

PERFORMANCE EVALUATION OF WATER USER'S ASSOCIATIONS ALONG FIVE VILLAGE TANKS IN CHITTOOR DISTRICT, ANDHRA PRADESH, INDIA

K.Naga Sahadeva Reddy

Lecturer

Civil Engineering Department
Institute of Technology
sahadevareddy.naga@gmail.com

G.N. Pradeep Kumar

Professor

Department of Civil Engineering
S.V.University
Tirupati (A.P) India
saignp@gmail.com

C. Raja Gopal Reddy

Professor

Department of Civil Engineering
M.S. Ramaiah Institute of
Technology
Bangalore-India
dr_crgr@yahoo.co.in

ABSTRACT

While construction of new tanks to tap the left over possible resources is in operation, one has to consider the steps to be taken for the improvement of performance of the existing tanks. Rehabilitation of the existing tanks would help to utilize the already developed irrigation potential with greater efficiency. Andhra Pradesh attaches great importance to the rehabilitation programme of old tanks because of its large dependence on tank irrigation. The programme attaches priority to regain the lost irrigation potential. In embarking on a rehabilitation programme it is important to define what is meant by rehabilitation and its methodology. Participatory irrigation management (PIM), in its various forms has been implemented all over the world for several decades. This paper deals with evaluation of water users associations functioning along five village tanks in Chittoor District, Andhra Pradesh, India. The strength and weaknesses of the functioning of WUA'S have been analyzed. Partial functioning of WUA'S in the study area have been observed from this study and many constraints have been found in effective mobilization of resources. The awareness levels about the provisions of Andhra Pradesh Farmers Managed Irrigation Systems Act 1997 (APFMIS ACT 1997) and subsequent amendments have been analyzed by using descriptive statistical tools.

Keywords: Participatory irrigation management (PIM), irrigation potential, Resource mobilization, rehabilitation, statistical tools, tank system and Water User Association (WUA)

1.INTRODUCTION

A tank is a natural (or) manmade reservoir created by simple earthen construction that captures surface runoff. Tank system is an important traditional decentralized form of irrigation. Its environmental importance lies not only in its function of collection and impounding of water for irrigation but also enabling percolation and the recharging of ground water. In addition, tanks provide water resource for pisciculture, silt for fertilizing and clay for brick making. Tanks are normally classified into

system and non-system tanks. System tanks are those which receive water from nearby major streams or reservoirs in addition to water from their own catchments. They enable the farmers many times to raise more than one crop. Non-system tanks depend on the rainfall in their own catchment area and are not connected to a river system. Usually a single crop is raised under these tanks. Swaminathan. M.S., 1991: Sustainable Management of Water Resources – Implications for Food and Livelihood Security, IX IHD Endowment Lecture, April 15, CWR, Anna University –

Reproduced in the Journal of Indian Water Resources Society, Roorke, India, Vol 11, No.3 July.

In Andhra Pradesh, tank irrigation has been traditionally a major component of minor irrigation systems. Their water use efficiency has considerably come down as the storage capacity has been considerably reduced over years on many cases. Some of the tanks have become in-operative while a few are functioning satisfactorily. In most of these tanks, inadequate maintenance, lack of regulating arrangements resulted in the loss of storage capacity. Unauthorized encroachment in foreshore, water ways, etc, has also aggravated this problem. The deficiencies in current performance including the poor state of physical structure and inadequate control of water, lead to large differences between the extent of ayacut that the system is intended to irrigate and the actual extent of ayacut being irrigated by it. The low performance of existing tank irrigation system is causing concern to the farmers. (APFMIS ACT 1997)

While construction of new tanks to tap the left over possible resources is in operation, one has to consider the steps to be taken for the improvement of performance of the existing tanks. Apart from extending the irrigation facilities to new areas, stabilization of the present irrigated area and bridging the gap are expected to be achieved by the better management of the tank system. Rehabilitation of the existing tanks would help to utilize the already developed irrigation potential with greater efficiency. Because of this, several states are embarking on important rehabilitation programmes. Andhra Pradesh attaches great importance to the rehabilitation programme of old tanks because of its large dependence on tank irrigation. The programme attaches priority to regain the lost irrigation potential. In embarking on a rehabilitation programme it is important to define what is meant by rehabilitation and its methodology. (Abeyratne.S., 1990)

Very little thought has been given to the operation and maintenance of the system and distribution of water. As a result of this lack of attention to water management, the delivery of water to the farmers has become unreliable in timing of delivery as well as in terms of volume and equity. Among various measures taken for reversing the trend, **involvement of farmers**

i.e. the end users, has now been a well-recognized fact. Therefore, the need for FPIM (Farmers Participatory irrigation management) and role of primary stakeholders in irrigated agriculture is now no longer a point of debate. The debate is more on how best to achieve PIM in a sustained manner. It is also an established fact that mere improvement of physical systems without matching efforts on farmers' participation, agricultural productivity may not improve to commensurate with investment made in irrigation structure. (Bagadion. B.U., 1998)

Realizing the importance of PIM concept, Government of Andhra Pradesh has taken innovative steps to empower the farmers. Various farmers' organizations at different levels have been constituted and promoted to operate and manage the irrigation resources. However, successful planning and implementation of PIM concept depends upon multifarious institutional, technical and social parameters, which are significantly influenced by local conditions and largeness of irrigation commands. Farmers' involvement in tank rehabilitation helps to meet the felt needs primarily and their utmost cooperation in carrying out the rehabilitation programme effectively. The active farmer involvement is cost effective in terms of the mobilization of local resources, improvement and maintenance of activities, reduction of irrigation department staff time, provision of local wisdom for better design and planning of systems, reduction in the destruction of facilities, improved fee and fine collection, reduction of disputes and provision of an organized means of extension and farmer training. (Leaf.M.J., 1988)

1.1 THE MAIN OBJECTIVES OF PIM ARE:

Create a sense of ownership of water resource and the irrigation system among the users. Improve deliveries through timely and proper maintenance;

Achieve optimum utilization of available water resources by better operation of the system. Achieve equity in water distribution;

Facilitate the users to decide on timing of water supply, period and frequency of supply. Provide choice crop to farmers based on soils, climate and other related facts;

Improve water use efficiency. Increase produce per unit of water, where water is scarce and increase production per unit of land where water is adequate;

Develop sense of economy in water use amongst the users. Develop community responsibility to collect water charges and raise required internal resources;

This paper deals with evaluation of water users associations functioning along Dandapalli Pedda Cheruvu, Kannikala Cheruvu, Nayani Cheruvu, Circar

Pedda Cheruvu, Chellamma Cheruvu, Chittoor District, Andhra Pradesh, India. The strength and weaknesses of the functioning of WUA'S have been analyzed. Partial functioning of WUA'S in the study area have been observed from this study and many constraints have been found in effective mobilization of resources. The awareness levels about the provisions of Andhra Pradesh Farmers Managed Irrigation Systems Act 1997 (APFMIS ACT 1997) and subsequent amendments have been analyzed by using descriptive statistical tools.

Table-1 Operation - Water Regulation

Sl.No	Items	Implementation of APFMIS Act 1997	
		Before	After
1	Operation & Maintenance of the irrigation systems	I &CAD Dept. with the assistant of field functionaries	WUAs/DCs with the assistance of competent authorities & members
2	Distribution of water	I &CAD Dept. up to the outlet level	FOs at all levels with the assistance of its members.
3.	Crop & Cropping patterns	Dictated by the I &CAD Dept. related to localization	Members of WUAs on their own choice based on irrigation supplies
4.	Maintenance works	Responsibility of I &CAD	With the Fos.
5.	Operation	Done by Dept.	Divided by FO Dept helps in implementing it.
6.	Funds for maintenance	Funds allotted by the Govt. of AP @ Rs.40/- per acre. About	Entire water charges which is raised to Rs.100 per acre (from

		70-85% utilized for salaries of staff, balance for works	Rs.50 per acre allocated to FOs. This is shared between WUA, DC and PC in the ratio 6:2:2 if DC is not there this goes to WUA. The salaries of staff are borne by govt. separately
7.	Power to resolve disputes in the command	I & CAD Dept. & Revenue Dept. but could not exercise	WUAs will effect settlement of disputes. They also have provision to prosecute in a court.
8.	Assessment of irrigated area	Revenue Dept.	WUA will play a key role in assessment.

2. REVIEW OF LITERATURE

There are several studies carried out in past by several researchers on Participatory Management of Irrigation system all over the world. The first and the best-documented nation-wide programme to build participation in irrigation management, as a corner stone of irrigation policy, occurred in Philippines (Bagadion, 1988). The process of institutionalizing this approach entailed workshops, training programmes, and information dissemination within the agency and the farming community. This learning process was carried out with the help of outside consultants, academic researchers and donors, but initiative came from within agency (Bargain and Kurten, 1985).

The International Commission on Irrigation and Drainage (ICID), and the International Network on Participatory Irrigation Management (INPIM) in Tehran, Iran 2-5 May 2007, suggested that Participatory Irrigation Management by water users can take a wide variety of form. Farmers can be involved in various system management functions, including planning,

design, operations, maintenance, rehabilitation, resource mobilization and conflict resolution

Sundar and Rao (1982) in their paper highlighted in regional variations in the farmers' attitudes towards organizing for tank management. They feel that local presence of government in the form of irrigation official is necessary and helpful to ensure equity in water distribution

Cernea (1984) in his study on working of WUAs, found that some of the WUAs not only were managing their resources efficiently, But also were involved in various other resource generating activities.

3. MATERIALS AND METHODS (METHODOLOGY)

3.1 STUDY AREA

Chittoor District was formed on 1st April 1911 dividing then Kadapa, Nellore and North Arcot districts as a result of recommendations of Pataskar Commission, and has a population of about fifty lakhs. It is famous for Tirupati, Kanipakam and Sri Kalahasti temples. It lies in the Poini river valley of southernmost Andhra Pradesh, on the Bangalore - Chennai highway. It is a market center for mangos, grain, sugarcane, and peanuts. Its industries include oilseed and rice milling. Chittoor District receives an annual rainfall of 918.0 mm. The south west monsoon and north east monsoon are the major sources of rainfall for the district. On average the district receives 438.0 mm of rainfall through the south west monsoon (from June to September). On average the district receives 396.0 mm from north east monsoon (from October to December) the remaining during the other period.

The important rivers in the district are :

Ponnai and Swarnamukhi rivers which originate in Eastern Ghat. Other rivers include Kusasthli, Beema, Bahuda, Pincha, Kalyani, Araniyar and Pedderu. None of the rivers are perennial.

Majority of irrigation demands is met either from tanks and bore wells. However, tank irrigation is more prevalent in the district. There are as many as 616 tanks in the district.

In this present study the following tanks, are considered for performance evaluation of Water Users' Association (WUA). They are Dandapalle Pedda Cheruvu, Kannikala Cheruvu, Nayani Cheruvu, Circar Pedda Cheruvu and Chellamma Cheruvu.

3.1.1 DANDAPALLI PEDDA CHERUVU:

Dandapalli Pedda Cheruvu is situated about 0.8 km NW of Dandapalli village in Gangavaram Mandal. In addition to the drainage from its free basin of 15.5 sq km, it receives the surplus of 327 uplying tanks, which are mostly private works. It surpluses into the Kavundinnayanadi. Ayacut area 120.6 Ha (298) acres.

3.1.2 KANNIKALA CHERUVU:

Kannikala Cheruvu, (Figs, 4.4 and 4.5) and (Plate 4.2), is situated about 0.4 km west of Mamadugu village in Gangavaram Mandal. In addition to the drainage from its free catchment basin, it receives the surplus of 19 uplying tanks. Ayacut area 87.42 Ha (216 acres)

3.1.3 NAYANI CHERUVU

Nayani Cheruvu is situated about a 1.65 km NW of Jeedimakulapalle village in Gangavaram Mandal. In addition to the drainage from its basin of 3.88 sq km (1.5 square miles) It receives the surplus of 27 uplying tanks and discharges into Kotta voddu Cheruvu. Ayacut area 67.585 Ha (167 acres)

3.1.4 CIRCAR PEDDA CHERUVU:

Circar Pedda Cheruvu is situated about 1.21 km NE of Kolamasanapille village in Palamaner Manda. It receives the surplus of 31 uplying tanks and discharges into Moram Cheruvu. Ayacut area 76.08 Ha (188 acres)

3.1.5 CHELLAMMA CHERUVU

Chellamma Cheruvu is situated about 0.4 km SE of Mondipotanapalle in Palamaner Mandal. It receives the surplus of 8 upper tanks and surpluses discharges into Kavundinnayanadi. Ayacut area 61.1097 Ha (151 acres)

This chapter presents the details of evaluation of performance indicators of Water Users Association (WUAs) of (a) Dandapalli Pedda Cheruvu (b) Kannikala Cheruvu (c) Nayani Cheruvu (d) Circar Pedda Cheruvu and (e) Chellamma Cheruvu.

3.2 PERFORMANCE EVALUATION OF WATER USER'S ASSOCIATION

3.2.1 DANDAPALLE PEDDA CHERUVU

Table 2. Performance Indicators of Dandapalle Pedda Cheruvu

1.	M.C Meeting Regularity	Monthly	Good
2.	M.C Meeting Attendance	30-60	Average
3.	G B Meeting	Half yearly	Satisfactory
4.	G B Meeting Attendance	25-50	Average
5.	Formation of sub-committees	4	Good
6.	Functioning of sub-committees	No meetings	Poor
7.	Raising Internal Resources	Not levied	Poor
8.	Raising Internal Resources from Assets	Not generated	Poor
9.	Record Maintenance	4	Good
10.	Financial Auditing	Prepared and audited	Average
11.	Economic use of water	<5	Average

It may be observed from the values of Performance Indicators as listed in Table 2 pertaining to Dandapalle Pedda Cheruvu

- Managing Committee meeting is conducted on regular basis.
- The attendance is found to be average. Steps must be taken to publicize to improve the strength of the attendance. This is because, larger the attendance, better the innovative ideas with which works can be taken up.
- Steps have to be initiated to increase the number of General Body meetings.
- Though four subcommittees have been formed, their functioning is not up to the mark. Steps are to

be initiated to encourage the subcommittee members to complete the task allotted to them. If they are unable to complete the assigned task, the reasons may be analyzed in General Body meeting to come out with appropriate measures.

- It appears from the table that, no steps were initiated to generate internal resources. This will result in collapse of the system. Hence, steps must be taken to educate not only water users but also all villagers, through extension studies about their roles and their contribution either in the cash or labour. Similar is the case with raising internal resources from assets.
- It is worth appreciating the WUA of Dandapalle Pedda Cheruvu as the four records are maintained separately.

- Members of WUA have to be advised to implement the suggestions / observations made by auditing committee.
- It is disheartening to note the wasteful use of water, as this association falls under the category of 'average' with respect to economic use of water.

different methods of optimal use of water. A few of such steps may be (i) methods of reducing transmission losses in water (ii) proper land use and water application practices and (iii) selection of suitable crops for the existing soil conditions.

3.2.2 KANNIKALA CHERUVU

Through extension studies, various beneficiaries of the association have to be enlightened regarding

Table 3 Performance Indicators of Kannikala Cheruvu

1.	M.C Meeting Regularity	Monthly	Good
2.	M.C Meeting Attendance	40-70	Average
3.	G B Meeting	Half yearly	Satisfactory
4.	G B Meeting Attendance	25-50	Average
5.	Formation of sub-committees	4	Good
6.	Functioning of sub-committees	No meetings	Poor
7.	Raising Internal Resources	Not levied	Poor
8.	Raising Internal Resources from Assets	Not generated	Poor
9.	Record Maintenance	4	Good
10.	Financial Auditing	Prepared and audited	Average
11.	Economic use of water	<5	Average

It may be observed from the values of Performance Indicators as listed in Table 3 pertaining to Kannikala Cheruvu

- Members of Managing Committee are found to meet regularly, which is a positive sign.
- The attendance is found to be not such an encouraging one. They have to be motivated to assemble in large strength.

- Steps have to be initiated to increase the number of General Body meetings to discuss the issues related to especially water distribution.

- It may be noted that four subcommittees have been formed. But, their functioning is not up to the mark. Steps are to be initiated to encourage the subcommittee members to come out with positive results.

- Immediate steps are to be initiated to educate not only farmers but also all the other beneficiaries to raise internal resources, as these are the foundation pillars for further growth of the association.
- It is worth appreciating the WUA of Kannikala Cheruvu as the four records are maintained separately.
- Members of WUA have to be advised to implement the suggestions / observations made by auditing committee.
- In this case also, It is discouraging to note the uneconomical use of water, as this association falls under the category of 'average' with respect to economic use of water.

Through frequent meetings among members of various committees and I & CAD officials, all the water users under WUA of Kannikala Cheruvu, have to be enlightened about latest techniques of optimal use of water and field practices.

3.2.3 NAYANI CHERUVU

Table 4 Performance Indicators of Nayani Cheruvu

1.	M.C Meeting Regularity	Monthly	Good
2.	M.C Meeting Attendance	100-110	Good
3.	G B Meeting	Half yearly	Satisfactory
4.	G B Meeting Attendance	50-75	Average
5.	Formation of sub-committees	4	Good
6.	Functioning of sub-committees	No meetings	Poor
7.	Raising Internal Resources	Not levied	Poor
8.	Raising Internal Resources from Assets	Not generated	Poor
9.	Record Maintenance	4	Good
10.	Financial Auditing	Prepared and audited	Average
11.	Economic use of water	<5	Average

It may be observed from the values of Performance Indicators as listed in Table 4 pertaining to Nayani Cheruvu

- Managing Committee meeting is conducted on regular basis.
- The attendance is found to be good.
- Steps have to be initiated to increase the number of General Body meetings.
- It may be observed from the table that members of the sub-committee are not at all meeting. This will result in communication gap, which will result in no progress of the proposed activities. Hence, the members should be enlightened about the meetings

and their usefulness in planning of water management activities.

- Table 4 indicates that, no steps were initiated to generate internal resource. This will results in collapse of the system. Hence, steps must be taken to educate not only water users but also all villagers through extension studies about their roles and their contribution either in the cash or labour. Similar is the case with raising internal resources from assets.
- It is worth appreciating the WUA of Nayani Cheruvu as the four records are maintained separately.

- Members of WUA have to be advised to implement the suggestions / observations made by auditing committee.
- It may be observed in this case also, that a lot of measures are to be initiated for optimal use of water.

The water users have to be educated with latest state of art in various utilization and conservation techniques of water.

3.2.4 CIRCAR PEDDA CHERUVU

Table 5 Performance Indicators of Circar Pedda Cheruvu

1.	M.C Meeting Regularity	Monthly	Good
2.	M.C Meeting Attendance	30-40	Average
3.	G B Meeting	Half yearly	Satisfactory
4.	G B Meeting Attendance	25-50	Average
5.	Formation of sub-committees	4	Good
6.	Functioning of sub-committees	No meetings	Poor
7.	Raising Internal Resources	Not levied	Poor
8.	Raising Internal Resources from Assets	Not generated	Poor
9.	Record Maintenance	4	Good
10.	Financial Auditing	Prepared and audited	Average
11.	Economic use of water	<5	Average

It may be observed from the values of Performance Indicators as listed in Table 5 pertaining to Circar Pedda Cheruvu

- Managing Committee members are found to meet monthly as suggested in guidelines. This is a good practice.

- The attendance is found to be average. Steps have to be initiated to publicize to improve the strength of the attendance. This is because, two or more brains coming together is better than a single one doing all the things.

- Steps have to be initiated to increase the number of General Body meetings.
- Though four subcommittees have been formed, their functioning is not up to the mark. Steps are to be initiated to encourage the subcommittee members to complete the task allotted to them. If they are unable to complete the assigned task, the reasons may be analyzed in General Body meeting to come out with appropriate measures.
- It appears from the table, no steps were initiated to generate internal resource. This will result in collapse of the system. Hence, steps must be taken to educate not only water users but also all villagers through extension studies about their roles and their contribution either in the cash or labour. Similar is the case with raising internal resources from assets.
- It is worth appreciating the WUA of Circar Pedda Cheruvu as the four records are maintained separately.
- Members of WUA have to be advised to implement the suggestions / observations made by auditing committee.
- It is disheartening to note the wasteful use of water, as this association falls under the category of 'average' with respect to economic use of water.

Through extension studies, various beneficiaries of the association have to be enlightened regarding various efficient methods of conveying, distribution and conservation of water.

3.2.5 CHELLAMMA CHERUVU

Table 3.2.5 Performance Indicators of Chellamma Cheruvu

1.	M.C Meeting Regularity	Monthly	Good
2.	M.C Meeting Attendance	50-60	Average
3.	G B Meeting	Half yearly	Satisfactory
4.	G B Meeting Attendance	25-50	Average
5.	Formation of sub-committees	4	Good
6.	Functioning of sub-committees	No meetings	Poor
7.	Raising Internal Resources	Not levied	Poor
8.	Raising Internal Resources from Assets	Not generated	Poor
9.	Record Maintenance	4	Good
10.	Financial Auditing	Prepared and audited	Average
11.	Economic use of water	<5	Average

It may be observed from the values of Performance Indicators as listed in Table 3.2.5 pertaining to Chellamma Cheruvu

- Managing Committee meeting is conducted on regular basis.
- The attendance is found to be average. Steps must be taken to publicize to improve the strength of the attendance, this is because, larger the attendance, better the innovative ideas with which works can be taken up.
- Steps have to be initiated to increase the number of General Body meetings.

- Though four subcommittees have been formed, their functioning is not up to the mark. Steps are to be initiated to encourage the subcommittee members to complete the task allotted to them.
- It appears from the table, no steps were initiated to generate internal resource. This will result in collapse of the system. Hence, steps must be taken to educate not only water users but also all villagers through extension studies about their roles and their contribution either in the cash or labour. Similar is the case with raising internal resources from assets.
- It is worth appreciating the WUA of Chellamma Cheruvu as the four records are maintained separately.
- Members of WUA have to be advised to implement the suggestions/observations made by auditing committee.
- It is disheartening to note the wasteful use of water, as this association falls under the category of 'average' with respect to economic use of water.

Various beneficiaries of the association have to be enlightened regarding different methods of optimal use of water. It is found from the WUA of not only the five tanks considered in the present study, but also from WUA of most of the tanks, that there are some positive points of associations. However, if concentrated efforts regarding conservation and efficient utilization, as listed below, are made, then, it is sure that each WUA will certainly achieve its stated goal.

4 .CONCLUSIONS

The following conclusions are drawn from the present study:

The potential for expansion of irrigated area remains limited. The economics of irrigation development is less favorable in the past two decades. The unit cost of development increased as the most suitable sites were

exploited. Irrigation construction costs have risen to two to three times their previous level. Most investment is now for the rehabilitation of existing schemes. The cost of rehabilitation per hectare is thought to be considerably less than for a new project.

Many irrigation projects around the world have performed poorly because they failed to take into account the needs, constraints and practices of local people. Participatory Irrigation Management (PIM), in which users help to define problems, set priorities, select technologies and policies and monitor and evaluate impacts, is expected to improve performance. To be successful, irrigation management has to be participatory. This is one of the lessons coming out of decades of failures of centrally-planned irrigation development projects.

Success requires that all stakeholders in irrigation management, including users, policymakers, researchers, and others recognize that participation is not simply another way to deliver the same technological solutions. Commitment to participatory approaches demands significant changes in the way we think about both the theory and practice of sustainable irrigation management.

Evidence suggests that giving users a role in managing their own irrigation resources can lead to projects that are more efficient and effective than their top down predecessors.

Participatory Irrigation Management through Water Users' Association (WUA) is found to be one of the possible and feasible solutions to overcome above problems. However, a WUA requires evaluation of its performance in order to find loopholes and pitfalls in its functioning. Then suitable corrective measures have to be applied to improve its functional efficiency.

Performance Indicators (PIs), 11 in number, will assist in evaluating the performance of a WUA. They are as per the table below:

Table 4

Sl no.	Performance Indicator	Poor	Average	Satisfactory	Good
1	M.C Meeting Regularity	Yearly	Half yearly	Quarterly	Monthly
2	M.C Meeting Attendance	<25	25-50	50-75	>75
3	G B Meeting	No meeting	Once in year	Once in year	Two in year
4	G B Meeting Attendance	<25	25-50	50-75	>75
5	Formation of sub-committees	1	2	3	4
6	Functioning of sub-committees	< 4 meetings	4-8 meetings	8-12meetings	12-16 meetings
7	Raising Internal Resources	Not levied	<25	25-50	>50
8	Raising Internal Resources from Assets	Not generated	<5	5-10	>10
9	Record Maintenance	1	2	3	4
10	Financial Auditing	Not Prepared	Prepared and Audited	Got Approved	Implemented
11	Economic use of water	Negative	<5	5-10	>10

❖ Comparing the values of PIs of WUA under consideration with those listed above, the strong and weak points of the WUA can be determined.

❖ Using the elaborate suggestions made at the end of the preceding chapter, the weak points of the WUA can be corrected to improve its functional efficiency.

- ❖ However, the development of a customer relations brochure containing basic information relating to FAQs regarding water policies and procedures along with descriptive information relating to the rules and procedures of the water conservation program is a must.
- ❖ The development and implementation of a water rate structure that provides a pricing incentive to curtail non-essential water use is another booster in motivating water users to conserve water.
- ❖ Long term conservation measures, both on irrigation front and domestic front consist of an extensive educational, public-awareness program along with a comprehensive leak detection, loss control program and alternative water source and reuse evaluations.

As a case study, performance of WUAs of the five tanks in Chittoor district of Andhra Pradesh state, viz., Dandapalle Pedda Cheruvu, Kannikala Cheruvu, Nayani Cheruvu, Circar Pedda Cheruvu and Chellamma Cheruvu is studied. PIs of WUAs of these five tanks were collected and compared with standard values as listed in the table. Accordingly, each PI was categorized as either GOOD, SATISFACTORY, AVERAGE OR

POOR. Suggestions, suitable to the case study, were made to improve the performance.

Steps have to be initiated by the officials of I and CAD and members of PC and DC of a WUA to educate the farmers regarding these methods through extension wing of Agriculture Department and also through media and wall posters highlighting the advantages of PIM.

5. SCOPE FOR FUTURE WORK

- User participation in irrigation management raises new questions for research, including how to design appropriate mechanisms for organizing stakeholders and facilitating collective action. User participation clearly has implications for irrigation management research, broadening the agenda in terms of technologies, institutional innovations, and methods of doing research.
- To address the technical and institutional challenges in participatory irrigation management, new research approaches are needed. Research outputs clearly need to be consistent not only with users' economic demands and constraints, but also with their goals and social realities.

6. REFERENCES

1. Abeyratne.S., 1990: Rehabilitation of small – scale irrigation systems in Sri Lanka: State Policy and practice in two systems, IIMI paper No.6., Colombo, Sri Lanka.
2. Ambler. J., 1992: Basic elements of an Innovative Tank Rehabilitation Programme for sustained productivity in Tamilnadu, Ford Foundation, Aug. New Delhi.
3. Bagadion. B.U., 1998: Farmers Participation in irrigation management - The Philippine Experience: International seminar on farmers participation in irrigation development, April 10- 18, NIA Penthouse, Philippines.
4. Cernea. M.M., 1984: The Social Organization of Water Users Associations in Bank projects. Draft paper, The World Bank, Washington, D.C., USA.
5. Easter. K. W., 1982: Tank Development: the North – Eastern Thailand Experience; Proceedings of the International Workshop on Modernization of Tank Irrigation System – Problems and issues, Centre for Water

- Resources, Anna University, Feb. 10- 12, Madras, India.
6. Easter. K. W. and Palanisami. K., 1986: Tank Irrigation in India: An Example of Common Property Resource Management, Proceedings of the Conference on Common Property Resource Management, April 21-26, 1985, Washington, D.C., 1986, National Academy Press.
 7. International Commission on Irrigation and Drainage and International Network on Participatory Irrigation Management - Proceedings of the conference jointly organized by ICID and INPIM, Tehran, Iran 2-5 May 2007.
 8. Korten. D. C., 1989: From Bureaucratic to Strategic Organization: Transforming A Bureaucracy – The Experience of the Philippine National Irrigation Administration.
 9. Leaf.M.J., 1988: Measures to Activate Farmers' Organizations; Irrigation Management (Draft Paper), LBII, WAPCOS (India) Ltd.
 10. Lenton. R., 1992: Irrigation Management Strategies for the 21st Century; Canadian Journal of Development Studies, Special Issue, p.121-129.
 11. Lusk. M. W., and Parlin. B. W., 1988...Bureaucratic and Farmer Participation in Irrigation Development, Paper presented at the World Congress on Rural Sociology, June 28, Balogna, Italy.
 12. Mejia.A.M., 1998: Participatory approach – Basic concepts and principles: International seminar on farmers participation in irrigation development, April 10-18, NIA Penthouse, Philippines.
 13. Palanisami .K. and Easter. W.K., 1984: Tank Irrigation in India and Thailand: Problems and Prospects, ODI / Irrigation Management Network Paper 10e, November, pp. 2-12.
 14. Raghuvanshi, C. S., 1989: Farmers Participation in overall planning and management of irrigation systems; Journal of Indian Water Resources Society, Roorkee, India, Vol.9, No. 2; April, p 26-30.
 15. Rajagopalan. V., 1982: Changing Roles of Rural Institutions for Management of Tank Irrigation Systems; Proceedings of the International Workshop on Modernization of Tank Irrigation System. Problems and Issues, Centre for Water Resources, Anna University, Feb. 10-12, Madras, India.
 16. Reymond Peter. J; 1999 Hand Book on procedural Changes – in the functioning of the irrigation system of Water Users Association after APMIS 1997.
 17. Sakthivadivel.R., 1990: Participatory Approach in Tank Rehabilitation – An Experimental Study; Promoting Peoples' Participation in the Rehabilitation of Tanks in Karnataka (ed) Sundar. A., Wamana Publications No.1, Oct. Hyderabad, India.
 18. Sengupta. N. 1991: Managing Common Property; Irrigation in India and the Philippines, Indo-Ducth Studies on Development Alternatives-6, Sage Publications.
 19. Singh. K.K., 1991: Irrigation Management by Farmers':The Indian Experience; Seminar

- on Farmers Participation in Managing Irrigation System, December 23 and 24, IMTI, Trichy, Tamilnadu state, India, Vol.II.
20. Sundar.A., and Rao. P.S., 1982: Farmers' Participation in Tank Irrigation Management in Karnataka: Proceedings of the International Workshop on modernisation of tank irrigation system – Problems and Issues, Centre for Water Resources, Anna University, Feb. 10-12, Madras, India.
21. Swaminathan. M.S., 1991: Sustainable Management of Water Resources – Implications for Food and Livelihood Security, IX IHD Endowment Lecture, April 15, CWR, Anna University – Reproduced in the Journal of Indian Water Resources Society, Roorke, India, Vol 11, No.3 July.
22. Uphoff., N., 1986: Improving International irrigation management with farmer participation: Getting the process Right, Boulder, Colorado; Westview Press.
23. Walker.H.H., 1983: Declaration of INPIM's 10Th International Seminar on PIM and 4Th Asian Regional Conference, 2-5 May 2007, Tehran, Iran.