proposed changes were discussed and the results of the first water issue under the new plan were evaluated. Following this meeting the new water plan was implemented as discussed, with only minor difficulties.

The sixth "under the tree" meeting took place on 11 July. The technical assistant (TA), five farmer representatives, and about nine farmers were present. Special provisions for two head-end turnouts were discussed. Some adjustments to the plan were suggested by the FC1 and D2 farmer representatives. They suggested providing a reduced water flow to the head-end turnouts during the first half of the issue in order to guarantee sufficient irrigation to more difficult allotments. The TA insisted that the turnout gates should remain partly open during the first half of the water issue and fully open during the second half. At the meeting this arrangement was discussed with reference to FC1 only but during the water issue D2 also received water in the same manner with the knowledge of the TA. IIMI research officers presented water-measurement data and problems of excess water flowing to the drains was discussed. Farmers were reminded not to allow water to flow into the drains (and into the unofficial cultivated areas). Following this meeting the TA made a nighttime field inspection, and observed that certain farmer representatives were deliberately allowing water to flow into the drainage to benefit farmers in the non-bethma area.

The seventh "under the tree" meeting was held on 21 July, one day prior to the seventh water issue. The project manager, the TA, 5 farmer representatives, about 12 farmers and IIMI research officers were present. Again the issue of giving water to the tail-end field channels first was discussed. The head-end farmer representatives were asked to keep their turnout gates completely closed during the first half of the water issue. Water problems in the tail-end field channels (FC2 and FC3) were also discussed. The respective farmer representatives were asked to keep the head-end allotments closed until water could reach the tail end of their field channels. The water-rotation cycle was reduced from 10 to 7 days. Farmers requested an 8-day cycle to meet the water demands of newly planted soya, but a 7-day cycle was decided upon in order to allow 5 water issues before the anticipated last date of the irrigation season (20 August).

Implementation of the seventh water issue was affected by an island- wide curfew, which interrupted the water issue. For this reason there was no "under the tree" meeting prior to the eighth water issue. The next meeting was held on 7 August, after the eighth issue. The ninth water issue, which began on 11 August was extended at the request of farmers.

Only field-level problems were discussed during the meeting on 7 August, since a tract committee meeting had been held in the morning of the same day. A special meeting of 20-25 farmers was held on 3 September, just before the last water issue (3-6 September). The purpose of the meeting was to discuss the logistics of this last water issue which was to be made upon payment by farmers of Rs 40 (US$1.30) per irrigated acre (0.4 ha).

In general, the introduction of "under the tree" meetings was welcomed by the farmer representatives. Of the seven farmer representatives in the bethma area, five participated regularly. One Tract-3 farmer representative (in FC5) attended only one of the eight meetings. A problem observed during these meetings was the lack of leadership among the farmer representatives. Although the tract-committee president (who as the farmer representative) of FC 2 in D1) was invited he attended only some of the meetings and often came late. The farmer representative from FC3 worked very actively within his turnout and played a leadership role within his immediate area but was not regarded as the leader by the other farmer representatives,

IIMI's Influence on Water Rotations

One of the results of the new rotational pattern was to reduce the water consumption of the direct-issue allotments in the head end of D1, since the new pattern gave water to the tail end first. However, because of the poor locking arrangements on two particular turnouts (T2 and T4), these turnouts were able to take water continuously even during the first part of water issue when the rotation called for full delivery to the tail and no delivery to the head.

The head-end portion of tract 3 includes four turnout groups: 1) direct-issue allotments at the head end of D1; 2) FC1 in D1; 3) direct-issue allotments from D2; and 4) Fc5 in D1. The tail-end area includes two field channels in D1: FC2; and FC3. Under the rotational plan in effect during issues 2-4 the head-end area received water for the first one and a half days of the three-day water issue. Beginning with the fifth water issue, the head-end area received water only during the second half of the issue; as a result the total water consumption of the head-end turnouts decreased from 9.0 mm/day in the 4th issue to 7.6 mm/day in the 5th issue. A critical factor in the successful implementation of the new water-rotation plan was a good flow of water in the first part of the issue so that water could be delivered all the way to the tail end of the system in as short a time as possible. This was the case in the 5th issue but subsequent water issues had decreased flows and water did not reach the tail as readily or in the full quantities planned.

A contributing factor to difficulties in delivering water to the tail end of FC3 was overuse of water at the head end of this field channel, The major reason was that non-bethma cultivators in adjacent fields were using the water, and the head-end farmers of FC3 were allowing them to take the water through their fields and into the drainage channels where it could be pumped into the non-bethma fields. Another factor contributing to extra water use in the head end was that farmers cut openings in the channel bund to supplement the standard 4-inch (10-cm) outlet to take more water into their allotments at one time. The farmer representative of FC3 was unable to control the situation.

To deliver water to the tail end of FC3, it was necessary that the direct-issue allotments at the head end of D1 be closed, This matter was often discussed at tract-committee meetings and at "under the tree" meetings, but with little cooperation from the head-end farmers. On several occasions the representative of FC3 attempted to close these direct-issue allotments but was not successful.

Following the 5th water issue the rotational plan became somewhat flexible in its implementation as farmer representatives gained experience with it. For example, FC1, which suffered from water scarcity during the 5th issue when the plan was first introduced was gradually given somewhat longer rotational times to compensate for its long length. The farmer representative for this channel partially opened the turnout gate during the first half of the issues (when FC1 was supposed to be closed) and opened it completely for the second half.

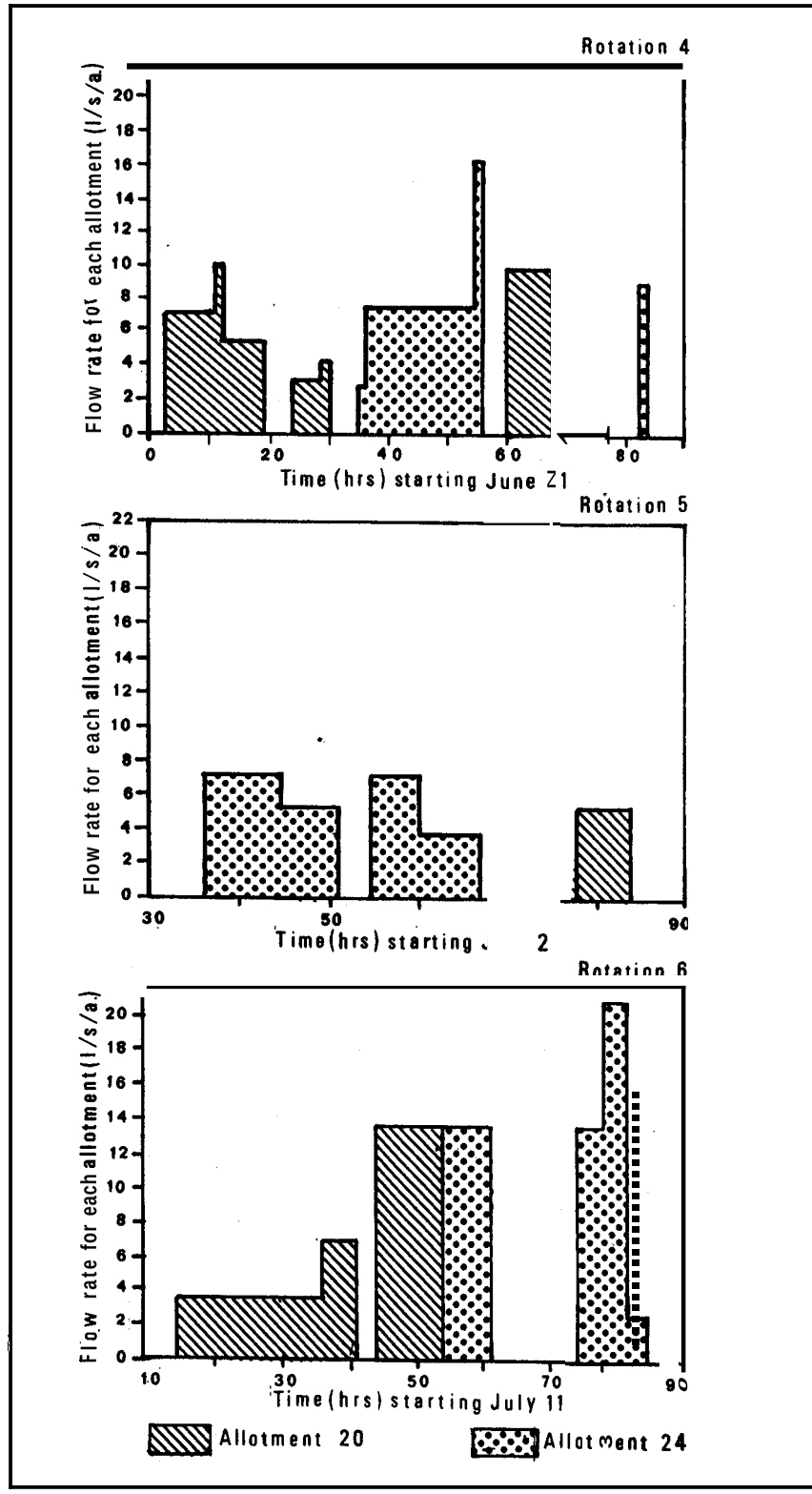
Irrigation Practices within the Field Channels

This section gives a comparison of two allotments in FC1, one at the tail end (allotment No. 20) and the other at the head end (allotment No, 24), under the IIMI-influenced rotational plan. The heavy soils at the head-end portion of FC1 received seepage water from the distributary. As a result, farmers grew primarily rice in this portion of the field channel whereas in the tail-end allotments they grew only OFCs. Farmers in allotment 24 had a particular advantage in that they could receive water field-to-field from allotment No. 25 which was served by a direct issue outlet from the distributary.

The amount of water received by these sample allotments is shown in Figure 1. There were 5 farm plots in allotment 20 and 8 farm plots in allotment 24. The comparison is based on water issue No. 4 just prior to the implementation of the IIMI plan, and the two succeeding issues (5 and 6) during which the plan was in effect. FC1 was the only field channel where a water rotation was carried out on a regular basis.

Water issue no. 4. The pattern of water distribution in D-1 was to give water first to the head end and then to the tail end. FC1 at the head end was supposed to receive water during the first part of the rotation. The planned rotation within FC1 was to give water first to the tail end and then to the head end. As can be seen in Figure 1 (top) this pattern was observed FIGURE 1

Figure 1. Water received by sample allotments



and allotment 20 (tail end) received water soon after the field channel started flowing. The head end of the field channel, represented by allotment 24, began taking water during the second half of the rotation, while allotment 20 (tail end) was still receiving water.

Water issue No. 5. During the fifth water issue water flowed in D1 for 3.16 days and in FC1 for 1.9 days. With this water issue a new plan was also introduced in FC1. At the encouragement of the farmer representative but contrary to the instructions from the TA water was given first to the head end of the field channel resulting in water shortages at the tail end. As can be seen in Figure 1 (middle)the tail-end plot in allotment 20 received a relatively low amount of water during water issue No. 5. Meanwhile in the head end (allotment No. 24), some farmers did not come to their fields to irrigate since they were uncertain whether water would be delivered.

Water issue No. 6. The water rotation within FC1 gave water to the tail end of the field channel first, during this issue. This was done at the request of the tail-end farmers who had not received adequate water during the previous issue. The farmer representative met their request by opening the turnout gates for the full three days that water was flowing in the distributary. This is an example of water rotations within the field channel being carried out at the expense of water rotation at the distributary level.

During this water issue all five farmers in allotment No. 20 came to their fields for irrigation while in allotment No. 24 only three of the eight farmers came to irrigate. Of these three, one irrigated not only for himself, but also for three of the absent farmers in the allotment. The extra water given to FC1 during this issue had a detrimental effect on water supplies to the tail end of FC3. Farmers there claimed that when the turnout gate of FC1 was opened it was not possible to receive water at the tail end of FC3. The farmer representative for FC3 periodically checked the adjustment of FC1 and closed the gate when it was open outside the rotational schedule.

ORGANIZATIONAL ASPECTS OF IRRIGATION MANAGEMENT

The details of implementing the new water management plan were discussed in the previous section. In this section, several organizational aspects are discussed in more general terms with regard to the new plan, and to other management strategies. Two levels of organizational constraints are considered: 1) the agency level and 2) the farmer level.

Agency Level

As in all irrigation schemes coming under the Irrigation Management Division management structure, the project manager at Dewahuwa plays a significant role in developing the cultivation plan and coordinating its implementation. The primary line agency which the project manager deals with is the Irrigation Department.

The role of the technical assistant (Irrigation Department). The technical assistant (TA) is the agency official responsible for irrigation activities at the project level. He develops an irrigation plan by determining the extent to be cultivated based on the current and projected tank capacity. He also has an influence on the particular areas to be irrigated, since he must consider the practicalities of water conveyance and distribution. Routine maintenance of the irrigation system (repairing of gates and other structures and desilting the main canal) is carried out by field officers.

At the beginning the 1987 yala season, the TA was preoccupied with other construction work in the region around Dewahuwa and could not pay close attention to the usual start-up tasks within Dewahuwa. Arrangements for routine maintenance were held up because of the absence of the TA from a critical meeting at which farmer representatives reported on the maintenance needs for their areas. This situation prompted a formal complaint from the project manager to the Irrigation Department.

Because of the added responsibilities given to farmer representatives during the 1987 yala the need for structural repairs was particularly critical. For example, turnout gates which had no locks for years needed to be provided with locks so that farmer representatives would have control over water releases. In spite of the lack of time on the part of the TA repairs were made to the structures but the quality of construction was generally poor. Two turnout gates at the head of D1 did not lock properly allowing farmers to take water whenever there was a flow in the distributary. A leak in the distributary near FC2 allowed farmers in that field channel to take extra water.

In the absence of supervision by the TA water issues became problematic because the irrigators who adjust the distributary gates take their orders directly from the TA; the project manager has no direct authority over them. In one instance the project manager observed inadequate water flow at the head

end of D1 and promised farmers to extend the water issue by a few hours, but was not successful in getting the work carried out by the irrigator.

The absence of the TA during the early months of the season was particularly noticeable since the irrigation-management practices that have evolved over the past decade depend upon his input and expertise. Farmers who know him personally often seek his help directly, rather than going through their representative. The TA was able to make adjustments in water issues based on his experience and farmers' feedback, rather than on engineering calculations. In the event that a particular area was deprived of water during one issue, a guarantee from the TA that more water would be available in the next issue satisfied those farmers.

The TA was not in full agreement with the plan of delegating responsibility for turnout-gate adjustments to the farmer representatives. He felt that there should be a salaried laborer under the Irrigation Department. There were a number of examples to support the TA's skepticism about the farmer representatives' ability to handle the task. In the early part of the season the farmer representative from FC1 opened the turnout gate once, locked it, and then disappeared with the key! Another farmer representative was in the habit of opening his turnout gate whenever he and his fellow farmers needed water, rather than according to the rotational schedule. In spite of the difficult beginning of the season the farmer representatives did learn to fulfill their responsibilities and eventually received full support from the TA in carrying out their tasks. The situation improved when the TA finished his construction duties outside Dewahuwa and was able to devote more time to the problems of the yala cultivation.

The role of the project manager. The project manager coordinates the various line agencies involved in irrigated agriculture, and mediates between these officers and farmers. He tries to represent the views of both sides and sometimes takes the side of either the farmers or the government agencies.

An example of the former situation is when a group of farmers in turnout 4 at the head end of D1 complained that two allotments were unable to take adequate water and requested a direct turnout from the distributary. This issue was raised at a special meeting of the TA, the project manager, and farmers of D1 head end (this was one of two turnout-group meetings organized during yala 1987). The project manager argued on behalf of the farmers though the TA rejected the idea on the grounds that it would have an adverse effect on water distribution within the distributary as a whole.

The project manager took the side of the government bureaucracy during channel cleaning at the beginning of the yala season. The project manager initiated cooperative channel cleaning in tract 3 to clean the distributary in the bethma area. Of the total of 400 farmers required to participate (both owners and bethma partners) only about 100 turned up. Each farmer was expected to clean a 14-foot section of channel on the assumption that 400 farmers would participate. Rather than increase the length of channel that each farmer would be asked to clean, the project manager demarcated the sections of all the 400 farmers, and identified the absentees in order to impose fines on them. The

process of measuring, the sections took so much time that many farmers who turned up left without doing any cleaning of the channel. Thirty four farmers were charged and asked to pay fines amounting to Rs 1125 (US$36.60). But only Rs 190 (US$6.20) was recovered, from six farmers.

Farmer Level

While farmer organizations have become effective at the project and tract levels, at the turnout level there is no organization per se. Each turnout group has a farmer representative, but he does not hold meetings with the turnout group. Thus, the term "turnout group" refers more to an area than to an actual group of farmers. Two cross-cutting sets of categories of farmers are discussed in this section: 1) land-tenure categories; and
2) socioeconomic categories.

Land-tenure categories. The farmers of Dewahuwa include Owners, lessees, and ande cultivators. Some are descendants of original allottees while others are temporary migrants from outside the scheme. Some farmers are full-time cultivators while others engaged in nonfarm employment (e.g., teachers) are part-time cultivators.

The main difference between tenurial arrangements during the maha and yala seasons is that mortgages do not normally apply during yala. A number of subcategories also need to be considered. For example, the category of "owner" includes original allottees who have access to the original allotment of five acres (2.02 ha), as well as second generation owners who have access to only a portion of the original allotments depending upon the number of siblings or land divisions. The minimum legal land division is one-third the original allotment size (1.75 acres or 0.7 ha) although there are numerous hidden subdivisions and tenancies which decrease the effective size of the cultivated plots. Some owners cultivate their land through ande tenancies, or through "partners" who provide a portion of the inputs and share a portion of the yield.

Lessees are of particular importance during the yala season, because of the fluid land-tenure arrangements prompted by bethma practices. Cash rentals are the most common type of leasing arrangement during yala. During maha most rentals are handled through payments in-kind collected at harvest time (wee poronduwa). The normal rent for an acre (0.4 ha) of land during maha is 30 bushels (626 kilograms) of unmilled rice. During the yala season, ande shares are sometimes paid in cash, but are figured as a proportion of the total income. A typical figure is 25 percent paid to the Owner as rent. Partnership arrangements may involve poor owners who need an outside party to provide finance or outside financiers who are mortgaging or leasing land (particularly during yala) and relying on a third party to do the actual cultivation. In such cases the cultivators normally retain half the income and also share half the cost of inputs. A caretaker is in the same structural position as a partner but receives a wage in cash.

Mortgages are the result of a tight credit situation in Dewahuwa and financiers who buy mortgage rights utilize the owners' land for as long as the owner cannot recover it. In *many* cases these mortgage relationships become

permanent and land is in effect sold for the price of the mortgage. Typical mortgage prices are Rs 20,000 to 30,000 per 5-acre allotment (US$321 to 482 per ha). Some mortgagees cultivate the land themselves, but most give it out on either an ande or caretaker type of arrangement. These arrangements normally apply to the maha season only, and during yala the original owner regains cultivation rights. Mortgagees who wish to cultivate during yala must pay an extra rental to the legal owner.

The time farmers spend cultivating their plots depends on the land-tenure arrangement. As a general rule, Owners are full-time farmers, while lesees are part-time cultivators. The proportion of labor time devoted to cultivation in the various categories of land tenure is shown in Table 5:

Table 5. Level of time commitment to farming.

	Full-time	Half-time	Part-time
Owners	x		
Lessee			x
Ande		x (maha)	x
Partnership			x
Caretaker			x
Mortgagee		x (maha)	

The significance of the various durations of tenure is that group action normally depends on a sense of shared commitment to a particular turnout area and lessee cultivators who will probably not be in that turnout area the following season have much less of an interest in helping develop an organization of farmers than do Owners who will remain in that turnout area indefinitely. The proportion of farmers under the various tenurial arrangements during yala 1987 was unusually skewed in favor of short-term (lessee, ande, caretaker) arrangements because of the low proportion of land cultivated, and the high demand from farmers to purchase cultivation rights. A comparison of land-tenure patterns during yala 1987 with the previous yala and the 1985/86 maha is given in (Table 6).

Socioeconomic categories. In addition to land-tenure categories, and crosscutting them are social and economic categories of farmers, such as the following: 1) originalallottees; 2) their children; 3) outsiders; 4) part-time farmers; and 5) entrepreneurial farmers. These categories are closely related and overlapping. For example, the original allottees and their children are treated as two separate groups with the entrepreneurial farmers emerging mainly from the latter. Some of the children of the original allottees have legal access to land. Others share their parents' land or cultivate land of non-relatives through various tenurial arrangements. Some "outsiders" cultivating in the scheme are children of original allottees, who separated from their families in Dewahuwa and now live in adjoining villages. Part-time farmers also may be children of original allottees, who currently hold government jobs such as teaching. Other part-time farmers are government servants andentrepreneurs.

Table 6. Land-tenure categories of sample farmers 1985-87.

Tenure	Maha 1985/86[a] (%)	Yala 1986[b] (%)		Yala 1987 (%)
	N = 70	Intensive N = 60	Extensive N = 97	N = 112
Owner	13	12	32	22
Family tenure	17	37	25	31
Lessee	3	37	29	36
Ande	32	7	6	5
Partnershi	-	7	6	5
Caretaker	3	2	2	-
Mortgage	32	-	-	-
Other	-	-	-	-

[a]See Bulankulame (1986) for an explanation of sampling procedures.
[b]See Ekanayake and Groenfeldt (1987) for an explanation of sampling procedures.

The largest category in terms of numbers is the most important. Children of original allottees comprise the target group for farmer organization. Typically, this group lives inside the scheme, cultivates each season, and has strong socioeconomic ties with other Dewahuwa farmers. Their situationcontrasts with those who live outside the scheme, and in some cases in another district, and reside in Dewahuwa only during the cultivation season. However, even among this group of seasonal migrants there are some who return to the same allotment each year and develop patron-client relationships with the owners of their allotments.

Part-time farmers who live inside the scheme and are employed as teachers or in other relatively high-status positions play an important leadership role among the farmers. For example, a teacher cultivating in the tail end of FC1 helped to organize the farmers in adjacent allotments to obtain extra water to the tail of that field channel which did not get a sufficient supply.

Wealthy or "entrepreneurial" farmers who have access to tractors and diesel water pumps are typically engaged in various trading activities during harvest serving as middlemen in buying and selling the harvest of their neighbors. Such farmers are usually from the scheme and often play a leadership role analogous to that of part-time farmers, However, because these farmers have significant areas under their control their leadership is often used for their own benefit. An example is seen in FC1 where a powerful farmer convinced the farmer representative to give him the turnout gate key so that he could take water to his fields outside the time of the scheduled rotation.

Implications for Irrigation Organizations

The basic organizational objectives under the Irrigation Management Division framework are to organize farmers on the basis of turnout groups, strengthen the leadership of farmer representatives, and facilitate the cooperation of line-agency officers at the field and project levels. Constraints to these objectives have been outlined. The following are some possible solutions to those constraints.

Turnout-based farmer groups. Despite the various categories of farmers cultivating within a turnout-group area, viable organizations at the turnout level can be based on farmers who are committed to long-term cultivation of an allotment, whether or not they are the legal owners. The target group would include not only owners and family-tenure cultivators, but also long-term mortgagees and lessees, regardless of whether they are permanent residents of the scheme or long-term seasonal migrants. This target group could be treated as the core for a turnout-level organization. The cooperation of other cultivators is also needed of course but many of the more transient cultivators cannot be identified until the season is already underway. With the leadership of a core group of long-term farmers, new farmers coming into the turnout group could fit into an already existing organizational structure. Turnout-group meetings with the participation of all farmers could be held once or twice during the season.

During the yala season when bethma is practiced some adjustments could be made in the organization to incorporate bethma partners. Many of the bethma partners would also be members of other turnout organizations but invariably a number of the yala cultivators would not belong to any turnout group organization. In this case the permanent members of that turnout organization could play leadership roles. At the allotment level two or three cultivators representing both owner and bethma portions could be given leadership for intra-allotment water distribution.

The role of farmer representatives. Only permanent members of a turnout group should be eligible to become a farmer representative. Regular training programs could help develop the leadership qualities of farmer representatives and strengthen the horizontal relationships among farmer representatives and between farmer representatives and farmers. Regular meetings of farmer representatives within an area, as practiced in D1 during the 1987 yala season, would strengthen their position and would also help improve water distribution. Such meetings would have to be followed up by greater interaction between farmer representatives and farmers so that farmers become fully aware of the decisions taken at the meetings. Cash incentives for field-level officers to attend meetings and to play a more active role in interacting with farmers are probably necessary. The type and amount of payment could be recommended by the tract committee or project organization. Even a simple matter such as refreshments during the meetings would be helpful in developing morale.

The role of field-level officers. The use of catalysts or institutional organizers for promoting farmer organization would bring the coordinating role of the project manager down to the level of the turnout or distributary. Although the project manager is highly effective at the project and tract-

committee level, it is unrealistic to expect him to be effective in promoting viable farmer organizations at the turnout level, Greater staffing intensity would be required for this to take place. In the absence of trained institutional organizers, existing field-level officers might play a greater role in directly working with farmers in lieu of, or in addition to, institutional organizers.

SUMMARY AND CONCLUSIONS

The basic water-management principle underlying the yala 1987 operational research in Dewahuwa was rotations within the distributary. The basic management principle employed was information feedback to farmers and project officials, and information flow between farmers and project officials. The information included measurements of water flow and duration, deviations from the intended pattern, and the attitudes of farmers and farmer representatives.

The primary mechanism to provide farmers and agency staff with feedback on their irrigation-management performance was the holding of post-issue meetings involving farmer representatives, the project manager, the TA, and IIMI research officers to discuss the previous issue and to plan the next issue. These meetings were supplementary to tract-committee and project- committee meetings which also brought together farmer representatives and project management on a regular basis.

Both the role of the farmer representative and the management practices of farmers within a "turnout group" changed significantly during the yala season. Farmer representatives were given responsibility for the turnout gates within their area (whether direct issues from the distributary or turnouts to field channels). In some cases they were also given responsibility for carrying out rotations within the field channel, Overall, the farmer representatives demonstrated that they are capable of meeting these new responsibilities. There is no doubt that the close interaction between the project manager and the farmer representatives was an important element in the success of this management procedure.

This report has documented how the rotational plan was carried out, and the management role of farmer representatives and agency staff in implementing the new plan. A key implication of the yala 1987 experience concerns the potential value of true "farmer organizations" at the distributary- and field-channel level. Can the farmer representative alone manage water rotations within his area or does he need an organizational structure among the farmers of his area?

The evidence suggests that without an organizational structure even a dynamic farmer representative (as in the case of FC3) is ineffective; the farmer representative cannot manage water alone. What type of organization would be most feasible and effective? A turnout group, which already exists in name, but not in practice, is clearly a logical boundary within which to build a capacity for self-management. The more critical question is how to do this. What steps would be necessary to implement a viable organization (e.g., training for farmer representatives or Irrigation Department field staff or both or community organizers)? What would be the costs, benefits, and alternatives?

Several suggestions for creating more effective organizations at the turnout level are discussed in the preceeding section. However, the experience of the 1987 yala has demonstrated that the choice of organizational strategy at the

turnout level depends in part on the operational practices in the system as a whole. If water rotations among field channels are desired, water rotations within the field channels may be necessary to move water down to the tail end quickly. Carrying this out successfully will require organizational input -- either pressure from the project manager and farmer representatives, or peer pressure from farmers themselves. A clear rotational plan, as was implemented during the 1987 yala, helps all concerned to understand the logic of the rotation.

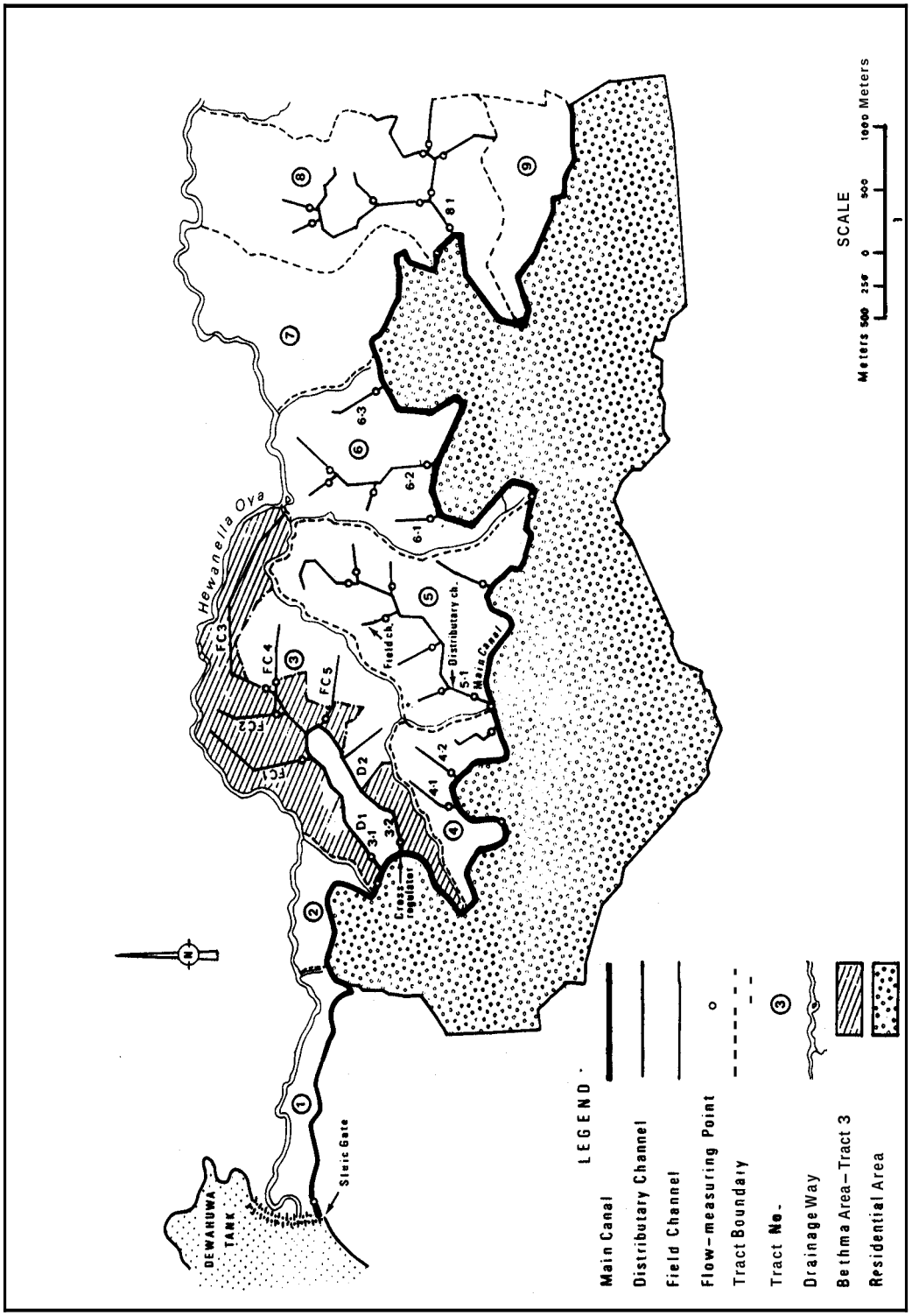
There appears to be a strong link between farmers' comprehension of the plan and their willingness to comply with it. Improving irrigation management thus requires not only an organizational structure (e.g., the turnout group, as well as the tract- and project-level committees), but also an operational plan which gives a clear role to farmer groups and which makes clear sense to the farmers. Finally, the importance of information feedback (from the irrigation system to farmers and officials) and information exchange (between farmers and officials) has been underscored. The post-issue "under the tree" meetings provided a chance to make small adjustments in the rotational plan before farmers became disillusioned with the new procedures. By maintaining vertical and horizontal information flows the operational plan can bend to everchanging circumstances.

MAPS

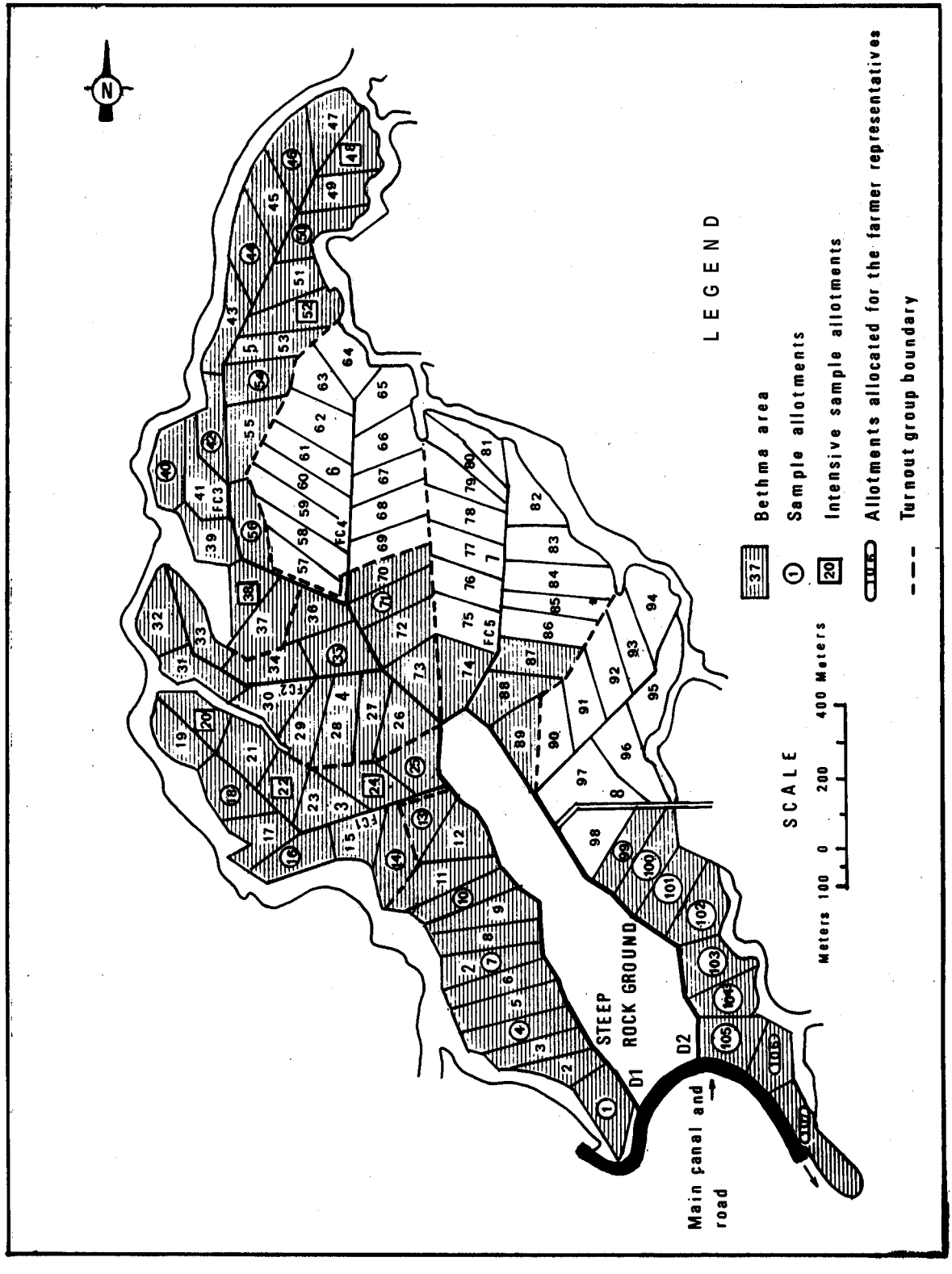
MAP 1 Dewahuwa irrigation system, showing the area of tract 3 (shaded).

MAP 2 Tract 3 in Dewahuwa, showing bethma area (shaded) and sample) allotments.

MAP 1 Dewahuwa irrigation system, showing the area of tract 3 (shaded).



MAP 2 Tract 3 in Dewahuwa, showing bethma area (shaded) and sample allotments.



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