# Planning and Design Issues of Rehabilitation

*Proceedings of the Workshop on Planning and Design Issues of Rehabilitation Held on 5/6 December 1995 at Irrigation Training Institute, Galgamuwa*


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# Foreword

Irrigation rehabilitation is one of the key items of the current agenda of the Irrigation Department and also of the other irrigation institutions in the country. Planning and design of irrigation rehabilitation constitute the most important step in the rehabilitation process as the construction which follows it would be limited to essential improvements identified after the rigorous planning and design process.

Unlike in new construction where the engineer is free to apply his theoretical and technical knowledge, irrigation rehabilitation requires a multidisciplinary integrated input in the planning and design process. Apart from that, even purely technical interventions have to be formulated considering the given limitations imposed by the existing irrigation system.

IRMU research studies have also revealed that much of the weaknesses in the rehabilitation lies within the planning and design process and that a broader outlook is necessary for a change.

The expertise and exposure necessary for a broader outlook is also available within the irrigation institutions though not evenly distributed for various reasons. Therefore, it was thought that a Workshop on "Planning and Design Issues of Rehabilitation" should be held jointly sponsored by IRMU and Sri Lanka Irrigation and Training Institute (SLITI), to bring some of the critical planning and design issues to surface. In this exercise, it was thought that those could be resolved within the workshop, and that to solve the remaining controversial issues participants would be able to agree on a research agenda.

This volume is the report of the proceedings of the above workshop held at the Irrigation Training Institute, Galagamuwa, Sri Lanka from 5 to 6 December 1995.

We are thankful to Mr. H. M. Jayathilake, Deputy Director, ITI for undertaking the co-sponsorship of the Workshop and contributing in various ways to its success, including facilitation of the workshop. We are also thankful to him and his staff for the logistical support extended to the Workshop. Special thanks are due to the Senior Directorate and the Project Director (NIRP) who actively participated in all the proceedings. We also appreciates the contribution of all the participants of the workshop without which this outcome would not have been possible.

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## Welcome Address

### Mr. B. M. S. Samarasekara, Deputy Director (IRMU)

It is a pleasure to see that the workshop is well attended with all members of the Senior Directorate and most of the Range Deputy Directors.

I would like to extend my thanks and gratitude for your presence at this workshop, which has been organized jointly with the ITI with the blessings and support of the International Irrigation Management Institute and the National Irrigation Rehabilitation Project.

Due to certain limitations there was a problem in inviting all the participants IRMU wished to have in the workshop. IRMU is keen to identify research activities that would be relevant to irrigation rehabilitation through the workshop. This would also provide a forum to share different experiences of rehabilitation and would be a training ground. It would be able to resolve at least some pressing issues of rehabilitation.

I wish you would enjoy the stay at ITI and contribute in all small and large group discussions and make every effort to make this workshop a success.

## Introduction to the Workshop—Planning and Design Procedure: NIRP Experience

### Mr. K. S. R. De Silva, Project Director (NIRP)

There are various drawbacks in the planning and design work related to irrigation rehabilitation. Rehabilitation design of a minor scheme takes more than a year sometimes, which is often inexplicable. Though it is essential to consider the operational plan of a scheme before designing it, some engineers often design the scheme first on assuming certain things and then try to formulate an operational plan much later when the scheme is completed. We should look for the reasons behind these lapses. A workshop of this nature will help identify some of the causes behind these lapses.

Most countries have their own design standards for irrigation rehabilitation. NIRP is in the process of formulating one such based on its experience. Some of the problems mentioned earlier could be rectified by applying this design standard.

There are success stories aiso such as Ketawela where a computer program has been successfully used for water management. I am glad that the engineer responsible for implementing it has been invited to the workshop at the last moment though he was overlooked initially.

I went through the issue paper and found that it is very comprehensive. But I have my doubts whether there would be enough time to discuss every issue listed. However, I wish the workshop would be a success.

# Keynote Address

## Mr. L. T. Wijesooriya Senior Deputy Director (Rehabilitation and Training)

The history of irrigation development of the country can be divided into distinct phases. Studying the evolution of events would enable us to see where we stand today. During the first phase which ended around the 1960s most of the irrigation schemes were already developed. The word "rehabilitation" was not in the irrigation vocabulary at that time. What was much talked about at the time was "restoration."

The 1960-70 period focused attention on on-farm water management which was the prevalent world trend at that time. This was a donor-given concept supported by a donor-driven program.

The 1980s were dominated by the concepts of beneficiary participation and multidisciplinary approach to irrigation management. These concepts were included in the donor-driven rehabilitation programs which provided funds for rebuilding of now deteriorated systems built more than 30-40 years ago.

The Galoya water management program still referred to in most fora as the forerunner to the most spoken concepts today came to being during early 1980s. Many experiments were conducted and most of the later rehabilitation programs were launched on lines similar to those at Galoya. During this period, The Integrated Rural Development Project (IRDP) also undertook to rehabilitate minor schemes (25,000 acres) as part of its rural development effort. The Village Irrigation Rehabilitation Project (VIRP) also emerged during the same period idolising the same concepts though funding came from a different source.

Minipe-Nagadeepa commenced in 1990's contained an entirely different package. The National Irrigation Rehabilitation Project (NIRP) the forebearer of the VIRP demanded more farmer participation in all stages of rehabilitation including a 10 percent contribution.

The rehabilitation programs completed and ongoing are tabulated as follows:

| Completed Projects | | Ongoing Projects | |
|---|---|---|---|
| Project | Area (acres) | Project | Area (acres) |
| Tank Irrigation Modernization Project (TIMP) | 32,000 | Irrigation System Management Project (ISMP) | 155,000 |
| Gal Oya Water Management Project | 60,000 | National Irrigation Rehabilitation Project (NIRP) | 31,225 |
| Major Irrigation Rehabilitation Project (MIRP) | 24,525 | Minipe-Nagadeepa Rehabilitation Project | 19,745 |
| Integrated Rural Development Project (IRDP) | 25,000 | Gal Oya River Diversion Project | 30,000 |
| | | Integrated Rural Development Project (IRDP) | 6,000 |

With all these we still have to rehabilitate Galoya Left Bank (LB) schemes in the northeast of the country which did not get any assistance during the past 10-15 years. Walawe and several other schemes in the southern part of the country totaling about 250,000 acres have also to be rehabilitated. In facing this challenge we can use the experiences learnt from the past attempts at rehabilitation.

Let us answer the question "Were these projects really necessary?"; "Coudn't we have done the same or more if we had used our operation and maintenance (O&M) funds more effectively?"; "Were we forced to accept certain idealogies and concepts which did not work or were not conducive to the country?"; "Is the program mode of implementation more applicable to rehabilitation than the project mode we adopted in all donor-driven rehabilitation programs?"; and "What lessons could we learn from each of these programs?"

The time has come to have national standards for irrigation rehabilitation which not only the Irrigation Department (ID) but all other agencies that undertakes rehabilitation can use.

# SUMMARY PROCEEDINGS

## Introduction

The workshop on Planning and Design Issues of Rehabilitation was held at the Irrigation Training Institute (ITI), Galgamuwa, on 5th and 6th December, 1995 as a jointly organised workshop of IRMU and ITI of the Irrigation Department. Both NIRP and IIMI funded the workshop. It was attended by 48 participants from the ID, MECA and DAS. ID was represented by all members of the Senior Directorate, most of the Range DDs and selected engineers who have contributed to the planning and designing of irrigation rehabilitation. MECA was represented by a DRPM who was involved in the Uda Walwe planning and design work and a senior engineer working in the design office of MECA. DAS was represented by the Head, Water Management Unit of the DAS. (See the list of participants in Annex I).

## Objectives

The main objectives of the workshop were

- To identify planning and design issues pertaining to irrigation rehabilitation and to resolve or propose action to resolve those.
- To identify further research activities necessary to resolve those issues.

## Workshop Methodology

The workshop was centered on an issue paper jointly prepared by IRMU and ITI after consulting the ID engineers. The contributions to the issue paper was invited through a letter circulated among the ID engineers for which there was a very positive response. (The issue paper is in Annex II). The participants were divided into three small groups and different issues were given to each group to discuss. (See Annex III for group distribution).

| Issue Paper | Questions | Group |
|---|---|---|
| Part I | 1 & 2 | A |
| | 3 & 4 | B |
| | 5 & 6 | C |
| Part II | 1 & 2 | C |
| | 3 & 4 | A |
| | 5 | B |
| Part III | 1,2,3,4,5 | A |
| | 6,7,8,9,10 | C |
| | 11,12,13,14,15 | B |

# TECHNICAL SESSIONS

## Issue Paper–Part I

Q1. The presenter for the group said that the definition of rehabilitation has changed with time. Farmer participation and crop diversification are some of the concepts that have also influenced the scope and the process of rehabilitation which the group has duly incorporated in the definition. The definition of "rehabilitation" according to the group's perspective is given below.

Rehabilitation is a process of improving an inefficient irrigation system after full diagnosis and investigation of resources such as water, land and human resources and redesigning *wherever necessary* the construction of the system to meet the current and *foreseable* future requirements including crop diversification and improving institutional arrangements for operation and maintenance (O&M) with beneficiary participation at all levels to meet the ultimate objectives of the system.

The words in italics were introduced after the plenary session deliberations. Some objected to the inclusion of the word redesigning as it is beyond the scope of rehabilitation given the budgetary limitations and the total change of an already established irrigation system needs a lot of money whose expenditure cannot be justified by the benefits that could be acquired. They also said that redesigning would also affect the regime conditions established over years and therefore would bring unnecessary new problems.

However, there are situations where redesigning is the only solution to an aggravated problem and therefore having a predetermined notion that a system should never be redesigned is not sound. Those who supported this view also said that in certain places where the regime condition has been achieved through a major change in the channel section there would be less system response to rotation and therefore such sections should be changed. There will be a need for redesign where there is a complete change in the objectives of the system like crop diversification. There would be other situations like increase in the command area due to encroachment which necessitiate redesigning of the irrigation system to cater to these requirements too, if it is possible to do so without affecting the legal landowners. Roughness factor of the canals would have changed after many years of use. In such situations too redesigning may be required.

The words "wherever necessary" were included to incorporate both these views.

The idea that rehabilitation should look into the future requirements of the schemes was also not seen as practicable. The words "foreseable future" were introduced to make it more practicable.

The word "inefficient" appearing in the first line of the definition was introduced when it was pointed out that the original word "deteroriated" proposed by the group was found to be inappropriate. Some members were of the view that there can be a system or part of the system that has not been deteriorated but not functioning efficiently. Such sections or systems should be changed in the rehabilitation. (*By this members emphasised that the main thrust should be to improve the efficiency of the system and not how it look liked externally.)*

In presenting the group's view the presenter said that the need for rehabilitation arises out of poor O&M. However, the large group's view was that the need for rehabilitation can also occur for other reasons as well. They said that with time everything deteriorates and that alone could create a need for rehabilitation. A new need of the farming community that prefers to adopt a different crop could also create a need for system rehabilitation.

There was a difference of opinion about using the word diagnose. The term obviously has originated from the medical profession. It refers to the determination of the causes of a problem by observation of the affected system. However, some said this is a word introduced by donors/consultants to confuse matters and the ID need not borrow such words. The Oxford Dictionary interpretation of the word diagnose is to assess the cause by looking at the symptoms. This is different from investigation which the dictionary notes as carrying out detailed experiments to determine the cause of failure. One view was that engineers should stick to investigations which will reveal the cause without doubt. Another observation

made in the plenary session was that the unnecessary long durations of some previous studies resulting in wastage of funds have made this process unpopular.

The other view was that if a disease could be diagnosed without costly experiments why not give that simple exercise a chance. It would also give the engineers a clue to what further experiments should be carried out and therefore diagnoses and detail investigations could be complementary to each other. Diagnose also mean that you give your patient sufficient room to come out with his/her difficulties and also getting his participation in the analysis process to some extent. In irrigation rehabilitation it means that farmers will be consulted to find out the overall difficulties and problems they encountered and will be encountered in future in case of a change like new crops, a new rotation system they want to try, etc., to ascertain the causes and also to establish the necessary changes. In a diagnostic analysis not only engineering problems but the overall scenario of the system will be considered as the main source of information would be the beneficiary and not the physical system.

The group in its presentation also said that before a project is undertaken for rehabilitation the following factors and constraints need to be investigated:

a. Availability of water: diverted water flowing into the scheme would result in an excess of water. Similarly, water may be scarce due to various reasons such as increase of the command area and change of the hydrological pattern.

b. Land Availability: Encroached land, if irrigable may have to be provided with irrigation facilities.

c. Human Resources Availability: For example, farmers' capacity to participate in the management activities has to be investigated. It is found that some farmers are not willing to take over the rehabilitated schemes, which were intended to be handed over to them.

It was also pointed out that beneficiary participation is required at every stage of the rehabilitation process. Otherwise, the result of the rehabilitation effort may not be very effective because the farmer requirements will not be reflected in the rehabilitation.

Q2. The following were the super goals, goals, objectives, indicators to assess the achievement of objectives, and the outputs expected in achieving the objectives of the different partners of rehabilitation.

**Agency**

Super Goal : Optimize water usage and maximize production

Goal : Improved system management

| Objectives | Indicators |
|---|---|
| Improved physical status | BM study |
| Improved institutional arrangements | Number of registered farmer organizations |
| Enhanced productivity | Yield per acre/Cropping intensity |
| Efficient water use | Water management |
| Enhanced environmental sustainability | Salinity/Water quality |

## Output

- Rehabilitated system
- Strengthened farmer organizations
- Trained officers and farmers
- Strengthened extension services
- Water measurement structures/institutional arrangements
- Flood control drainage facilities

## State

Super Goal : Better living conditions
Goal : Increased GNP

| Objectives | Indicators |
|---|---|
| Sustainable irrigation system | Less O&M cost by the state |
| Increased food production | Yield per acre/Cropping intensity |

## Output

- Rehabilitated system
- Strengthened institutional arrangements

## Farmers

Super Goal : Better living
Goal : Higher income

| Objectives | Indicators |
|---|---|
| Higher productivity | Yield per acre |
| Improved input services | Fertilizer usage |
| Improved communication facilities | -- |
| Improved marketing facilities | Farm-gate price of produce |
| Equitable water distribution | Yield per unit of water |
| Improved environment | Hospital turnover |

## Output

- Rehabilitated system, headworks, canals and structures

In presenting the above, the group said that its members have only identified typical objectives but there could be many. The time limit restricted their focus only to those few typical objectives.

The group also pointed out that the objectives of the agency, state and farmers should add up to give the final objective of the rehabilitation.

The view of the larger group was that improved institutional arrangement identified as the second objective of the agency could be an output rather than an objective. It was also noted that if adequate attention is not paid to the development of the farmer organizations they may require rehabilitation after some time and therefore it is good to have improved institutional arrangements as an agency objective rather than as an output.

The validity of the less O&M cost as one of the indicators of the objective of achieving a sustainable irrigation system was questioned at the large group meeting. It was said that it is what donors want us to believe but not the reality. Even if it is taken as an indicator it is not a very suitable indicator for all occasions. Although farmers were expected to make monetary contributions to the O & M of the system this has not happened at the expected level. (Dr. K. A. Haq of IRMU said that the research carried out so far has revealed that the farmers expect the assistance in the form of O&M funds, technical advice and training.)

It is more realistic to expect non-monetary contributions from farmers. It was revealed that the O&M of the distributary canals and field channels handed over to farmers is not being done properly at some schemes. As a result, less complaints by the farmers may be a better indicator. The larger group's view was that even if the proposition that the less O&M cost by the state is going to work alright in the future, classifying it as an indicator is wrong and it should be classified as an objective.

Turning over the system is a means to achieve less O&M cost by the state but it should not be categorized as an objective of the rehabilitation which is often done by donors. There was also controversy regarding the proposition that turning over leads to less O&M cost.

A question raised at the large group was how to assess the degree of participation, especially of the beneficiaries. Arising from this is the further question "What is the expected level of participation?" The concensus of the large group was that the most important question was not any of those but the ways to ensure maximum participation. The response was that it all depends on how each party understands the other's objectives and try to accommodate them in the rehabilitation process. If that happens rehabilitation will end up satisfying all the parties involved and will ensure maximum participation.

The group's view that farmers want equitable water distribution was also challenged at the large group deliberations. The comment was that farmers only talk of equity in distribution when they are being affected by the inequitable distribution of water. The farmers who get more than their individual share of water never call for equitable distribution of water. The equitable distribution of water will be the dream of the agency as it would relieve it from having to attend to frequent complaints from the farmers who are affected by this unequal distribution of water. The individual farmer would want water in sufficient quantities at the required time. Reliability and adequacy of water would be the objectives of the individual farmer.

The donors were also considered as partners in the rehabilitation exercise in addition to the other partners identified in the issue paper. Their super goals, goals and objectives were also listed.

Super Goal : Enhance free economy

Goal : Enhance GNP of the recipient country

Objective : Improved income of the beneficiaries

Q3. The group developed the following guidelines as a prelude to preparing the criteria, and they should be assessed before a decision is taken for rehabilitation.

I. The condition of the scheme and difficulty in system operation— This will assess whether there is a need for rehabilitation and if so, how strong its need.

II. The percentage of farmers' income generation from the scheme— This will assess to what degree farmers are dependent on the scheme for their livelyhood. If they are totally dependent on the scheme the benefits of rehabilitation will be more strongly felt and if they are only part-time farmers benefits will be limited.

III. Location of the scheme—Is it situated in a less-developed pocket where both the officers and contractors do not dare to visit or in a place where very good access is available so that it appears in every rehabilitation exercise without fail.

IV. Activeness of the farmers, their organization, etc. —This will assess to what degree farmers would benefit from the exercise. If they will not take advantage of the new system to increase productivity the investment would not bring the expected results. If they are not prepared to put some effort in O&M of the scheme, the scheme will deteriorate to the original situation early, without going through the expected project benefit period.

V. Apart from the above there are other factors like size of the scheme —major, medium, minor, type of the scheme—anicut, tank, drainage; zone where the scheme is located —dry zone, wet zone, intermediate zone; scheme habitant type— settlement or village which needs different consideration in the criteria of selecting schemes for rehabilitation. Different weightages should be given to these different types as proposed by the group in the cost criteria for selection of schemes.

- major and medium schemes be given higher weightage
- drainage schemes and tank schemes be given a higher pro rata cost and anicuts be given a lesser pro rata cost
- Dry zone tanks should be given higher priority as the farmer (being a full-time farmer) has to totally depend on the tank supply because of the limited rainfall available and that too being limited to a certain period of the year whereas for the wet zone farmer the irrigation is only a supplement as there is more rainfall and as it is spread throughout the year. The other reason is that the dry zone farmer has to meet a higher crop water requirement as a result of high evapotranspiration in the dry zone and would need water more than the wet zone farmer to save the crop
- Settlement schemes be given higher priority over village schemes as the benefit is equally distributed unlike in some village schemes where one or a few individuals own the land.

Cost criteria should also depend on the canal density. The argument here is that to improve the scheme with a higher canal density it needs more money. Topographically bad and hydrologically poor systems should also be given higher priority as they need to preserve the little water they get.

Hydrologically better schemes also can be subdivided in to two classes. There will be schemes which are hydrologically better but due to limitation of land their command area cannot be expanded and the only potential that remains is to increase the cropping intensity and yield. There may also be other schemes where land is not a constraint and therefore the performance can be improved by both expansion of the command area and increase in the cropping intensity.

However, the large group felt that these differences are better reflected in the ERR analysis and therefore should be considered at that level.

*(Most of the arguments made by the group stem from their anxiety to maintain equity in distributing the rehabilitation funds so that those go to the most needy people. They at times went against the donor's notion of giving priority to the scheme that would give the highest benefits as found in an ERR analysis.)*

The large group was also of the view that most of the problems of not taking up the most deserving schemes lies not only in the total dependence of the economic analysis but also in the absence of a good database for minor irrigation schemes. Repeated inclusion of certain super-blessed schemes could have been avoided if such a database was present.

The Kurunegala experience has shown that it is difficult to satisfy the limits set by ERR analysis (the criteria adopted in ADB project) compared to the pro rata criteria (as adopted by NIRP).

However, the group was generally of the view that these analyses should not be the only tools as there have intangible effects on the community which often do not come into the benefit assessments when these analyses are used. A scheme in a less-developed pocket can spur many of parallel activities in the area which often might not happen in a developed area but one may not be able to properly assess these and therefore may not be included in the benefit analysis.

Also if one goes solely by the economic criteria one might end up with developing the already-developed area creating regional imbalances which would create destablization of the country in the long run.

During the deliberations it was also revealed that the inaccuracy of hydrological parameters is also a big problem encountered in irrigation rehabilitation. Using topo sheets (one inch to a mile) in identifying the catchment area is not satisfactory. Aerial photographs would give values which would differ about 30% from those of the topo sheets.

Q4. The following will be looked into in assessing the rehabilitation requirement though the group deliberated that this is not an exhaustive list.

1) Physical Condition of the Scheme
   - * Operational difficulties
   - * Stability *( also safety)*
   - * Necessity of any modification *(for better performance)*
   - * Farmer acceptance *(of the component of the scheme)*

2) Cross and Longitudinal Canal Profiles
   - Cross sections
     - * Regime conditions
     - * Stability
   - Longitudinal sections
     - * For assessing the desilting requirement
     - * For assessing the location of regulators

3) Equity
Water measurement in main canals and distributary canals only be considered at the design stage

4) Water Use Efficiency
* System losses
* Application efficiency

5) Possible Future Changes
* Crop diversification
* Operation pattern
* Operating of distributary canal by farmers

6) Future Trends
* Crop diversification
* Farmers' attitude
* Night irrigation

7) Operational Problems
* Maintaining of water surface profile
* Operational pattern
* Canal capacities
* Cordination of operation
* Illicit cultivation

8) Maintenance Problems
* Distributary canal maintenance, 50% by farmers and 50% by managers
* Silt traps, bathing steps, etc.
* Watershed management

9) Agronomic Problems
* Land preparation issues (assessing actual stagger (in some cases 50% has been reported) against the standard 1/3 stagger adopted in the technical note)

10) Socioeconomic System
* For assessing marketing potential of various crops, degree of application of necessary inputs
* Drinking-water wells

11) Resource System
* Soil investigations for burrow area and for foundations

Q5. The group was of the view that what has to be done in the rehabilitation exercise should be decided before identifying the information requirements. If it is only going to be an exercise of restoring the physical irrigation system alone, the input of an irrigation engineer should be enough. However, if it is going to be a broader package of assuring a higher income for the farmers, which might include

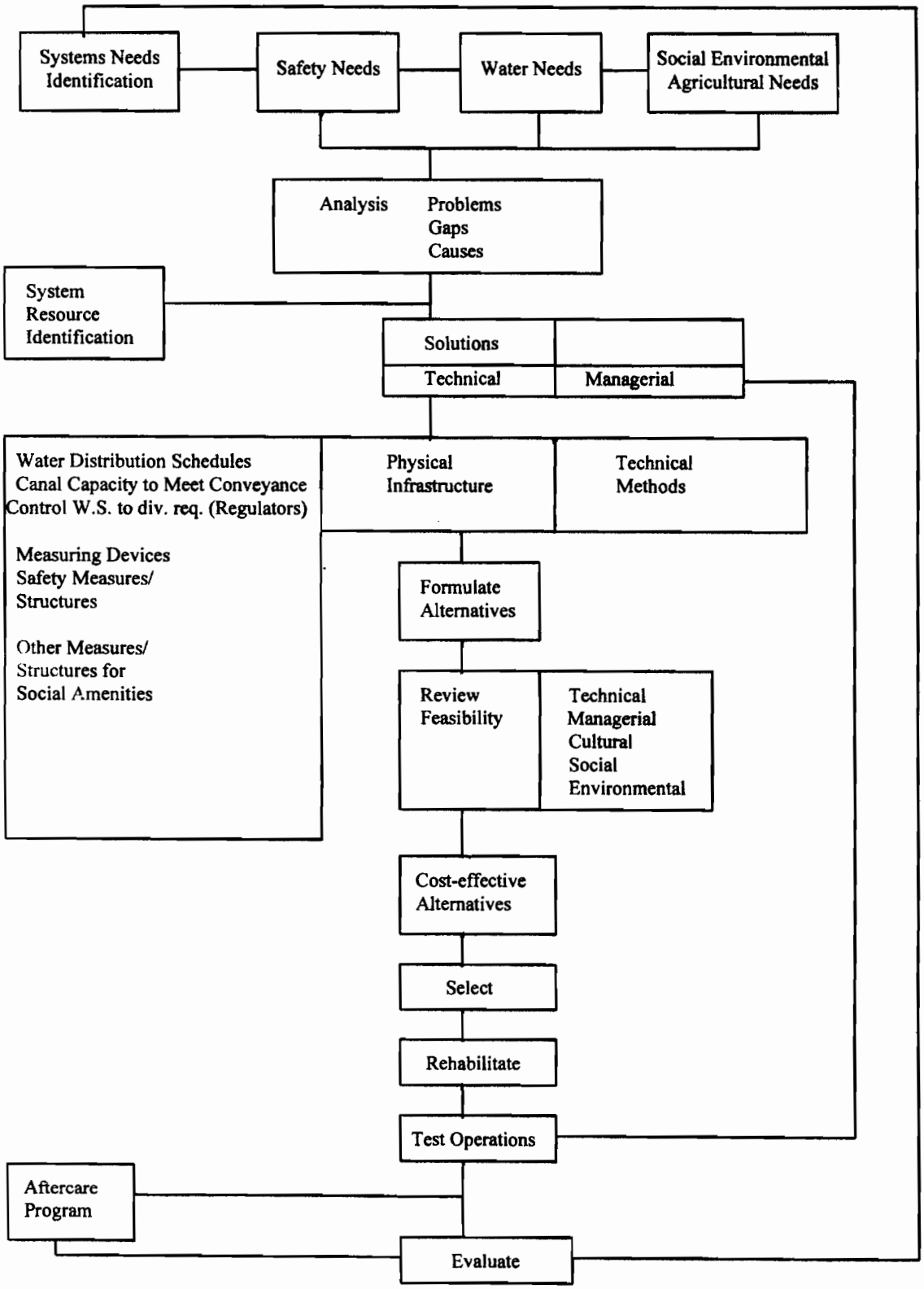
rehabilitating it to suit higher-value crops, a multidisciplinary involvement is required. The information requirements may change accordingly. Some of the information areas that would be necessary in such a wider exercise is listed below.

- irrigation engineering
- forestry
- land-use information
- agricultural data
- sociological data
- institutional data
- marketing data

The group identified the following information sources and under each they have stated what kind of information could be expected.

1) Farmers
   - Hydrology (Floods and droughts)
   - Hydraulics
     * equity in distribution
     * water use efficiency
     * operational problems
   - Structural
     * physical condition of the structures
   - Agricultural
     * agronomic problems
   - Sociological
     * present management system and possible future changes
     * present living patterns and aspiration of farmers and future trends
   - Environmental
     * salinity
2) Traders
   - Demands and supply of Agricultural produce and price
3) NGO
   - Environmental Aspects and Training
4) Commercial Ventures and Banks
   - Credits and extension services
   - Type of crop
5) Religious Leaders
   - History, priorities, and heritage,

In the large group the question was raised as to why attention was not paid to women in the irrigation scheme as suggested in the issue paper. By ignoring the differences of opinion among different members of the farming community one might not grasp the total aspirations of the society, especially members of the community such as women who might have very positive ideas to contribute to the overall success of the scheme which will go unheard if no concerted action is taken.


Systems Needs Identification
Safety Needs
Water Needs
Social Environmental Agricultural Needs
Analysis
Problems
Gaps
Causes
System Resource Identification
Solutions
Technical
Managerial
Water Distribution Schedules
Canal Capacity to Meet Conveyance
Control W.S. to div. req. (Regulators)
Measuring Devices
Safety Measures/ Structures
Other Measures/ Structures for Social Amenities
Physical Infrastructure
Technical Methods
Formulate Alternatives
Review Feasibility
Technical
Managerial
Cultural
Social
Environmental
Cost-effective Alternatives
Select
Rehabilitate
Test Operations
Aftercare Program
Evaluate

There was a difference of opinion regarding the involvement of the NGOs in the rehabilitation exercise in general and their capacity to work as an effective information source, in particular. Some were of the view that they are a new kind of business organizations that served the self interest of the individuals involved in them. However, there was also a strong view that each should be assessed in its own merits and the NGOs should not be branded as such in general.

Q6. The group was of the view that the flowchart proposed in the issue paper has adequately expressed equately the process of the rehabilitation. However, the group wanted to propose certain amendments and additions to improve it to give it a comprehensive picture. The group said that the availability of resources should also come into the flowchart along with the needs identification. In the "social, environmental need" box the group added agricultural needs too. After the "test operation" box there should be an "if" box where if the result are satisfactory then the overall project could go for the final evaluation. However, if the results of the test operation show negative effects, necessary steps should be taken to rectify them through an aftercare repair program. With those amendments the new flowchart would be as given on the previous page.

*( The reverse arrow after evaluation suggest that the rehabilitation process does not end after the scheme undergoes a rehabilitation (like an injection given to a sick person to cure a particular illness). It has to be an ongoing process like taking care of a person with a package care program which includes frequent checkups, investigations, dieting, exercises and both preventive and curative medicine to maintain his/her physique and health. It suggests that the rehabilitation should also be incorporated in a wider management plan and should not be considered separately. In other words, it suggests that the rehabilitation should be elevated from its present "project" mode to "program" mode.)*

## Issue Paper–Part II

Q1. The group deliberating on the issue on reservation noted that there should be a reassessment of reservation limits in the light of competition for land, in general, and irrigable land, in particular. The group said that this is a need especially in schemes where we are going to restore the reservations. The experience of Nuwara weva in Anuradhapura was a classic example to show how reservations have been encroached upon and how difficult it is to restore the reservations to the original state. Even after limiting the reservations to a low value, 300 encroachers were found within the amended reserved limits.

The group pointed out that the reservations of the RDA are being marked in the ground but not in the irrigation reservations. The group emphasised that physical identification of reservations in the ground is vital though fencing dose not seem a solution. (Under the INMAS program fencing was tried but people pulled them down.) The group said that the ordinary man should be aware of the presence of the reservation.

The group recommended bamboo trees, cane, and vettiver grass as vegetations for main canals (contour canals) that could be grown along the reservations to preserve the area.

The group recommended approved crops (crops should be perennial) and trees in other (ridge) canals.

In the case of spill tail canals the group was of the view that farmers could be educated and moved out of the reservation areas with their consent in the majority of cases, failing which legal action would be constituted to eject them.

In the case of the tank bed, the FSL and HFL should be marked on the ground at intervals with permanent concrete posts. Promoting tree plantation is also recommended as it will demarcate the boundary and also protect the area from soil erosion.

The group also mentioned that there had been an area called *gas gommana* in ancient tanks just upstream of the tank bed. Trees like *kumbuk, nabada* and *thimbiri* were cultivated in the tank bed to absorb salinity. Just downstream of the tank there was an area called *perahana* where again trees like *kumbuk, beli, gamsuriya, wetakeiya* were planted. The literal meaning of "perahana" is filter and these trees were supposed to have act as a filter.

During the discussions, the concept of reassessment of reservations was discussed at length. It was queried whether an owner of a house built beyond the amended reservation can go to courts in the event of a flood damaging his house because the department reservation is below where he has built his house and because the flood that originated beyond the reservation did the damage. Could he claim that if the department had demarcated the reservations correctly this would not have happened. The discussions revealed that there is a requirement for upgrading the know-how of the engineers regarding legal provisions available for reservation management. *(The ITI could undertake a training session or IRMU can conduct a study on assessing the legal provisions available for reservation management with the assistance of the attorney general's department.)*

During the discussions it was also revealed that during Eng. K. D. P. Perera's time the department sent circulars amending (reducing) the reservations.

The Senior Deputy Director (Rehabilitation and Training) commented that a draft agreement is being prepared by an inter-ministerial committee to transfer the reservations to the farmers on a system of lease to cultivate approved crops with necessary conservation methods and to protect the reservations. He said the feedback of this forum will give better insights to the committee to perfect the agreement.

There was no major objection in giving the farmers the responsibility of maintaining and managing the reservations but the participants cautioned that transfer of rights to cultivate and to the produce would have to be given to the farmers keeping the final authority in the hands of the irrigation manager. In Huruluweva it was said that farmers have put up fences and officers are unable to move in the reservation even to perform necessary official functions. It was also emphasised that the green light should be given to the cultivation of only perennial crops and not of seasonal crops.

In the plenary session it was also revealed that the absence of a plan (BOP) indicating the reservations has caused problems in instituting legal action against the encroachers. Some commented that having a plan at the irrigation office is also not sufficient to institute legal action. The plans and BOPs should be sent along with a completion report to the District Administration where the reservation would be gazetted to legalize the reservations etc.

There were other complications too.

- Private land has to be acquired before it could be gazetted as reservation.
- The District Administration alone has the legal power in instituting legal action regarding all state land.
- For the BOP to become a legal document it has to be signed either by the Director of Irrigation (DI) or the Surveyor General. It was not clear whether the DI can be deputized in this instance.

The DI has sent a circular to all ranges that the spill should be operated once a year. One of the reasons for this circular was to establish the presence of the spill tail canal. If this is carried out very few will dare to meddle with the tail canal reservations. However, as this could be only practiced in large schemes with gated spills, it is not applicable in the majority of cases.

Problems of implementation also surfaced during the discussions. One member brought to the notice of the forum that the Survey Department is asking a huge amount of money to carry out the surveys. It was observed that as it is also another government department it need not be paid. However, the Survey Department personnel should be informed in time for them to arrange allocation for work the Irrigation Department (ID) requests to be performed. As there are BOPs of existing schemes available in the micro-film form in the ID head office the engineers could request for printouts of old BOPs from micro-films before making a fresh attempt to do a survey.

It was also brought to the notice of the forum that the fishermen using irrigation tanks have put up permanent buildings in the tank bed without any permission. These fishermen need to be provided with facilities at locations that do not interfere with the department activities or with the safety of the bund.

During the plenary sessions there was a suggestion to have the tank reservation as BTL in unbuilt areas and HFL + 0.5 meters in the other areas.

There was general agreement that during rehabilitation built drawings and BOPs should be prepared and sent to the District Administration for necessary action. This may be necessary mostly in old anicut schemes where in the majority of cases no BOPs were available.

There was also a suggestion that adequate compensation could also be provided to the encroachers to leave the reservation if restoration of the reservation is undertaken in developed areas.

Q2. Commenting on replacing *liyadde*-to-*liyadde* irrigation with a duly formed field channel, the group stated that as long as farmers are happy with the existing arrangement there should not be any interference. However, if management has already become a problem with the arrangement of *liyadde*-to-*liyadde* irrigation it has to be changed by constructing a field channel. In such a case too, a small ditch is preferable as land might become a constraint. As there is a chance that the farmers may not like to give part of their land to rectify a problem of another farmer these should be negotiated prior to rehabilitation, setting even preconditions for rehabilitation if there is a real need for a separate canal.

There was an alternative view expressed during the plenary session that social pressure could be exerted on the farmers who do not allow water to flow to the neighbor's field. This is practiced satisfactorily in the eastern province. It was also said that customs among the people are respected as law in our judicial system which reinforces the action to exert social pressure on people who defy them. It was also noted the fragmentation of land agravates the problems of *liyadde-to-liyadde* irrigation.

Q3. The group first identified the problems created by land fragmentation before resorting to finding solutions. The following are the problems listed:

- Operation (i.e., water management, etc.) becomes a problem as the number of farmers seeking water increases there is an increase in the requirements of the number of individual outlets and in regulating their intakes.

- Mechanization becomes a problem due to the limited land size.

- Low inputs lead to low productivity due to the nonviability of the plot to make a good return on the investments.

- Adherence to the cropping calendar becomes difficult with requirements that have to met of the increased number of farmers. This is so, especially when the plot becomes small at which time they do not have enough interest to go by the decisions of the kanna meeting or of the community (FOs).

- Social disputes and litigations become a common occurrence.

The group recommended the following actions to remedy the situation.

- A thorough sociological survey to assess the magnitude of the problem. The group emphasised that it should not be a sample survey but a complete survey of the community.

- Seeking avenues to resettle within the scheme.

- Realienating land (this includes reblocking out land eliminating unirrigable lot ) and translocation (this means giving land to the farmers in other schemes).

- Crop diversification (this will make the land productivity and income per unit of land high, leaving a higher income from a relatively small plot).

- Rotation of farmers (this is called kanna maru in Sinhala where farmers take turns in cultivating the large field without fragmenting it and cultivating pieces each season).

- Cooperative system (though the Soviet Union remains a classic example of failure in the cooperative system, Sri Lanka can try it in a limited way so that land fragmentation become less of a problem, e.g., they can do plowing on a cooperative basis but do the other activities individually maintaining the spirit of the capitalist system (individual motivation) intact.
- Legal

- Reference was made to the *puranawela* and *akkarawela* concepts where equity was established by having fields both upstream and downstream. It also gave the opportunity to the farmers to be conscious in economizing water.

- During the deliberations it was revealed that these arrangements (land distributed within the scheme and among the adjacent schemes designed to maintain equity among the community) have been largely responsible for land fragmentation the subject under discussion. The experience in some minor schemes is that land fragmentation has made plots so small it has become uneconomical to cultivate them. There are schemes which have been abandoned due to this land fragmentation alone.

The Department of Agrarian Services has undertaken land consolidation work in several such tanks and has obtained satisfactorily results. Maradankadawela scheme is one such example. There were 34 farmers in the scheme having 140 lots at different areas of the scheme comprising a total of 30 acres which had not been cultivated a single season for years. A land consolidation task was undertaken and it gave promising results. Now the scheme is in operation. Though it has many advantages many difficulties too have to be surmounted in implementation. This kind of land consolidation is possible (under the present law) only where everybody agrees to cooperate. The legal procedure includes handing over the ownership to the state through a gift deed and once it is done surveys reblock out land and then transfer the ownership again to the new allottees.

In Dewahuwa too, the land consolidation exercise had been performed with satisfactory results.

The question was asked as to whether the time was right to bring a new law for land consolidation. There was also a suggestion that there should be a minimum limit where agricultural land could be fragmented for selling or other purposes in future to keep this problem at bay. There was another suggestion that farmers should be encouraged to practice the traditional methods of *thattu maru* and *katti maru* to prevent land fragmentation among family members and also necessary action should be taken to incorporate such operations in to law. Still another suggestion was that the land register should be updated before a rehabilitation is undertaken.

Q4. The group agreed that the attention paid to the road network in framing the rehabilitation proposals is inadequate. The reason was that the money spent on road improvements cannot be justified in the financial analysis. If improvements to the road network are incorporated without assessing the additional benefits it would bring to the schemes they will not become economically viable.

The following were suggested by the group:

- Careful disbursement of funds allocated for road maintenance and repairs.
- A 10 percent contribution of farmers should be made use of for road work.
- Mobilise farmers through "shramadana" for road work.
- Accurately quantify the benefits of road improvement and ask for additional amount for roads *(if a project is selected according to cost/benefit criteria, higher benefits will justify higher costs. By correctly quantifying the benefits of road development, funds for road work can be increased).*
- Make use of other programs like *samurdhi* to obtain funds for roads.
- Obtain funds from NGOs.

During the discussions it was pointed out that the attention paid to roads was not enough. One major reason is the money allocated for O&M of roads is not sufficient to maintain them. Using the roads for public transport complicates issues more. It was suggested not to metal and tar the roads under rehabilitation to avoid this. In minor schemes, the maintenance of irrigation roads is the responsibility of DAS. But since the ID constructs the roads under rehabilitation, farmers tend to consider them as ID roads.

Donor agencies also discourage undertaking improvements of roads under irrigation rehabilitation. They feel it should be the responsibility of the community themselves and not of the irrigation agency.

Q5. The group was of the view that the community center could provide the following facilities to the community:

- as an assembly hall where the meetings of the FO could be conducted and as a training premises
- as a meeting place for conducting promotional programs of the line agencies (marketing, agriculture, demonstration of agriculture machinery ) where the officers would be able to address farmers
- as a sales center for the household products of the community (eggs, meat, curd, etc.)
- as a collecting center before selling the produce of the community to the outsiders
- as an information center where the notices, scheme layout plan, and maintenance plan are displayed

To function as a multipurpose center described above it needs the following improvements:

- adequate cover and safety for stored products
- sufficient space for storage

(Presumably the group would have thought the safety of racks, cupboards, storage bins, notice boards, display boards, etc., would be the responsibility of the caretaker organization)

The large group was concerned with the safety, maintenance, and making use of the building to the optimum. They suggested that the capacity of the Farmer Organization to maintain, safe keep and manage the facility should be evaluated before one is given. It should be given only if it is requested by the organization. The building as far as possible should be built close to irrigation property so that the same watcher can be used to safe keep it without incurring additional cost.

## Issue Paper–Part III

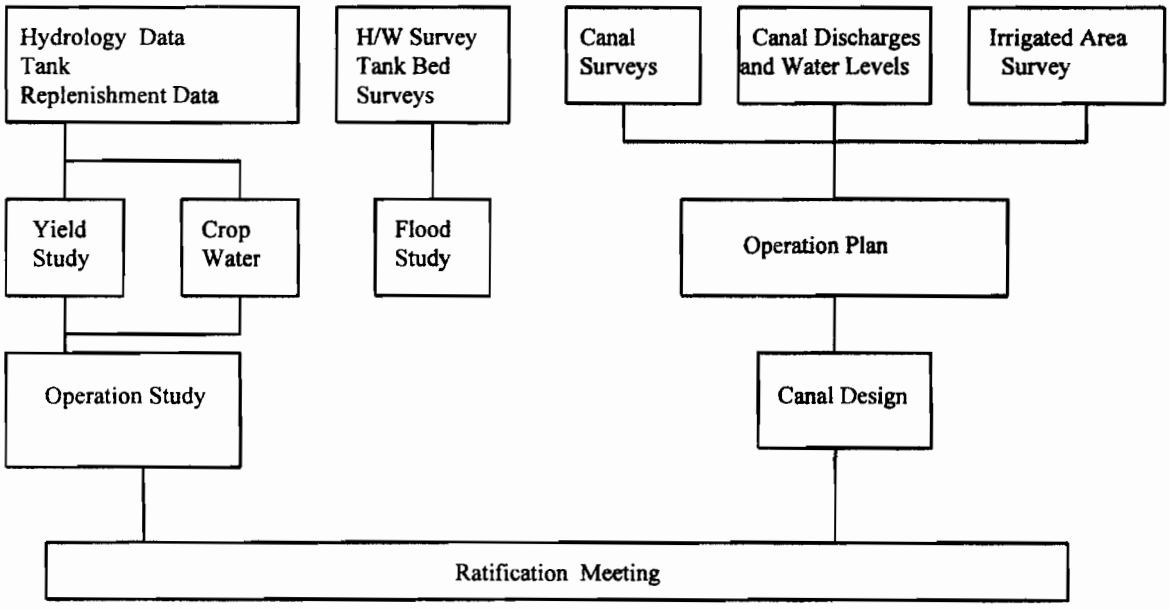
Q1. The group identified the following as necessary investigations that should be carried out before a rehabilitation planning and design exercise is done:

- Survey of irrigable area survey
- Survey of headworks and tank bed
- Surveys of canals
  *(This would have included surveys of cross sections and longitudinal sections of the canal; walk-through surveys with the farmers in identifying leaks, operational problems, safety issues, maintenance problems and repairs required in the canal structures for maintaining clarity and defining the method of survey.)*

- Canal discharges and water levels at critical points in the canal *which will assess the canal losses, conveyance efficiencies, field water balance etc.*
- Collection of tank replenishment data
- Collection of hydrological data

The group has also identified the steps that should be taken before the proposals are put forward to a ratification meeting.

The following is their flowchart which put these investigations in a logical order with the activities of subsequent analysis:




( It was expected that the group would apprehend the importance of consulting farmers to determine

- farmers' expectations from the scheme to have a base for identifying deficiencies in the scheme
- farmers' view about the rehabilitation requirements
- farmers' suggestions and proposals to remedy the deficiencies/for rehabilitation
- farmers' opinion about how the scheme should be operated and maintained after rehabilitation and how they would identify this along with the investigations listed. However, it did not happen most probably due to time limitations

One could also argue that the term investigations would have suggested purely technical queries which might have misled the group in identifying the above.

However, proposing a ratification meeting after doing all the investigations and subsequent analyses independently show that there is still some more orientation needed to put the ID technical staff in the right track. These responses should be taken along with the responses given to the questions of Part III of the Issue Paper to realize there is still room for improvement in getting the participation of farmers and other line agencies to the planning and design process of irrigation rehabilitation.

The large group was of the view that regarding minor schemes, a perimeter survey of the irrigable area would be sufficient, but a comprehensive irrigable area survey is required where it is not available in the case of major and medium schemes.

The large group agreed that for the purpose of estimation there is no need to take all the cross sections of a canal in a minor scheme but it would be sufficient to take cross sections for a sample area and extrapolate it into the rest of the area. However, for payment purposes it would be necessary to take the cross sections as stipulated in the guidelines before construction is carried out.

The question of assessing the canal discharges are also discussed at the large group. Though these could be computed it was agreed that as a prototype is available the most reliable thing would be to measure it.

In the flood studies, tanks upstream of the catchment of the tank in question should be studied.

Q2. The group was of the view that rotation also could be practiced in the main canal when it is long. The group identified the following as some of the factors that should be considered before deciding whether to go for rotation and if so, the level of rotation.

- capacity of the offtakes and canals
- farmers' perceptions about the rotation
- possibility of night irrigation for rice and adherence to day irrigation for other crops
- actual stagger in the land preparation work
- cropping intensity
- crop factor
- quantity of water available would also affect the decision of how rotation should be planned

Assessing the probable cropping intensity after rehabilitation could be a hard exercise in which much guess work would have to be performed. A fair guess would be a moderate increase which should be assessed by studying irrigation difficulties that will be eliminated/reduced with rehabilitation. It is always advisable to ensure the canal has enough capacity to adjust to the operation plan moderately.

*(It would be interesting to study various rotations practiced in various schemes and assess their relative success to propose a guideline to help assess the requirement of rotation and level of rotation.)*

Q3. In the group presentation it was said that there is a critical day in a year to start cultivation so that the maximum use could be taken of the rainfall. However, this could only be practiced in large schemes like Mahaweli where farmers are assured of water. In a minor scheme totally dependent on a small catchment this could only be a theoretical exercise. The critical date which is determined by a statistical analysis is not good enough to do operations of a minor scheme which might end up in failure as statistics is a subject of chance. The farmers should only be persuaded to do this if they could be compensated (e.g., through an insurance scheme) for any possible failure.

However, a participant who was the Deputy Director of the ID (Ampara) for several years said farmers start cultivation even in minor tanks in anticipation of rain and the rain god has never disappointed the eastern farmer. However, another member pointed out that in Inginimitiya the same procedure was adopted but it ended up in failure and therefore the experience of the eastern province cannot be generalized.

*(It would be worthwhile to carry out a statistical analysis and establish probabilities of failure/success and approach insurance companies with the results to formulate an insurance scheme suggested by the group. It would also be interesting to find out whether differences in soil type had a bearing on the success of dry plowing in the eastern province and the failure of the similar process in the Inginimitiya area.)*

Q4. The group was of the view that the following steps could be taken when the type plans have to be incorporated in a canal which has changed from its original design section and has achieved regime conditions.

- Assessment should be made to see whether the regime condition has created a canal which is not responsive to rotation. If the canal is insesitive to rotation resection the canal.

- Introduce transitions where the regime condition in the canal need not be resectioned as it has not become a hindrance to proper operation.

- Amend the structure type plan to suit the new canal dimensions.

Speaking on amending the structure type plans the group presenter said that there are computer software packages in the market like auto-cad which make this kind of amendments very easy.

*(There is a need to train a batch of irrigation engineers to master these new packages where real design situations are used in simulated or actual exercises.)*

Q5. The group was of the view that Broad Crested weirs are sturdy, modular, and reliable and therefore could be used to measure the discharge at most critical locations.

The parshall flume is accurate, but is expensive, is faithful to a model, and is also sensitive to fluctuations; therefore, it should be used only with care.

Because the calibrated gauge is simple, economical, and acceptable to the farmers it could be used at all other locations. Whatever the structures available in the canal can be calibrated with the fixed gauge and therefore it can be used as a very cheap measuring device.

Baffle distributors are acceptable to the farmers but are expensive and succeptible to manipulation by farmers.

In the large group discussion attention was also given to cut-throat flumes. These flumes are constructed using aluminum sheets, they are popular and inexpensive, acceptable (to farmers), portable, and are fairly accurate devices.

Q6. The group favored the gated regulators because they are flexible, the water will not get pooled up as in the labrinth weir which causes mosquito menances and there would be no siltation in the upstream of the gated regulator as in the case of the long-crested weir which cannot be flushed out

As regards manipulation the group said that the solution would be to educate and convince the farmers not to manipulate gated regulators.

During the deliberations the question of difficulty in establishing the required level of the gated regulator was also discussed. It was said that the discharge is proportional to $H^{0.5}$ in the case of gated regulators which act like an orifice but is proportional to $H^{1.5}$ in the case of long-crested weirs. As a result, the gated regulators require skill and patience to operate and also consume much time to establish the required upstream water level at the gated regulator. The necessity of adjusting it with changes in the canal also makes it difficult to operate gated regulators as it is sensitive to canal fluctuations.

The above relationships would clearly indicate the sensitivity of each device to the variations in the canal flow.

Also during the large group deliberations it was said that some of the problems attributed by the group to the long-crested weirs could be easily solved by installing a silt gate in the crest wall.

Q7. The group was of the view that the leak in the sluice gate mainly occurs due to bad fabrication. Exercising quality control in fabrication and selection of good manufacturers were suggested as solutions.

In the large group discussions it was revealed that there are no type plans or set departmental standards for vertical steel gates.

Q8. Double banking was not recommended by the group as a solution to the severe siltation in the canals as major changes are not possible in a rehabilitation exercise where the area is already developed. However, it could be adopted in critical locations to avoid severe siltation brought about by major drainage inlets.

The group was of the view that silt traps could be used to avoid severe siltation in all other places. They also suggested that bends be protected against erosion to reduce silt load created by eroded bank material.

Q9. Group was of the view that gabion walls are costly and not flexible as the prefabricated steel mesh boxes have fixed sizes.

However, they also have the advantage of being able to construct easily and quickly. The group was of the view that the same thing could be achieved with rubble packing.

In the large group, the claim that the same thing could be achieved through dry rubble packing was disputed as the mesh creates a mass effect. There is a design manual available for gabion wall construction and it was said that it should be studied before passing a verdict on gabion walls.

In the plenary sessions it was revealed that there is a design manual for gabion wall construction which is available with the Deputy Director's office, ID, Kandy.

Q10. The group recommended dredging/desilting of the tank bed in circumstances where the minimum dead storage is not available. They further said prevention is better than cure in this particular case and that catchments have to be protected to arrest soil erosion rather than trying to desilt at a higher cost.

In the plenary sessions it was revealed that the DAS had undertaken desilting of a few minor tanks at the pressure of the farmers and the results were encouraging. It was said that the last water requirement of the crop could be provided to save the crop by the increased capacity gained through the desilting. However, a view was expressed that by raising the spill by a very small amount would achieve much more than what it could be achieved through an expensive desilting exercise as much is gained at a higher level due to higher coverage of the water surface than at a lower level. The response was that the tanks, especially in the North Western Province, are situated in developed areas and it is not possible to raise the spill even by a small amount.

A third view was that a higher dead storage than what is minimally necessary for human consumption and aquatic life be provided to give the trees and plants of the surrounding area their required water. A question was asked as to what extent this water would propagate/ replenish the plants. The response was that though it would depend on the soil type, etc., it could spread even a mile.

*( As there was disagreement and also different views expressed it appears that it requires further investigations before coming to conclusions. As farmers keep on pressurising the irrigation agencies some substantial multidisciplinary study has to be carried out to ascertain the effect of desilting of both live and dead storages on both the tank operation and environment.)*

Q11. The group stated that for this question it could only give the same answer that it gave to question number 4. The group was of the view that the present set of type plans gives an adequate base for the engineers to work with. The only modifications necessary are to adjust the structure to the site conditions which were adequately explained in the answer to question number 4.

In the plenary discussions a question was raised as to whether any engineer has done major change in the design of a type plan which would have improved the effectiveness or economy of the structure. If so, those experiences can be made use of to have a modified set of type plans. Reference was made to the new drop structures that were adopted under the Irrigation Systems Management Project (ISMP).

During deliberations it was revealed that the type plans have been prepared for the new drop structure adopted in ISMP and it is now being adopted in NIRP. Apart from that no other experiences which would lead to a major change in the type plans were available.

Q12. The group questioned the cost-effectiveness of using fiber-glass planks. Even the effectiveness of the seal where fibre-glass is used was questioned by the group. They were of the view that it may be sometimes feasible if it is used along with other materials in a gate but certainly not as planks. However, the group was of the view that a pilot study be carried out to test these hypotheses.

During the plenary sessions Eng. W. M. U. Navarathne of the DAS stated that the latter has already pilot tested these for both gates and planks and has found that they could be manufactured at a relatively lesser cost. He said that gates were manufactured by embedding the fiber glass parts in a steel frame. A corrugation was used to give a higher strength to the fiber glass part. He said even the planks were manufactured using a steel frame to embed the fiber glass.

Some observed that these could be easily damaged by floating timber logs. Eng. Navarathne said that as the gates are manufactured by fixing individual parts of fiber-glass planks fitted to the frame using nuts and bolts, if such a part is damaged, it could be replaced easily. Eng. Navarathne however agreed that fiber-glass may not be a very effective alternative where it is susceptible to frequent impacts by floating logs.

Q13. The group was of the view that the formed canal concept adopted by the TIMP had been a failure due to brick-lined canals getting damaged easily and the ease in breaking the canal by farmers.

They have not be able to redress most of the issues they were to redress though they were constructed at a higher cost compared to earth canals. In long canals either parallel earth canals or where such they are not possible due to the nonavailability of land, concrete canals were suggested instead of brick-lined canals. Grouping of outlets and upstream regulation were also proposed.

Q14. The group agreed that there is a strong potential for improving agricultural productivity per unit of land through the conjuctive use of surface water and groundwater. This has been proved by the success of off-farm agriculture activities in the North-Western and North-Central provinces where several agro-wells have come up during the last decade.

A pilot project should be carried out in a scheme taken up for rehabilitation to ascertain this potential and to analyze its effects on the environment.

One participant said that a study on the use of agro-wells as a supplementary source of irrigation was commenced under NIRP at Palukadawela and it revealed that the best economy of water is achieved (they use just the ET plus percolation) when farmers use pumping water (at a cost) to irrigate their land. However, NIRP donors were of the view that pumping water is beyond the scope of the rehabilitation; therefore, they wanted it to be dropped.

He also said that in Pakistan the farmers commence the cultivation with groundwater and continue cultivation with reservoir water. He also said that the problem with groundwater was its quality. In Pakistan, they have good quality groundwater sources and also not-so-good-quality sources. The farmers mixed these to irrigate their fields. Sri Lanka also could make use of this important source of groundwater to enhance the agricultural productivity of unit area of land.

Studies have also revealed that the wells located in the downstream of the tanks fill faster. Although these wells are being used currently for other crops they could be made use to supplement late irrigation requirement of rice too.

The large group strongly agreed that further studies should be carried out to see whether this could be considered when irrigation rehabilitation is taken up in future programs where extensive studies would give the necessary information for analysis of conjuctive use of surface water and groundwater in the schemes.

Q15. The group was of the view that irrespective of the presence of salinity, the drainage channels should be improved in rehabilitation. It also wanted to point out that apart from waterlogging that results from improper drainage there are other factors that cause salinity. They are over irrigation, salt water intrusion, as could be observed especially in coastal areas, and liberal or overuse of fertilizer in agriculture. (Recently the babies born in some parts of Puttalam District were found to be blue in color—the blue baby syndrome—due to excessive amounts of nitrogeon in the water in that area.) These should be checked frequently to prevent salinity and that would be the responsibility of the irrigation managers. There are simple methods to measure salinity and appropriate measures should be taken to rectify if salinity is encountered.

## New Issues

The project Director responded to the DD ITI 's request to add issues if any that would have been missed in the formulation of the issue paper. He said that he wanted to focus the attention of the participants about the difference between the economic and financial evaluation which often does'nt get recognition of the engineers. He pointed out that in the econonmic analysis we look for ERR and not for IRR. Also economic prices and opportunity costs are taken in the analysis and not the market or the farm-gate price/cost. Engineers also should consider with or without project in calculating the benefits and never go for before and after project concept which has been the common practice. He further said that engineers should be given a training on these aspects as proper economic evaluation is vital for analysing the feasibility of a project.

**Annex 1**

# List of Participants

**Senior Directors**

1. K. Thurairajarathnam, Snr. DD (SS)
2. L.T. Wijesooriya, Snr. DD (Rehab)
3. D.W.R.M. Weerakoon, Snr. DD (O & M)
4. W.P. Jinadasa, Snr. DD (RW)
5. M. Sinnappo, Snr. DD (PD)
6. V. Regunathan, Snr. DD (PI)

**Range Deputy Directors**

7. W. Gamage, DDI Ampara
8. S. Piyadasa, DDI Anuradhapura
9. U. Delpachitra, DDI Colombo
10. G.V. Rathnasara, DDI Hambantota
11. M.B Pemasena, DDI Kandy
12. H.P.S. Somasiri, DDI Kurunegala
13. K.W.I. de Silva, DDI Polonnaruwa
14. L.W. Senevirathne, DDI Puttalama
15. H.M. Jayathilake, DDI ITI

**Deputy Directors' Head Office**

16. S. Senthinanathan, DDI Machinery
17. Mrs. J. Amarakoon, DDI Planning
18. G.T. Dharmasena, DDI Hydrology
19. R.A. Nandasena, DDI Training

**CIEs and IEs, Head Office and Ranges**

20. D.M. Abeyratne, CRE Minipe Nagadeepa
21. J.C. Muthumala, CIE Kurunegala
22. U. Wickramarathne, CIE Kurunegala
23. Mrs. Y.G.M.C. Godaliyadde, CIE Kandy
24. Mrs. L.W.L.D.P.S. de Silva, CIE Colombo
25. Mrs. E.I.M.V. Fernando, CIE Anuradhapura
26. S. Imbulana, CIE, Designs
27. S.S. Sivakumar, SIE Vavuniya
28. W.A.R. Ranjith Parakrama, IE Rathnapura
29. N.U. Hemakumara, IE Huruluweva

30. R.M.W. Rathnayake, IE, DDI's Office Kandy
31. Miss. R.A.D. Jayanthi, IE, Designs Branch

**NIRP**

32. K.S.R. de Silva, PD NIRP
33. N.D.T.M. Amarasekara, CIE NIRP
34. Mrs. P.I.L. Imbulana, NIRP
35. S. Nadarasa, Consultant Engineer, NIRP

**IRMU**

39. B.M.S. Samarasekara, DD (IRMU)
40. Dr. K.A. Haq, Tech. Advisor, IIMI/IRMU
41. N.N. Kamaladasa, CIE (IRMU)
42. M.K. Noordeen, IE IRMU
43. Miss. C. Ramachandran, Engineer, IIMI/IRMU

**MECA**

46. K. Nimal Wickramaratne, MECA
47. N.K. Daya Abeyratne, MECA

**Annex 2**

## Issue Paper (Part I)

1. Discuss among your group and arrive at a definition for the term 'rehabilitation' in relation to irrigation rehabilitation works recently/currently undertaken by you.

Consideration may be given to managerial, institutional, technological and other aspects that you think are relevant in addition to physical restoration.

2. What do you think are the goals and objectives of rehabilitation in the angle of different parties involve in an irrigation system including the state, agencies, farmers, donors.

You may include both short term and long term goals and objectives of each party identified above. list the indicators necessary to measure level of achievement of each objective?

3. What do you think of the criteria of selection adopted by various rehabilitation projects which do not differentiate

- Tanks and anicuts
- Schemes located in different hydrological zones
- Village schemes and settlement schemes
- Major, medium and minor schemes?

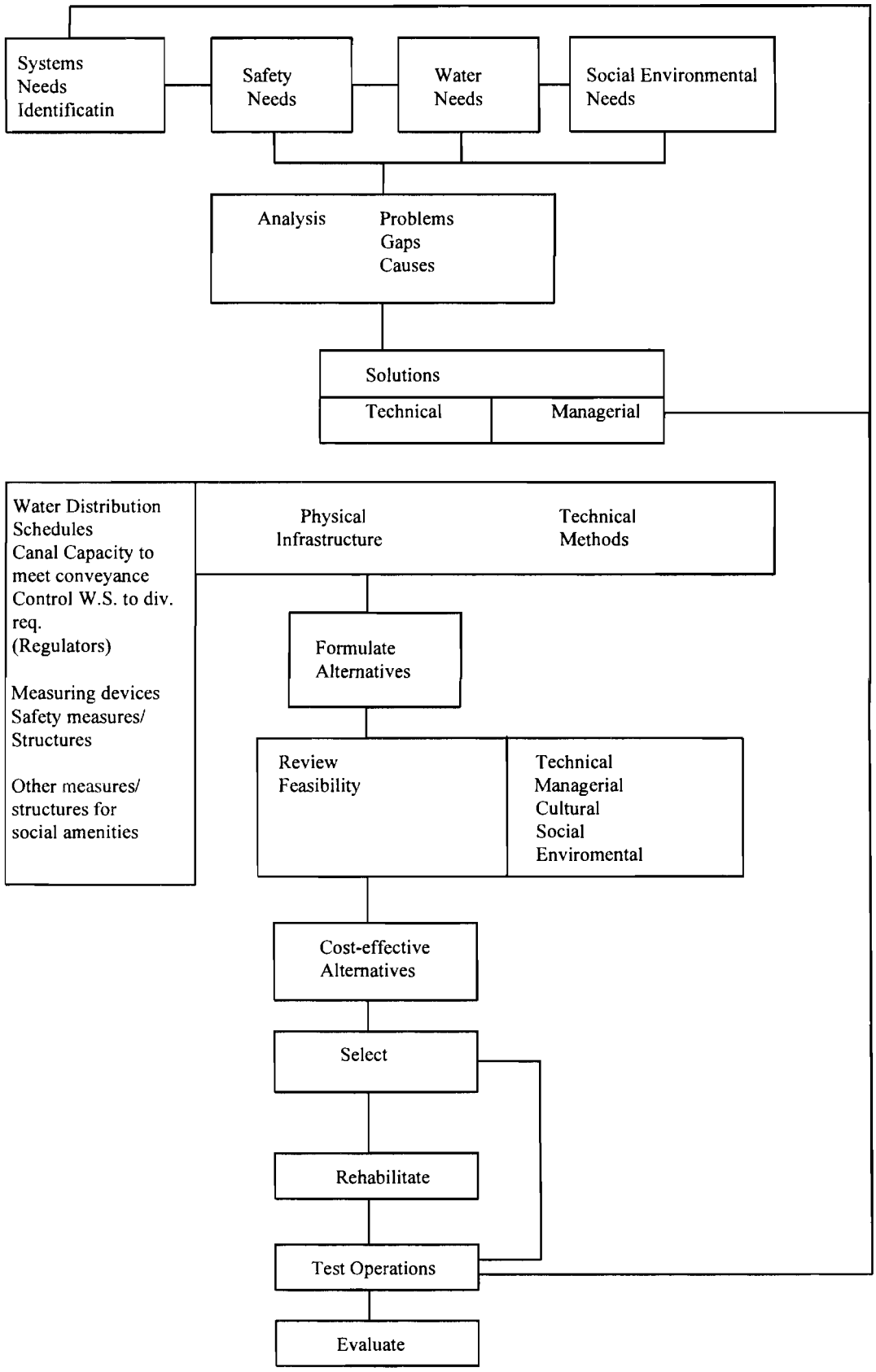
What suggestions you have to improve the criteria of selection of schemes for rehabilitation? Also discuss whether priority should be given to less developed districts and areas.

4. What will you look for, in assessing rehabilitation requirements? Discuss under following categories.

Physical condition of structures
Cross and longitudinal canal profiles
Equity in distribution of water
Water use efficiency
Present management system and possible future changes
Present living patterns and aspirations of farmers and future trends
Operational problems
Maintenance problems
Agronomic problems
Others

5. What would be the sources of information to assess the rehabilitation requirements? Would you consider average farmer, farmer leader, elders, women, youth, line agency officials, maintenance/water issue labourers in addition to office records and field measurements as useful sources of information? What information could be obtained from each of the parties?

6. A flow chart for rehabilitation process is given on the next page. Review critically with your group members and suggest improvements.


Systems Needs Identificatin
Safety Needs
Water Needs
Social Environmental Needs
Analysis
Problems
Gaps
Causes
Solutions
Technical
Managerial
Water Distribution Schedules
Canal Capacity to meet conveyance
Control W.S. to div. req.
(Regulators)
Measuring devices
Safety measures/ Structures
Other measures/ structures for social amenities
Physical Infrastructure
Technical Methods
Formulate Alternatives
Review Feasibility
Technical
Managerial
Cultural
Social
Enviromental
Cost-effective Alternatives
Select
Rehabilitate
Test Operations
Evaluate

## Issue Paper (Part II)

1. Encroachment of Irrigation reservations has been a major problem in the recent past. Can rehabilitation undertake re-demarcating and preservation of reservations? What is your view about fencing as a solution? What options have we got? What about redistributing the reservations among the individual farmers for temporary cultivation of approved crops where they will have the right for the produce of the plants as practised in Huruluweva feeder canal area under the SCOR project?

2. Under what circumstances liyadde to liyadde irrigation should be changed by having a field canal with type structures, in minor irrigation schemes?

3. In some minor schemes land distribution and tenure is a constraint for improved productivity. What form of land reform/consolidation can be advoated during the rehabilitation stage. Relate your experiences if any.

4. Roads have been identified as an essential infrastructure for development. O & M and Farm roads in an irrgation system helps to improve the economic status of cmmunity apart from they being essential for O & M of the system. Do you think that the attention paid for raid network in the irrigation system is adequate in framing rehabilitation proposals. Given the budgetory limitations how would you apportioned funds for this requirement?

5. How effective is the provision of a community centre under NIRP which provides a meeting place, collecting and distribution centre for the produce and inputs of the farmers. Any suggestion for improvements?

## Issue Paper (Part III)

1. What are the minimum investigations that should be carried out before a rehabilitation exercise? What are the additional investigations that would provide enhance information? How to arrive at an optimum. Consider following investigations also in your analysis with any other investigations you think is necessary.

Irrigable area survey
Tank-bed contour surveys
Cross sections and longitudinal sections of Bunds
Cross sections and longitudinal sections of Canals
Measurements of Discharges and water levels at selected points in the canal
Canal losses and field water balance studies
Reservoir operation study
Flood study
Cropping patterns and method of water delivery
Walk-through surveys
Farmer consultation workshops/meetings
Participatory appraisals

Also arrange the above investigations in a flow chart.

2. Generally, irrigation systems in Sri Lanka are designed so that the main canal operation on continous flow during peak demand periods. However rotation is practised at different levels of the system at times.

What are the factors in your view, that should be considered in selecting the method of water delivery. How would you incorporate any changes of the method of water delivery in the rehabilitation design.

In your experience what were the farmers reaction to different methods of water delivery under different conditions.

3. Suggest ways of maximising use of rainfall in meeting part of irrigation supply? What would be the constraints in implementing a water management plan designed to achieve this. Relate your experience with respect to areas where chena cultivation is practised.

4. There is much said about the importance of maintaining the regime conditions that exist in old schemes while rehabilitating them. How could you ensure this condition with the typed structures that is going to come up with rehabilitation?

5. One of the rehabilitation objective is improved irrigation efficiency as a result of improved system and improved management. However system performance cannot be assessed without measuring water deliveries, at appropriate points in the system. In terms of usability and acceptability what do you think is best out of the following? Discuss their relative merits under varying circumstances.

Broad Crested Weirs
Parshall Flume
Calibrated Gauge
Baffle distributors
Others

6. Regulator gates are often subjected to manipulation. Especially u/s farmers could manipulate the gates to their advantage depriving water to the tail enders. Can the long crested weirs (labrienth, inclined and duckbill) be a solution to this. Would this structure receive the tail enders acceptance in a water short scheme?

7. It has been observed that most of the management losses occur due to improper sealing or seating and operation difficulties of the control gates. Do you have similar experiences in your schemes. Propose improvements in the gate material, design, fabrication, assembly and installation.

8. A large sum of money is spent annually on desiltiing of canals. Propose remedial measures ( including structural and environmental protection measures ) that should be incorporated during rehabilitation.

Can double banking be the solution? By double banking are we creating another set of problems for operation like eliminating useful night storage tanks?

9. Gabion walls are becoming popular. Are they cost-effective in arresting canal bank erosion at vulnerable locations?

10. Dead storage of the tank, while helping to serve the domestic needs helps to preserve the tank centred environmental system. ( Around 100 mms/month of surcharge is sufficient to preserve the plant environment on which the animal, soil, aesthetic micro climatic spheres can depend) Having this in mind discuss the pros and cons of the dredging /desilting of tanks as often requested by farmers.

11. What difficulties you encountered in adopting the type plans in rehabilitation. What modifications or improvements you suggest to the type plans? Relate your experience, if any, where you have made any improvements to the type plans before adopting them.

12. There had been a suggestion to replace the timber planks with fibre-glass planks as there is a problem of maintaining, as well as providing, timber planks due to scarcity and value of timber. Your comments?

13. Managing long canals have been a major problem for irrigation managers. Greedy upstream farmers, vegetational growth, seepage and silting contributes to poor water availability at the tail-end. Tank Irrigation Modernisation Project adopted formed canal concept in long canals to overcome this problem. Brick-lined divided canals (limiting the number of beneficiaries per canal) are constructed so that no tampering is possible and seepage, silting and vegetational growth is also prevented. How effective is this solution? Can this be adopted in other systems and if so under what circumstances? Are there any particular reason why this was not adopted in subsequent rehabilitation exercises.

14. Conjuctive use of surface and ground water in agriculture is becoming more vital. To what extent should the ID involve in ground water extraction and management. Can agrowells be included as a source of supplementary supply the command area as part of rehabilitation.

15. Waterlogging and improper drainage systems contributes to salinity, the effect of which is not often quantified. Can rehabilitation exercise address the salinity problem by undertaking drainage improvements? What investigations should be carried out to assess the extent problem.