CHAPTER 4

METHODOLOGY OF STUDY

4.0 General

The primary and secondary data collected from the field is analysed for functionality and non-functionality of the LIS. Primary data is collected through structured questionnaires from the farmers and expert engineers, directly from the field and it is analysed for the relationship between the perceptions and functionality & non-functionality of the LIS. Direct data from the managements of farmer managed LIS is collected through structured formats in Telugu directly addressed to the managements to evaluate the management performance of LIS. An LP model is formulated to maximize the net income under the LIS through optimizing the resource (land & water) utilization with several constraints. Efficiencies of different sub-systems of LIS and finally that of LIS and the risks in the functioning of these sub-systems are discussed and a model for the best managed LIS is proposed.

4.1 Analysis of commissioned LIS

All the 975 I. I Schemes commissioned by APSIDC up to March-2001 are selected for the study. The secondary data pertaining to these schemes is collected from the divisional records of APSIDC. This is tabulated in Microsoft Excel and analyzed for functionality and non-functionality of the schemes.
The analysis is done for the entire state, regional wise, district wise, time series (date of commissioning) wise, command area (ayacut) extent wise and program (program of execution) wise.

These functional & non-functional LIS are further analyzed by number, by contemplated ayacut, by capital cost, by capital cost/Ha, by percentage number, by percentage ayacut and by percentage cost.

4.2 **Perceptional analysis through structured questionnaires**

About 38 number of the L.I.Schemes maintained by the APNIDC is taken up as sample population for this study. The samples are selected randomly in seven districts. The irrigated extent (ayacut) under these schemes ranges from 0% to 100% of contemplated command area. Required structured questionnaires are designed to collect the micro level data and perceptional data pertaining to the above L.I.Schemes. Separate questionnaires for ascertaining the views of the engineers (experts) and beneficiaries (water users) are designed to have a full-fledged data for in-depth study. The questionnaire is sent to the field through experienced engineers, to collect the data from relevant persons.

The data collected is posted analyzed in Excel sheet. Extensive field visits to the selected L.I.Schemes in the sample are made to ascertain the views of the beneficiaries in person and to verify the integrity of the data and to ascertain the causes for less or full development of ayacut.
The answers in the structured questionnaire are given weightage points on a selected scale (calibrated during the analysis). The out come of the analysis is used to differentiate the functional and non-functional schemes. The perceptional weightages are compared with the functionality and non-functionality of the L I Schemes. The structured questionnaires are enclosed in Annexure 2 & 3.

4.3 **Evaluation of farmer managed LIS & bring out the best management.**

About hundred farmer managed LIS which were running with the farmers for more than two years are selected from all over the state. The managements of these schemes were sent well structured formats about the data to be furnished with a request to fill up and return them by post. The feed back in proper shape came back from 22 L I Schemes in nine districts of the state. This is to bring out the competencies of the managements in four aspects, which are supposed to optimize resources under L I Schemes on sustainable basis.

These aspects are:

**Productivity of Land:** This is measured in Rupees per Ha

**Productivity of Water:** This is measured in Rupees per Cubic Meter of water.

**Water cess collection as percentage of demand**

**R & M expenditure as percentage of Collection**

Each one of the above parameters is arranged in ascending order and numerals are arranged in ascending order in the adjacent column. The numerals for all the parameters of each scheme are added to arrive at the total weightage for the scheme.
Then these total weightages are arranged in descending order. The topmost one is the best managed scheme. The schemes from the top are adjudged as the well managed schemes in descending order and managements pertaining to these scheme as better managements and the resources under these schemes are optimally utilized. These formats in English are enclosed in Annexure 4.

4.4 Maximization of income through LPP model

The L.I.S is mainly divided into eight sub-systems namely:

1. Water source.
2. Intake to draw required water.
3. Pumping machinery.
4. Pressure main.
5. Electricity (power) supply.
7. Distributary system
8. Land development with reference to application efficiency of water.

An LPP model has been formulated for maximizing the return from the contemplated command area by optimizing each one of the above subsystems, which will finally arrive at the maximum return from the command area of a given L.I.S. subject to certain constraints.
4.5 Engineering model to arrive at the irrigation efficiency of a LIS

The sub-systems as taken in Chapter 4.4 are considered.

- Water availability in the source at any given time.
- Efficiency of the intake to draw required water.
- Dependability of the pumping machinery.
- Dependability of the pressure main.
- Dependability of the power supply in quantity & quality.
- Land consolidation after commissioning.
- Efficiency of the distributary system to supply water to the fields in time and space.
- Land development with reference to application efficiency of water.

4.5.1. Water availability in the source

Water must be available throughout the base period of the crop. Water required for all the crops in the irrigated extent at any given time should be less than the water available in the source. This is a major constraint. Any deficiency in the availability of water during base period of the crop will result in fear psychosis among the water users and culminate in the closure of the scheme for the succeeding season. As such, it is assumed that sufficient water required for the crop is available in the source throughout the base period of the crop.

4.5.2. Efficiency of the Intake to draw water
Sufficient water is available in the source, but the Intake may not be able to draw required water for the standing crops. This will happen when the sill level of the intake is fixed incorrectly and the top of the intake pipeline is kept above the bed level of the source and when the intake is continuously silting. Some temporary measures are being taken by the farmers to mitigate this difficulty up to some limitation. When these measures reach un-viable levels, permanent repairs (measures) are to be taken up, which cannot be taken up by the farmers without the financial help from the government Running the scheme in the above two situations reflects the high involvement and cohesiveness of the farming (user) community.

The irrigation efficiency of the scheme falls sharply with the increase in number of interventions by the farmers. The probability of running the scheme falls more sharply with the number of interventions by the farmers, to improve the discharge through the intake. Based on the data two exponential equations are generated. The first one with fourth order exponential to represent the irrigation efficiency and the second one with fifth order exponential to represent the probability of running the scheme.

4.5.3. Efficiency of the pumping equipment

Sufficient water is available in the source. Sufficient water is passing through the intake. The pumping equipment may breakdown frequently resulting in unscheduled grounding of pump sets for repairs during the base period of the crop. Increasing number of such breakdowns and repairs during the base period of the crop will result in water stress to the crops, which may intern seed dissensions in the water
users. When these breakdowns and resulting dissentions assume unviable proportions, the maintenance of the scheme by the farmers becomes a question mark.

4.5.4. Efficiency of the pressure main

Sufficient water is available in the source. Sufficient water is passing through the intake. The pumping equipment is running without any unscheduled breakdowns. The discharging efficiency and reliability of the pressure main gravity main will come into picture.

The efficiency of the pressure main/gravity main is the percentage water delivered by it to the water drawn by it. When there are profuse leakages in the pressure-main/gravity-main the beneficiary (farmer) who is affected by the drainage from this leakage will obstruct the running of the scheme until the leakage is closed. When the leakages are nominal or when the leakages are directly entering the drain the I. I Scheme may be allowed to function in spite of the leakages. As the probability of occurrence of leakage at the drainage point is minute, it is assumed that the discharging efficiency of the pressure-main/gravity-main is almost hundred per cent when it is functioning.

Now the reliability of the pressure main comes into picture. Unscheduled pressure main blasts or profuse leakages in the pressure main may occur frequently during the base period of the crop. Every blast/profuse leakage in the pressure main will result in grounding of the L I Scheme until the repair/rectification is over. Increasing number of such blasts/profuse leakages in the pressure main and repairs
during the base period of the crop will result in water stress to the crops, which may intern seed dissensions in the water users. When these blasts profuse leakages in the pressure main and resulting dissentions in the farming (water user) community assume unviable proportions the maintenance of the scheme by the farmers becomes a question mark.

The irrigation efficiency of the scheme falls sharply with the increase in number of unscheduled blasts/profuse leakages in the pressure main. The probability of running the scheme falls more sharply with the number of unscheduled blasts/profuse leakages in the pressure main. The equations derived in the case of Intake hold good even in this case.

4.5.5. Efficiency of the power supply

Sufficient water is available in the source. Sufficient water is passing through the intake. The pumping equipment is running without any unscheduled breakdowns. The discharging efficiency and reliability of the pressure main/gravity main are good. Dependability of the power supply in quantity & quality may hamper the running of the L 1 Scheme.

Most o the L 1 Schemes are designed to run for 16 hours a day. If the power supply given to the scheme is. anything less than 16 hours a day the irrigation efficiency of the scheme comes down proportionately.

Even when the power supply is for 16 hours or more a day, its quality shall be maintained. If rated voltage is not maintained the power control equipment will trip
off even with low or high voltage resulting in stoppage of pump sets. This is very common in our areas due to the low quality of the power distribution system & frequent occurrence of over-loads. Most of our 11 Schemes are running with centrifugal pump sets, which will take 15 to 60 minutes for priming and start pumping again, depending upon size of the vacuum pump and volume of suction side to be filled. The irrigation efficiency of the scheme falls sharply with the increase in number of unscheduled power break downs/voltage fluctuations during working day in the base period of the crop. The probability of running the scheme falls more sharply with the increase in number of unscheduled power break downs/voltage fluctuations during working days in the base period of the crop. The equations derived in the case of Intake hold good even in this case but with a slight modification. In this case, the number of power break downs/voltage fluctuations are considered per day instead of the base period of the crop.

4.5.6. Land consolidation

When all the above sub systems are functioning well, it may be possible that the contemplated extent (ayacut), for the sanction of 11S have been boosted to bring down the capital/maintenance cost of the scheme to economic viable limits or it may be to keep the B/C ratio with in the bankable limits. In addition, some of the contemplated extent might have been used for village expansion or other infrastructural development works. In this process, the net availability of land for irrigation will come down.
Stabilization of command area (ayacut) has to be done limiting the contemplated extent (ayacut) to the net available extent (ayacut). During the stabilization process, any adjacent commandable lands outside the command area may be added to compensate the deleted land. The final stabilized command area (ayacut) in place of the contemplated command area (ayacut) may be adopted for arriving at the irrigation efficiency of the scheme.

4.5.7. Efficiency of the distributory system

All the above sub systems are functioning well. However, the construction of distributory system may not be complete or may not be efficient to supply required water to the crops in time & space.

Distributory system of the scheme is almost comparable to the nerves system of the body. Distributory system is supposed to supply water to any part of land in the irrigated area at any required time. If it is not properly designed, constructed and maintained, it may not be able to supply water to some parts of the command area (ayacut) bringing down the irrigation efficiency of the scheme. It may also sow the seeds of descent in the farming community, which could not get sufficient water for irrigating their crop. Partial irrigation of the command area will also result in the escalation of water rate. As such, it is one of the main components in determining the irrigation efficiency of the scheme. It is taken as the percentage of irrigation extent (ayacut) potential created against the command area (ayacut) contemplated/consolidated.
4.5.8. Land development

All the above sub systems are functioning well. However, necessary land development suitable to the crops has to be done for efficient application of water. Without proper land development the loss of water during application will be as high as 30%. If proper land development is done, about 30% water can be saved due to the improvement of water application efficiency.

As such, land development is also one of the prominent factors in improving the irrigation efficiency.

The lesser of the two, i.e. either the consolidated command area (ayacut) or the potential created (potential created in the consolidated command area) is taken as the potential created area (ayacut potential) for this purpose and the proportion of the land developed is taken as the percentage of land developed.

Over all irrigation efficiency of a lift irrigation scheme is the product of the efficiencies the above first five sub-systems & the efficiency of land development of the scheme in the numerator and the product of land consolidation & efficiency of the distributory system in the denominator.

An engineering model has been evolved covering all the sub-systems of the LIS to arrive at the system irrigation efficiency of LIS. In addition, a management model is proposed for the best management of LIS.

Model of a best-managed LIS is presented in Figure 5.57, which includes the sub-systems of LIS, characteristics of the organization system and the characteristics of the management.