WATER MANAGEMENT UNDER SMALL VILLAGE TANKS

A.M.T. GUNAWARDANA

NOVEMBER 1981

AGRARIAN RESEARCH AND TRAINING INSTITUTE

WATER MANAGEMENT UNDER SMALL VILLAGE TANKS

A Paper based on experiences in Water Management Under the
Kurunegala Rural Development Project

A.M.T. GUNAWARDANA

Occasional Publication 25 NOVEMBER 1981

AGRARIAN RESEARCH & TRAINING INSTITUTE
P.O. BOX 1522
Colombo
SRI LANKA

FOREWARD

At the request of the Ministry of Plan Implementation and the World Bank, the Agrarian Research & Training Institute agreed to undertake the evaluation of the Kurunegala Integrated Rural Development Project. The Evaluation Plan consists of a base line survey to analyse the pre-project situation and several indepth and management oriented studies. Some of these studies are meant to examine the implementation of important project components with a view to assess their performance from time to time. This study on Water Management under some re-habilitated village tanks is one of them.

Irrigation Development and related Water Management is the largest single cost component in the Kurunegala Integrated Rural Development Project. Expenditure on this item is nearly 25% of the total project budget. In fact this is the principal input on which all other components such as extension, credit and agricultural input supplies which are directed towards increased food production depend. Water Management and Irrigation rehabilitation could also be treated as complementary inputs as the former is meant to enhance the usefulness of the latter. The importance of this component therefore, influenced the ARTI to identify this subject as a priority area for early study. It was also thought that the results of this study could be made use of to develop methodology for Water Management under ARTI's major research project on Water Management at Galoya.

This publication is based on observations made after the rehabilitation of the first set of tanks under the project. Although the study is not based on statistically valid samples the smallness of the sample gave an opportunity for the researcher himself to see some of the finer issues involved in the water use under the small tank irrigation systems.

It is hoped that this study, even in a limited way, may provide some insight into the generally unknown area of water use under small tanks. Although the study is primarily meant as a component study under the Kurunegala Project, it is bound to have general significance as the rehabilitation of small tanks is a main objective under another major national project.

Mr.A.M.T.Gunawardena, R&TO was responsible for this study. My thanks are due to him for his efforts and to the others who made this publication possible.

T.B.Subasinghe
DIRECTOR.

TABLE OF CONTENTS

WATER MANAGEMENT UNDER SMALL VILLAGE TANKS

1. INTRODUCTION

The total extent of paddy land fed by minor irrigation schemes amounts to approximately one third of the asweddumised area in Sri Lanka. These village irrigation works, village tanks, anicuts, small channels (elas) etc., are about 60,500 in number[1]. Of these about 12,500 are village tanks in working condition and possibly more lie abandoned.

In Kurunegala district, the total number of village tanks is estimated to be around 3,000 in number. Of the total of 168,105 acres of asweddumised paddy land in the district, about 43% is fed by minor schemes of this nature. Hence the importance of this system of irrigation in the district is obvious.

2. THE EXPERIMENT IN WATER MANAGEMENT

Under the Kurunegala Rural Development Project, it is expected to rehabilitate 500 village irrigation schemes during a period of 5 years (1979-1983). Once the physical rehabilitation work is done, the project intends to adopt a system of controlled use of water as a complementary input primarily for preventing crop losses in Maha and achieving a higher cropping intensity in Yala. For this purpose the project has adopted the Walagambahu model developed at the Mahailluppallama research station[2]. The model as adopted in Kurunegala emphasises the advancing of cropping calendars, avoidance of staggered cultivation, dry sowing of the crop, use of short duration improved varieties, and mobilisation of group action through education and training, with greater reliance on rainfall for Maha cultivation conserving tank water for Yala season. It also encourages the use of fertilizer and proper control of weeds and pests as means of achieving higher productivity.

---

1 Arumugam, S. (1957) Development of Village Irrigation Works, Colombo, Irrigation Department.

2 World Bank (1979) Staff Appraisal Report, Kurunegala Rural Development Project.

This model for water management was first adopted in the Kurunegala district in Maha season 1978-1979 on 10 selected tanks. Under the rehabilitation programme of the project, these ten tanks were given priority and were rehabilitated in 1979. Subsequently the water management experiment was adopted in the 1979-1980 Maha season on the same tanks, even though rehabilitation work on some of these tanks was not completed by that time. The particulars of the ten tanks are given in Table 1. The following criteria[1] were adopted in the selection of the tanks for the 1978-1979 experiment.

(a) No cultivation was done during the previous Yala season.
(b) Extent of paddy land under each scheme between 30 to 50 acres.
(c) Number of farm families between 10 and 25.
(d) Water issues and management to be done by a person involved in the programme.
(e) Farmers' acceptance of the programme
(f) The scheme must be representative of the area and should be accessible.

Table 1: Characteristics of Tanks Selected for the Water Management Experiment

Agro-climatic Zone	Name of Tank	Command area (Acres)	No.of farm families
Dry	Ihalagama wewa (Tambarambuwa)	20	18
Semi-dry	Monnakulama wewa	45	45
Semi-dry	Nugampola wewa	17	16
Dry	Ihalagama wewa (Mahannaneriya)	64	36
Dry	Ankenda Kumbukwewa	31	26
Semi-dry	Nithogama wewa	35	36
Dry	Pahala-wewalayagedera wewa	18	34
Semi-dry	Pahalawewa (Nagollagama)	19	31
Semi-dry	Moragaswewa Mahawewa	29	40
Semi-dry	Mamunugedera gama wewa	34	52
	Average	31	33

1 Wijesuriya, R.A. Cropping Systems Pilot Production Programme in Sri Lanka, paper presented at the Cropping Systems Conference, 1980, IRRI

3. THE OBJECTIVE OF THE PAPER

The objective of this paper is to identify and analyse the factors that influence the use of water under small village tanks in general and the application of the project's approach in particular. This assessment is made, based on the experiences of the water management experiment during the 1979-80 year, referred to as the ten tanks project. The paper is divided into three main sections.

(a) A discussion of factors influencing water management
(b) An evaluation of the success of the water management experiment
(c) Conclusions

The data for the study were collected through informal interviews with farmers and officials of the tank areas, maintenance of simple records on water issues, cultivation calendars and other related materials and through attendance of meetings and discussions concerned with the project.

4. FACTORS INFLUENCING WATER MANAGEMENT

4.1 The 'Size' of the Tank

From an engineering point of view, the size of a tank is measured in terms of its capacity. Capacity is a function of depth of water and the water spread. From a farming point of view, however, it is customary to describe the size of a tank in terms of the asweddumised area it irrigates. The classification of tanks into minor and major irrigation schemes is also made in terms of the area fed, with a maximum of 200 acres as the limit of a minor scheme. The size of the tract and the capacity of the tank are usually related, of course.

An examination of village tanks in Kurunegala indicates that it is useful to classify village tanks into three groups on the basis of the area served, since the three groups show certain distinct characteristics which have a bearing on the water management effort.

The extent of land irrigated, referred below is a rough approximation used to indicate the probable size of each category. The idea behind the classification is to bringout the distinguishing features of the smallest, medium and the larger village tanks.

Group I	- Small tanks	- Serving less than 20 acres.
Group II	- Medium size tanks	- Those serving between 20-40 acres
Group III	- Large Tanks	- Those serving over 40 acres.

The best prospect for good water management through the adoption of the project's model appears to lie primarily with the second group of tanks.

It appears that the large tanks need 'special treatment' in the water management effort, due to certain features of these tanks, the most important ones of which are listed below. These issues are discussed in more detail in the later sections of the paper.

a) Most of these tanks belong to the 'Maha wewa' group, i.e., they are the main tank of a particular village; a complicated land tenure structure prevails, parcelisation of land and scattering of parcels[1] are common.

b) Usually land under the larger tanks, having a more certain water supply, cultivated last; the order is chena[2] first, small tanks next, and large tanks last.

c) Normally the crop under such a tank is assured, so farmers prefer to mud sow (or transplant) the crop as there is a greater potential of obtaining a higher yield than from a drysown crop, under their level of management; changing these sowing preferences is difficult and not altogether reasonable.

d) The soil usually contains more clay and less sand, which makes it less suitable for dry sowing.

1 Parcelisation and scattering mean that a farmer's paddy holding consists of a number of pieces of land distributed among a few tanks; even the holding under any one tank is composed of number of units scattered within the tract.

2 Slash and burn system of cultivation.

e) The tank and land are usually located close to the Gangoda (settled area) particularly if they are associated with the 'Maha wewa' group; hence greater care for the crop may be possible, and dry sowing is a method involving much less care.

f) When the paddy tract is large as it is under larger tanks, soil conditions within the tract may vary considerably. For instance one end of the tract may have water logged conditions while the other end may be sandy and dry up easily. Under such conditions one package may not be applicable to all areas of a tract.

In the selection of tanks for the water management extension project, although the initial objective was to select tanks with command areas of 35-50 acres, some deviation has been made in the actual selection by including a number of smaller tanks.

The limitations of group I for this method arises purely from their low capacity per acre. The capacity per acre irrigated in the three groups of tanks was calculated using the available data on the water spread and the depth of water at spilling level for a sample of forty tanks.[1] The respective figures for the three groups were as follows.

Group I	1-20	Acres	=	2.57 Ac.ft/Acre irrigated
Group II	20-40	Acres	=	3.53 Ac.ft/Acre irrigated
Group III	40	Acres	=	3.55 Ac.ft/Acre irrigated

The data show that the capacity of the tanks in group I is small, while groups II and III show hardly any difference, indicating the disadvantage of the smallest tanks.

The limitations of this group (small tanks) were further evident when comparisons were made of the amount of water the tanks of

1 Consists of a random sample of 20 tanks from among 50 tanks selected for rehabilitation (excluding those selected for the water management extension project) and 20 tanks situated closest to the above 20.

different groups contained in three different months[2]. The data are summarised in table 2 for easy comparison.

Table 2 – Variation in Depth of Water in Tanks, by Group, in Three Different Months

Month	Group	(N)	Depth of water		
			0-3 ft	4-6 ft	6 ft
November 79	Group I	(11)	–	10	1
	Group II	(7)	2	2	3
	Group III	(12)	2	4	6
February 80	Group I	(11)	10	1	–
	Group II	(7)	3	4	–
	Group III	(12)	4	6	2
April 80	Group I	(11)	11	–	–
	Group II	(7)	3	4	
	Group III	(12)	8	3	1

The comparison shows that in the smaller group, almost all the tanks were virtually empty by February. This is, of course, without an attempt to conserve water. In the project too, there were two tanks with command areas below 20 acres. As shown later, the cropping intensities achieved here were low.

Based on these observations, it is possible to generalise that the medium group of tanks offers most potential for water management, in particular the application of the model adopted in the project. The larger tanks demand a modified approach while the most one could expect from water management in the smaller tanks appears to be an 'assured Maha crop'.

4.2 Paddy Holdings – Their Size, Composition and Tenure.

There are certain features relating to the size, composition and tenure of the paddy holding which interfere with the use of the

2 Using the same sample of tanks referred earlier. However, relevant data were available only for 30 of the sampled tanks.

proposed system of water management. These features are:

a) The relatively large operational paddy holding[1]

b) The distribution of the holdings among a number of tanks

c) The parcelisation of the part of the holding under any one tank into number of separate units scattered over the tract

d) Operation of the Thattumaru and Kattimaru systems of land operation and of Ande tenancy.

The paddy holdings of farmers in the project areas were relatively large and were distributed among a number of tanks[2]. The system of farming followed in the project areas (and in general in Kurunegala district) is based on family labour[3]. Hired labour is both scarce and expensive, particularly in the peak periods. There is no migration of labour into these areas (unlike the major paddy growing areas), and any hired labour available would be from the village itself. Hired labour means the involvement of cash payments which most farmers cannot afford to make for labour. Furthermore the high risk situation do not encourage the intensive use of hired labour, if the crop fails farmers will have lost their cash outlay. For these reasons, farming activities are normally carried out with the labour resources available within the family unit. This invariably leads to delays in the operation of some of the paddy lands. Involvement with chena farming makes further demands on the family labour resources.

One advantage of having fields under a number of tanks is that the risk is considerably reduced. There is a good chance that at least some of the lands will produce a crop. Furthermore the farmer can organise his cultivation operations better. His resources and time could be better utilised by moving from one plot to another.

1 The implications (in water management) of unequal distribution of land are discussed elsewhere in the report

2 Many farmers had lands under more than one tank and this contributed to a relatively large holding. According to table 1 average size of holding under one tank works out to 1 Acre.

3 ARTI (1981), Kurunegala District Rural Development Project - An Analysis of the Pre-Project Situation, Colombo, ARTI.

Parcelisation and scattering of paddy holding in a single yaya is the other related feature of tenure affecting patterns of water management under village tanks. Scattering is usually associated with the kattimaru system of cultivation which further aggravates the position. According to the kattimaru principle, land is subdivided at the death or retirement of its owner, but each heir inherits, instead of permanent ownership rights to a particular plot, the right to cultivate in turn each of the plots into which the land has been divided. A person may cultivate a particular piece of land only every sixth or seventh year. The following statistics reveal the gravity of this problem.

Table 3 - Extent of Parcelisation of Land in Some of the Tanks with Water Management Extension Project

Name of Tank	Paddy acreage	No.of owners	No.of parcels	Average size of parcels (Ac)
Nithogama Wewa*	36	54	215	0.15
Ankendawa-Kumbuk-wewa	33	44	86	0.38
Wewalayagedera wewa	17.5	31	52	0.34
Pahalawewa	19	30	106	0.18
Moragaswewa*	45	40	130	0.35

(* belongs to the Mahawewa group)

Parcelisation is generally more acute in the 'Maha-wewa' group. There is usually a prestige value attached to paddy land here. Farmers are reluctant to sell such land, and when a land is given to children, the farmer sees to it that most (if not all) children get some land under the Mahawewa (main tank).

The implications of this very high level of parcelisation and scattering of land are:

a) Organised cultivation is made more difficult
b) A complex system of distribution of irrigation water is needed, particularly since farmers prefer to tap water direct from a channel to use drainage water from an other's field. Invariably water consumption is high in such circumstances.

c) There is a tendency to demarcate boundaries of a parcel with thick high bunds, which again may interfere with the flow of water.

d) When parcelisation is heavy, one could expect tension and conflict ; for instance due to boundary disputes.

e) Fencing is made more difficult.

f) Excessive parcelisation can lead to a general negligance of the fields.

g) Operation of a bethma[1] system in Yala is made more difficult.

The tattumaru and kattimaru systems of land tenure which operated in a number of tanks under the project, has undesirable consequences in that a tattumaru or kattimaru farmer is not interested in the long-term development of his land. A farmer will not be interested in maintaining channels and bunds or even using fertilizer since part of the benefits would go to one who follows him. This system was more common in the 'Mahawewa' group. A desirable feature of the tattumaru/kattimaru system is that it imposes a check on extensive subdivision. It may also reduce tension and conflicts that may otherwise arise from ownership problems and boundary disputes.

Ande tenancy[2] was a common phenomenon and its effects were similar to effects of the tattumaru/kattimaru system of cultivation, i.e. they deterred the long-term development of land and adoption of improved farming practices.

4.3 The Farming System

As was mentioned, the holdings are relatively large and usually distributed among a number of tanks. The system of farming adopted is chena first, fields under small tanks next, then moving to fields under larger tanks and generally coming to the Mahawewa last. This system of land operation seems under the circumstances to be a rational system of land use for the following reasons.

1 A system of cultivation of a part of the paddy lands under a tank by all farmers cultivating under that particular tank. This system is practiced when the available water in the tank is insufficient to feed the entire tract (usually in the yala season).

2 Share cropping.

a) This staggering of cultivation is an adaptation to the shortage of available resources, particularly labour. The system of paddy farming followed in Kurunegala was based on family labour, as discussed already.

b) Chena cultivation must receive priority in the system of cultivation. For reasons of cutting and burning the jungle, the operations must commence toward the latter part of June. Sowing must be done with the first rains; otherwise the crop will not be able to compete with the weeds. Chena crops are exclusively rainfed and hence are sown early and harvested early. Many of these crops are long duration crops - or atleast the harvesting phase is long and hence early sowing is important. From the point of view of cash income, chena crops are more important to the farmer than is paddy. Chena crops need some protection (watching) during the period before and during harvest. This means one should sow chena first, then paddy, and get back to the chena again as it enters the production phase. For all these reasons, cultivating chena first is important to the farmer and seems to be the most rational approach.

c) Sowing paddy under small tanks receives priority compared with that under large tanks. This too seems to be a rational approach as these tanks are the ones that dry up early. Under large tanks, there is little harm in delaying since the water supply is assured. The complex ownership pattern under these tanks further favours delayed cultivation.

d) Normally, paddy under small tanks is dry sown while in the case of larger tanks the crop is mud sown, as noted already. The reasons for dry sowing under small tanks are the relatively unassured water conditions in smaller tanks (hence the need for early sowing) and resulting risk involved (hence the low input strategy). In the case of the larger tanks, with a relatively more assured crop, farmers prefer to mud-sow even if somewhat late as higher returns could be expected from a mud-sown crop compared to a dry-sown crop under present levels of management. There are other reasons as well, such as the location of these fields close to settlements, the impression that farmers have that old fields are less fertile and hence less suitable for dry sowing, and the clay type of soil which favours mudding. It appears therefore that the system of cultivation farmers have adopted is extremely rational and appears to be the most suitable way of dealing with the situation. Hence any 'improvements' to the present system should take into account all the circumstances that lead to the present system of land use, and introduce real gains for the farmer.

4.4 Farmer Participation

The approach adopted in Kurunegala was based on (1) control of tank water and (2) dry sowing of the crop early in the season, combined with (3) certain improved management practices (such as use of weedicides and fertilizer) as means of achieving weed control and higher productivity. Decisions relating to the control of water were mostly taken by the KVSS with some consultation with the farmers. (There were 10 KVSS in-charge of water management work for the ten tanks). One of the conditions in the selection of tanks for the project, was the acceptance by farmers that the control of water to be handled by a person involved in the programme.

There was little participation of farmers in the water management activities. The participation was largely limited to the KVSS working with few farmers (usually good farmers from a extension point of view: often contact farmers were included). In certain instances, even the Kanna meetings were not involved. However it was found that the KVSS to a large extent were able to achieve what they desired (as far as control of water is concerned) through these means. However whether this is the optimum level of participation that one is working for is questionable. To my mind this is only a beginning. The success of this approach is less likely when farmer numbers are greater and when conditions are more complex (such as with greater incidence of encroachments).

There were some instances of farmer participation in the meetings held in connection with the water management project. These farmers have often made very useful suggestions (ref. to minutes of meetings). However most of their comments referred to defective structures and to incomplete work of the tanks and not really to water management proper.

This leads to an important aspect of farmer participation, namely their participation in the rehabilitation work of the tank. In actual fact, there was hardly any participation, except for their work as hired labourers. It was noticed in instances where rehabilitation work was going on at the time of the study, that farmers did not even know what was being done except for what they heard from their own people. The villagers thought that it was an 'engineering job' and hence they were not kept informed. They often had certain views of what should be done, how something should be done, and what was good for them. Of course they wanted a quick job too, as they were the ones who would lose otherwise. Unfortunately they were not consulted. They had no way of expressing their opinions or suggestions. The only line of communication available to them was the political channel which too might not convey the majority opinion in all instances.

The root cause of this approach to rehabilitation seems to lie in the tradition of engineering work done in this country. All construction work was considered as purely 'engineering' jobs. The present case, ie. the rehabilitation of village tanks, is something different from a purely construction job. It is different from the construction of a road, a culvert, or even a school building or laying of an electrification project. Somehow these function matters little to the villager. But if the tank is defective, their entire economic activity (except probably for chena) is going to be affected. Further, unlike a school building or a road, with tank rehabilitation their is a specific group (a small group) which is interested. Farmers also have something to contribute since they are knowledgeable due to their involvement in irrigated cultivation from childhood. All these demand a greater participation of people in rehabilitation work.

In order to achieve farmer participation in water management work, their involvement from the very beginning seems essential. One cannot expect the rehabilitation work to be done in isolation (sometimes even against farmers wishes) and later expect their cooperation in water management. My impression is that water management should begin from the commencement of planning for rehabilitation work. Farmers should be involved from this stage and the necessary physical structures for water management should be constructed in consultation with farmers so they understand and accept the implications of a new system for themselves.

4.5 Socio-Economic and Political Features of the Village

Issues relating to land tenure and operation, such as size of paddy holding, its distribution and operation, parcelisation, operation of Tattumaru and Kattimaru systems and Ande tenancy were discussed previously. Another related issue that has a strong bearing on water management is the size distribution of operational holdings under a tank. The more unequal the distribution is, the more difficult it is to undertake any organised cultivation. This is not a common feature among all tanks but exists with some tanks. Whenever such unequal distribution prevails there is usually one or a few 'large' farmers, and they decide on the cultivation operations. Invariably they possess land under other tanks and as a result their timing is dependent on how large and how widely scattered their total holding is. The other farmers are forced to follow them due to social and technical reasons (such as fencing, water use).

The other important social factor which has a bearing on water management is the cleavages that prevail in village communities. Although almost all families in a long-settled village could be traced back to one or few ancentral families, these cleavages do exist and act as a barrier to organised work. Politics usually adds colour to these cleavages.

4.6 The Effect of Rainfall

Certain tentative recommendations relating to early establishment and harvesting of Maha paddy have been made in the analysis of the pre-project situation of the Kurunegala district.[1] The hazards of 'early' sowing[2] were pinpointed in this document on the basis of the 1978 rainfall data, and this subject is further discussed here. On examining the rainfall data for a dry zone location for the last seven years (see table 4) it was observed that the pattern of having a period of rain for about 2-3 weeks in August or September, a dry spell of roughly the same duration, and finally the real Maha rains, tended to repeat almost every year. Due to this pattern of rainfall, there are dangers in trying to establish the crop too early. A crop sown before the first period of rains could germinate and be adversely affected by the drought spell that follows. Hence it is advisable to postpone dry sowing till the early spell of rain is over. Accordingly early October appears to be the most suitable time for dry sowing.

The soil types of Kurunegala district varies from the dry zone soils (i.e. the Reddish Brown Earths associated with yellowish Brown Earths and low humic glay soils) in the north, to Non Calcic Brown soils in the central area, to Red Yellow Podsolic soils in the south. Unlike the dry zone soils which are usually hard when dry and sticky when wet, the other soil types are rather easy to work under a wider range of moisture levels. In this regard the non-dry zone Kurunegala farmer may be in an advantageous position, since he could carry out his land preparation operations under wider range of soil moisture conditions.

---

1 ARTI (1981), Kurunegala District Rural Development Project: An Analysis of the Pre-Project Situation, Colombo, ARTI.

2 Sowing here refers to dry sowing.

Table 4 - Rainfall Data for Mediyawa. (Weekly rainfall in Millimeters).

MONTH	WEEK	1980	1979	1978	1977	1976	1975	1974	Average 1931-60
AUGUST	1	0	0	0	0	0	0	0	6.4
	2	0	0	1.0	15.0	0	5.1	13.5	13.5
	3	0	0	0	12.9	2.0	0	8.6	10.2
	4	0	0	0	4.1	8.6	0	0	7.1
	5	0	0	3.8	0	1.3	0	0	10.7
SEPTEM-BER	6	0	6.4	0	0	0	0	10.2	3.0
	7	0	82.3	0	0	0	38.4	19.0	11.9
	8	13.7	0	0	0	0	93.5	28.7	20.8
	9	11.2	0	24.1	3.0	7.1	10.4	5.8	29.5
OCTOBER	10	12.2	0	0	56.2	97.3	0	0	25.9
	11	174.2	15.8	0	292.4	129.5	0	0	46.0
	12	34.6	58.4	152.3	57.7	61.0	1.3	0	71.1
	13	0	166.9	116.5	81.6	0	53.3	0	67.3
NOVEMBER	14	2.8	149.7	239.2	75.2	65.5	65.5	49.8	68.6
	15	47.5	64.1	9.4	59.5	113.5	28.7	0	80.3
	16	165.1	133.8	19.5	138.0	69.6	62.5	22.9	63.8
	17	22.3	58.0	252.2	55.9	67.3	72.1	4.8	57.2

4.7 Farmers Own 'Limitations' and the High Risk Involved.

The high risk situation that is prevailing and the farmers' own 'limitations' (limitations of resources in particular) are two other interconnected factors that influence water management. Farmers tend to overcome risk in two ways, either by early sowing and adopting a low input strategy (dry sowing in small tanks), or by late sowing and adopting a relatively high input technology when water availability for Maha was assured by waiting until the tank is full. The farming system they adopt incorporates these two features in order to minimize the likelihood of loss of the Maha crop. These factors should be noted in suggesting any 'improvements.' The resource limitations have effects in a number of ways. The limitations of draught power and labour for land preparation work result in delays in cultivation as well as in staggered cultivation (within a particular tract). The limitations of cash impose difficulties in the hiring of draught power and also in adopting higher standards of management.

Relating to technology[1], farmers have their own perceptions about what level of technology is 'good' for them based mostly on their past experiences. From a pure 'technology promotion' point of view, one may consider such human characteristics as 'limitations', influencing the adoption of higher levels of technology such as the seed, fertilizer, weed control and dry sowing package introduced by the project.

4.8 Availability of Farm Inputs

The unavailability of farm inputs (or their unavailability at the required time) leads to non use or to a delayed use of these inputs. The most important inputs (apart from draught power discussed above) for which farmers are dependent on external sources are seed, fertilizer and pesticides. Weedicides too may become an important input in the future, if the practice of dry sowing becomes popular.

In the project, availability of inputs did not appear to be an important problem since seed requirements were well looked after by the project, while fertilizer was not a priority item to many farmers in the project areas. Only a very small number needed weedicides. But their availability may become important in the future. Experience in the project indicates that many farmers tend to use fertilizer under larger tanks (particularly in the Maha-wewa group), while very few use under smaller tanks which are usually dry sown. As explained later, this was the main reason for achieving high yields under some tanks and low yields under some others (particularly in dry sown crops).

---

1 Refers to technology relating to cultural practices in paddy cultivation

4.9 Structural Features of Tanks and Distribution System

Certain structural features of tanks which impose certain difficulties in the control of water were observed in the tanks under study. These features are enumerated below:

a) Certain tanks have more than one outlet, a main sluice and one or two other sluices. The multiple sluice structure imposes certain difficulties in the control of water. This is further aggravated by their location. The main sluice is usually at a lower elevation than the other sluices and so are the paddy fields it serves. Hence the fields fed by the secondary sluices would usually be experiencing water stress relatively earlier. This leads to uneven demands for water for different areas of the tract.

b) Even in instances where there is only one sluice, instances of uneven location of fields are observed, particularly in large tanks. This also leads to differential demands for water in different parts of the tract.

c) When tanks are placed one below the other, filling of one tank leads to the submergence of the lower part of the paddy tract served by the one above. This leads to a delayed start of cultivation operations in the lower part of the tract above.

d) The existence of lands on the side of the main tracts over which spill water flows. These lands (Kotupath lands) are under water when the tank is spilling and hence can be cultivated only when the heavy rains are over. Although these lands are not part of the main tract, their operation can have a strong influence on the main tract, particularly when strong personalities are involved. They depend on tank water for their cultivation.

e) The system of distribution of water within the tract is usually highly complex and this complexity is mostly due to the extensive parcelisation of land. It also depends on other factors such as the layout of the tract and its gradient. The normal layout of individual parcels (fields) is horizontal (parallel to the bund) and the liyaddas [1] within a individual

1 Liyadda - A paddy 'plot', bounded by bunds for purposes of impounding water.

parcel too are arranged horizontally. This necessitates horizontal distributary channels feeding from the main channel so that each parcel could be fed from one of these distributary channels. Most tanks conformed to this general pattern but with considerable modifications.

f) Asweddumisation of additional land under the tank, results in insufficient storage capacity of the tank to meet the requirement of the expanded tract. These encroachments too have to be supplied with tank water. In addition to the increased demand for water, there are other complications as well such as more complex distribution systems, and difficulties in adhering to a cultivation calendar. The problem is usually aggravated when powerful personalities are involved and the encroachments are relatively old. Encroachments were a major issue in one of the tanks - Ihalagama tank at Mahannaneriya.

g) Improper location of the sluice often causes problems. The elevation of the sluice in relating to the elevation of the fields is important. In certain instances, some fields remain at a higher elevation thus making them non-irrigable with tank water.

h) Cultivation of the tank bed leads to siting of the tank. Furthermore those who are interested in tank bed cultivation, will not be interested in the tank having water and would encourage the use of water as early as possible in the Maha season. This problem is unusually acute when powerful personalities are involved.

These features observed in the tanks were of a permanent nature and hence difficult (if not impossible) to be corrected. Such structural feature are a common incidence in most village tanks. They are usually ignored in tank rehabilitation work, due to the difficulties involved (in particular expenses involved) in correcting. The idea of enemerating these features is to give the reader some idea of the varied conditions commonly associated with these tanks, which are going to remain even after rehabilitation work.

4.10 Structural Defects of Tanks and Distribution System.

Another feature having a bearing on water management is any structural defects that these tanks suffer. Unlike the structural features discussed earlier these defects could be corrected relatively easily and are usually attended to in rehabilitation work.[1] Some of the structural defects of tanks in the project areas are noted below.

1) Defective sluice

The success of any approach to water management depends on the ability to control water at the sluice. As mentioned, some tanks have more than one outlet. The functioning of all outlets is important. The Nithogama tank had no proper sluice at the time of the project while in another, the sluice was defective.

2) Defective Spill Channel and Improper Location of Spill

As a result of defective spill channels and improper location of spill, water may run through paddy fields as was observed in one of the instances. Due to this reason, farmers wait until the heavy December rains are over to commence their cultivation.

3) Low Spill

Low spill results in low storage of water in the tank. There is however a limit to the height of the spill since it leads to submergence of land at the top of the tank,and also has implications for its own strength.

4) Poor Conditions of the Main Channel and Distribution Channels

In some instances both main channels and distributory channels were in a poor state of maintenance and needed extensive repair. In certain instances, main channels were in need of control structures. One noticable feature in rehabilitation efforts was the lesser emphasis paid to rehabilitation of the distribution system compared to rehabilitation of the tank.

---

1 In the project water management work has commenced even while rehabilitation work was going on in certain tanks.

5) Defective Bund

Certain bunds needed repair such as widening, repairing of eroded points, removing of weeds, gravelling and turfing.

Although it is expected that a tank will be 'handed over' for water management only after the rehabilitation work has been completed, many of the tanks that came under the project were in need of repairs and additional structures.[1] For instance, in one of the documents[2], a total of 63 repairs that these tanks needed was listed. These were the main subjects discussed in the meetings held in connection with the project.[3] However, even if one assumes a 'perfect job' in the rehabilitation, certain structural defects which will 'interfere' with proper control and careful use of water could be expected to remain.

5. EVALUATION OF THE SUCCESS OF THE EXPERIMENT

It is intended here to assess the success of the experiment from a broader perspective, looking at the various objectives that the experiment intended to achieve. The successes and failures of the experiment should be viewed with reference to the previous discussion on factors influencing water management.

5.1 Achieving a Higher Cropping Intensity.

One of the foremost objectives of conserving Maha water is to achieve a higher cropping intensity in the Yala season. According to the data available at the project office,[4] cropping intensity computed on the basis of extent sown was 133%, an intensity of 100% in 1979/80 Maha and 33% in Yala 1980 (see Table 4).

1 Ref. to minutes of meetings held in connection with the project. See comment made earlier relating to the state of rehabilitation of these tanks, and commencement of water management work.

2 Repairs listed by cultivation officers in respect of 10 tanks.

3 In listening to discussions that took place at these meetings and in reading through the minutes of meetings, one gets the impression that these meetings were held mainly (if not solely) to get the Irrigation Dept. to attend to these defective structures.

4 Report from DAEO, 9th June 1980.

The corresponding figure for the whole district for minor irrigation was 140% computed on the basis of extent sown, with the Maha intensity considered as 100%.[1] Thus the project failed to achieve a higher cropping intensity in Yala in its first year[2] compared to the achievement in the district as a whole under minor irrigation.

A word of caution should be added in connection with these statistics as the word "minor" by definition includes all irrigation schemes with command areas up to 200 acres. There is a strong posibility that comparatively larger schemes usually achieve higher cropping intensities in Yala compared to smaller ones and hence do influence the district figure. So the 133% attained in the ten tanks may be higher than in comparable sized schemes.

However, considering one of the criteria in the selection of tanks ie. no cropping in the previous Yala season, the present performance can be considered an achievement. The cropping intensity achieved in 1979/80 season is higher than that achieved in the previous season, when the water management project was introduced.

Table 4 - Performance of the ten tanks project (79/80 and 80 Yala).

Name of Tank	Extent sown Maha 79/80 (Acres)[a]	Yield Maha 79/80 (Bu/Acre)	Extent sown Yala 80 (Acres)	
			Rice	Other food crops/ Vegetables
Ihalagamawewa	20	42	20	-
Monnakulama wewa	45	67	15	-
Nugampola wewa	17	52	04	-
Ihalagamawewa (Mahananneriya)	64	50	-	-
Ankendakumburawewa	31	39	20	6
Nithogama wewa	35	72	-	10
Pahala wewalayagedera wewa	35	54	-	05
Pahalawewa	19	41	-	-
Moragaswewa	29	47	-	05
Mamunugamagedera wewa	34	58	10	08
AVERAGE	35	52	7	3

[a] Extent sown was equal to the command area in all cases. Maha crop was paddy

1 Based on census data.

2 Although the project commenced in the previous year a concentrated effort was made only in the current year.

An attempt was made to compare the cropping intensities achieved in the three groups of tanks, those feeding an extent of less than 20 acres, 20-40 acres and over 40 acres. However only 2 tanks fell into the third category, while the first two categories included 3 and 5 each. Hence the comparison is of limited value. The cropping intensities were, however, different: 117% in the smallest tanks, 156% in the middle group, and 117% in the largest tanks. The higher cropping intensities were achieved in the middle group.

5.2 Achieving Higher Productivity

The yields obtained in the Maha 79/80 season in the ten project areas ranged from 39 to 72 bu/Acre (Table 4). The district figure for the 1979/80 season for minor irrigated areas was 62 bushels. In two tank areas, yields above this figure were achieved.[1] The lower yields achieved in the other tanks could be attributed to the low technology strategy adopted by farmers, specifically the low use of fertilizer and poor weed control as discussed later under item 5.7.

When comparing with the previous season productivity, seven tanks have performed better, two worse, while in the other, the yield was the same. From this point of view, the performance in 1979/80 Maha is superior compared to the previous Maha.

A comparison of yields with cropping intensities indicates that higher cropping intensities had not been associated with higher yields and vice-versa.

It was further observed that dry sowing although was associated with early harvesting and high cropping intensities, was not associated with high levels of technology and higher levels of productivity. On the other hand mud sowing which was associated with high levels of technology and high levels of productivity was not associated with early harvesting and high cropping intensities. Thus the

1 In relatively larger minor schemes, high yields may have been achieved and this could have influenced the district figure.

achievement of the twin objectives of high yields and high cropping intensities appears to be somewhat conflicting under the prevailing conditions. An attempt to put together these observations and the possible causes is made at the end of section 5.

The average cropping intensities and the average yields of the three groups of tanks indicate, a far high achievement in terms of cropping intensities in the second category of tanks adding evidence to the superior performance of this group (see Table 5). In terms of productivity the larger tanks have performed better.

Table 5 - Cropping intensities and yields of individual Tanks.

	Name of Tank	Yield/Acre (Bu.) 79/80 Maha	Average	Cropping Intensity %	Average
Group I - Tanks with command areas 20 acres.	Nugampolawewa	52	49	123	117
	Pahala vevalayagedera wewa	54		128	
	Pahalawewa	41		100	
Tanks with command areas 20-40 acres	Ihalagamawewa (Tambaranbuwa)	42	52	<u>200</u>	156
	Ankenda-kumbukwewa	39		<u>182</u>	
	Nithogama wewa	<u>72</u>		128	
	Moragaswewa	47		117	
	Mamunugamagedera-wewa	<u>58</u>		<u>153</u>	
Tanks with command areas over 40 acres	Ihalagamawewa (Mahananneriya)	50	59	100	117
	Monnakulama wewa	<u>67</u>		133	

(Highest three values are underlined).

5.3 Popularisation of the practice of dry sowing

The pre-project analysis of the Kurunegala district has commented on the lack of popularity of the practice of dry sowing. Although it was anticipated to popularise this practice under the project, a successful job of introducing dry sowing was achieved only in two tanks. (Ihalagama wewa - Tambarambuwa and Ankenda Kumbukwewa). The available data indicate that in both these cases, early harvesting (see below) and high cropping intensities were achieved but were associated with low yields. The earlier discussions on farming system paid attention to certain reasons for farmers' lack of preference for dry sowing (section 4.3).

5.4 Control of Tank Water

In five of the ten tanks (Tambarambuwa, Nugampola, Ankendawa, Moragaswewa, Mahunugedera-gama wewa), satisfactory control of water was achieved. Of the other five, two had defective control structures while in the rest, irregular issues were made depending on demands made by farmers for water. (In one of the tanks, the padlock used for the sluicegate was broken twice in the season). The presence of encroachers seems to be a major reason for conflicts. As was mentioned, there was little participation of farmers in the control of tank water. The participation was mostly limited to a KVS working with a few farmers (usually good farmers from an extension point of view; often contact farmers). The subject of farmer participation in water management was discussed earlier in a more general way. (section 4.4)

5.5 Achieving Early Harvesting.

The expected harvesting times for the Maha season as discussed at the project meeting of 29th June 1980 are given in Table 6. Actual time of harvest, coincided with these dates. Assuming that the months of January and February are suitable for harvesting (meaning not too late) in only 5 of the 10 tanks could harvesting time be considered satisfactory. It was observed that dry-sown crops were harvested as early as January.

Table 6 - Time of Harvest of the Respective Tanks.

Name of the Tank	Expected time of harvest (for completion of harvesting operations).
Ihalagama (Tambarambuwa)	31st Jan.
Monnakulama wewa	20th March

Name of the Tank	Expected time of harvest (for completion of harvesting operations).
Nugampola wewa	15th March
Ihalagama wewa (Mahananneriya)	20th March
Ankendakumbukwewa	31st Jan.
Nithogama wewa	15th March
Pahala-wewalayagedera wewa	15th-20th Feb.
Pahalawewa	20th March
Moragaswewa	20th Feb
Mamunugamagedera wewa	20th Feb.

Early harvesting is the combined effect of early sowing and use of short-age varieties. Since in this instance, short-age improved varieties had been used, the late harvesting was the result of late establishment. A number of reasons were responsible for the delays in establishment. These include unavailability of tractors (at Monnakulama), defective sluice (at Nugampola), deyals due to other agricultural activities specifically chena and paddy and difficulties in obtaining animals for land preparation work (Pahalawewa, Nagollagama and Ihalagama wewa at Monnakulama). Closely associated with delayed establishment is the staggering of cultivation operations.

5.6 Avoidance of Staggering

Avoidance of staggering is another objective of the experiment. That the realisation of this objective has met with little success is evident from the following figures on the time of commencement of cultivation operations in a number of tanks during the experiment.

Name of Tank	Period of commencement of cultivation operations in the tract.
Pahalawewa (Nagollagama)	2nd Oct. - 14th Nov.
Ihalagama wewa (Mahananneriya)	10th Oct. - 5th Nov.
Ankendakumbukwewa	1st Sep. - 20th Oct.
Monnakulama wewa	1st Nov. - 20th Dec.
Nithogama wewa	2nd Nov. - 20th Nov.

In some of the tanks such as Monnakulama, cultivation was undertaken in three stages. The main reasons for the delays and hence for the staggering were farmers' own commitments in other fields or chena and the unavailability of draught power for land preparation work.

It appears that the process of planning cultivation operations on a tank basis is one of the causes for farmers' lack of 'cooperation'in organised cultivation. Farmers do in practice plan the entire system - the chena and the network of tanks which they operate - and not one single tank. Hence in planning water management, the entire farming system of a particular farming community (a village) should be considered as the unit and should be involved in decisions.

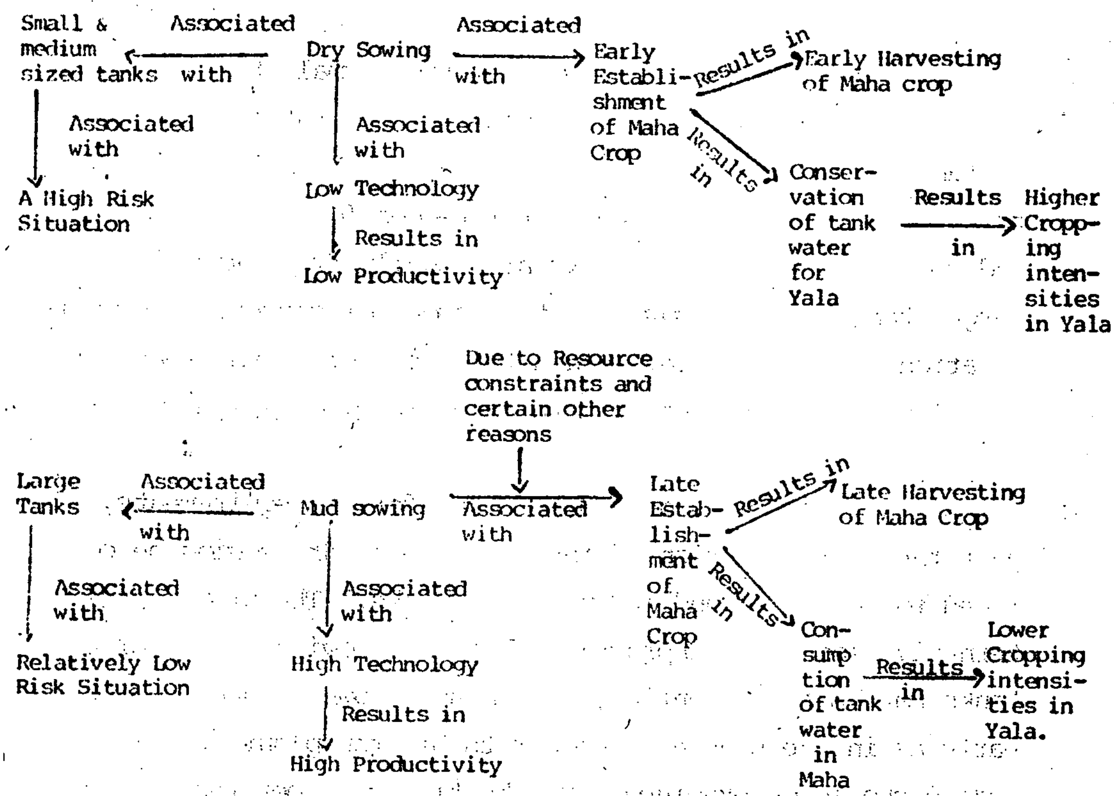
5.7 Achieving a Higher Level of Technology.

By technology here is meant the package of practices required to achieve higher yields from a paddy crop. In this programme these include new improved varieties, fertilizer and weed control. Use of short duration improved varieties were achieved in all instances. These include BG 34-8, 64/355, BG 94-1 and BG 94-2. (As commented in the pre-project analysis of the Kurunegala project, there has been a tendency to move from 4-4½ month varieties to 3-3½ month varieties in the district generally). There was however considerable variation among farmers in any one tract in the use of varieties; for instance in one tract, five varieties were in use.

Fertilizer use, on the other hand, was low in a majority of the tanks. Farmers' own perceptions of the requirement of fertilizer, financial constraints and the related issue of credit restrictions were the factors responsible. Nithogama was one of the tanks which recorded a relatively high rate of use of fertilizer (in addition weedicides also were used). The highest yields were achieved here, though it must be added that in this tank, the crop was mud sown and the tank had defective control structures, so water control was not practised On the other hand under the Ankenda-kumbukwewa tank, where dry sowing early in the season and satisfactory water control was achieved, the yields were low. The low yields here could be assigned to low rate of use of fertilizer and poor weed control, both of which are particularly important in a dry sown crop. The same comment could be made for the Ihalagama tank (at Tambarambuwa) which was the other successful case of introducing dry sowing.

Fertilizer and weed control seem to be particularly important for achieving high productivity in a dry sown crop.

Based on the experiences of the project the following generalisation could be made in reference to the different farming practices adopted the results obtained and associated conditions.



The available avenues of development under the circumstances appear to be (a) the improvement of technology associated with dry sowing as a means of achieving higher levels of productivity in instances where dry sowing is suitable. (b) In achieving higher cropping intensities in mud sown crops by advancing cropping calenders, using short duration varieties and possibly through transplanting.

6. CONCLUSIONS

a) Medium size tanks (those feeding around 20-40 acres) seem to be the group which offers fewer constraints and hence greater prospects for improved water management in general and the application of the project model in particular. In the smaller tanks, there is little gain from conserving Maha water for the Yala season (hence the objective should be to make best use of the water in Maha) while the larger tanks seem to demand a modified approach from the one adopted in the project. Dry sowing in particular does not appear to suit this group of tanks[1].

b) The farming system adopted - chena first, small tanks next and finally the large tanks - seems to be a rational system of land use under the prevailing conditions. Associated with the system are certain farmer preferences for dry sowing and mud sowing. The smaller tanks are usually dry sown while the larger tanks are mud sown, due to reasons discussed. Any modifications to this system should take account of the reasons that lead to the respective practices of this system.

c) It is suggested, in order to meet the farmer requirements, that the popularisation of the practice of dry sowing be confined to the small and medium-sized tanks. The probable alternative (possibly improvement) for mud sowing under large tanks may be transplanting, with plants sown in nurseries as early as in the season. The merits of transplanting in this regard should be examined. By the time a farmer reaches this category of tanks in his planting programme, he should be in a position to spend his family labour in transplanting.

---

1 The discussion is limited to small village tanks as the title of the papers itself refers. Hence the terms small, medium and large tanks should be interpreted in this context.

d) Early dry sowing tends to be associated with high cropping intensities and early harvesting but with low yields unless properly fertilized and weeds controlled. Hence the need to associate these practices with dry sowing. Easy availability of fertilizer is important in this regard. Hand weeding and row sowing (as attempted in the demonstrations) seem to be the answer to weed control, rather than use of weedicides, looking at the choice of means in terms of cost and preferences of farmers.

e) There seems to be little participation by the majority of farmers in water management planning and work under this system, while rehabilitation work is done completely isolated from them. Farmer participation is extremely important and should begin with the commencement of rehabilitation planning and operations. Hence it is suggested that farmers be involved in rehabilitation work of these tanks particularly in decision making. Having an elected representative of farmers under the new Agrarian Services Act could help as a contact point in obtaining this involvement. (Preferably some appropriate kind of organisation may be formed under this leadership for matters concerning rehabilitation and subsequent water management). Farmers should be told what is planned to be done, and their views should be obtained and respected. Farmers' satisfaction with a rehabilitation work should be considered as an important indicator in assessing programme performance since it affects any on-going water management effort.

f) It is extremely important to ensure high quality standards in rehabilitation work, both in obtaining farmers' cooperation in water management and for the physical control of water.

g) In matters concerning farming operations (such as timing of operations) and control of water, involvement of farmers is particularly important. In this respect, Kanna meetings are essential. At present, the participation is usually limited to few good farmers. A possible improvement may be to involve the elected representative and involve as many farmers as possible in discussions.

h) Tank rehabilitation work tends to take too long, leading to considerable difficulties for farmers. This can result in a loss of faith in the whole approach to rehabilitation and water management. Hence rehabilitation work should be completed as quickly as possible. In doing so, all defects should receive attention, since one defect could result in a lack of usefulness of all other work.

i) There are certain issues that need attention but cannot be corrected in the short term. Specifically these include the extensive fragmentation of paddy holding, the scattering of parcels, the prevailing land tenure systems, the land distribution pattern, and the water distribution system in the tract. These issues are usually interconnected.

j) In planning water management, it is desirable to look at the whole system of cultivation (the chena and the chain of tanks farmed by a certain village) not devoting attention just to individual tanks. This makes water management more meaningful in the village context and should make organised cultivation more feasible.

k) This project suffered from a common weakness in that it attempted to introduce a large number of innovations (an appreciable jump) under a set of highly variable conditions. A heavy extension input was accordingly made in a small area as done in most pilot projects. A justification for this may be the experimental nature of the project. An alternative to this approach would be to aim at less complex and extensive changes but over a larger area. In general, there is need for the popularisation of the concept and technology (if possible) of water management throughout the area.

l) The hazards of early dry sowing have been discussed in relation to rainfall. Accordingly it is desirable to commence dry sowing after initial Maha rains are over. This would mean dry sowing in the first half of October. Generally use of 3½ month varieties is preferred over 4-4½ month varieties. This suggestion needs further examination and approval by agronomists working on related problems.

m) The 'failures' of the project appeared to be the inability to achieve early establishment of the crop and avoid staggering. Farmers' other 'commitments' and unavailability of draught power have been the main reasons responsible. In this regard, availability of draught power seems to be an important pre-requisite in achieving any more organised cultivation. Hence this issue needs attention of the project.

n) In conclusion one should ask in summary terms, 'what benefits will result (to the farmers in Kurunegala) from the tank rehabilitation and water management effort under the project'. Since the rehabilitation of first set of tanks has been completed, this aspect should be examined, more extensively and systematically than we could do with a study of the first ten tanks. There are some encouraging signs of improvement, although the initial evidence in the form of widespread adoption of the new methods is not that strong, suggesting at most a more focused application of the method and a paringdown of the "package" itself. Attention needs to be given particularly to the cost factors to the farmer and to the government to be certain that the gains to each are sufficient to justify the costs.