4.0 TANK SYSTEM IMPROVEMENT: COST-EFFECTIVENSS

4.1 Background

One of the interventions undertaken, which account for a major portion of the investment, is the work of tank system improvement. The objective of this intervention is to improve the tank storage capacity, rehabilitate tank physical structures and infrastructure, in order to improve water distribution & delivery system in the tank command area. This would be achieved through the rehabilitation of physical works identified by the community and included in the ITDP for each tank. A unique feature of this programme is that the entire tank improvement programme, which includes conceptualization, planning, execution and operation of the programme, is entrusted to tank water user communities. As a part of the end of the project survey, the status of civil works improvement was assessed vis-à-vis the level of investments in the program for rehabilitation of various components of the tank system, and the outputs from the tank system and their utilization, including the following:

- changes in storage capacity of the tank,
- silt removed from the tank and its uses for various purposes,
- improvement in the water distribution system, and
- Ground water recharge.

In addition, the perceptions of the tank community regarding the implementation of the works by the community were also recorded.

4.2 Methodology:

A major deficiency in this assessment study was the absence of real time hydrology monitoring data. In view of this deficiency the methodology adopted for this assessment included the following activities.

4.2.1 Review of baseline data

Baseline data for all the sample tanks have been collected and computerized at the beginning of the M & L exercise. This data was reviewed and any gaps in the data were filled through recall method during the current survey

4.2.2 Review of past reports

A number of studies have been carried out as a part of ongoing M & L exercise, which includes midterm impact assessment. The information contained and the conclusions derived from these studies which had been submitted to JSYS in the documentation from time to time during the course of this assignment, were reviewed and incorporated in the current study wherever relevant.

4.2.3 Field data Collection

Field survey was carried out in the selected tanks systems (both project & control). The data from these tank systems were collected through structured questionnaire which had the following components:

- Project features;
- Physical achievement and financial cost of various interventions carried out within the tank system;
- Present condition of the tank components after interventions;
- Impact of the tank rehabilitation on storage, recharge, irrigation etc; and
- Perceptions of the tank community on implementation of tank civil works.

The data were collected by experienced field supervisors under the supervision of various sector specialists. The data collection was also supported by interactive sessions with the tank user community.

Group discussions were held with command area farmers. A transect walk was undertaken in the command as well as catchment area to ascertain the condition of the various civil structures repaired / reconstructed under the tank system improvement programme. The data collected was processed through appropriate software and the results have been presented in the following sections.

4.3 Civil works Improvement

The data collected regarding the cost of civil works improvement has been presented zone wise and batch wise in Table 4.1. The cost of civil works improvement was found to be between Rs.5.5 to 7.5 lakhs per tank across zones except in case of Bidar wherein the cost per tank has crossed Rs.10 lakhs. The cost per ha of command area varied between Rs.13000 to 26000. The cost of bund strengthening and rehabilitation of the canal distribution system accounted for more than half of the total cost. Some of the important components of civil works improvement which had direct impact on the productivity of the tank system have been discussed in the following sections.

4.4 Civil works in the Catchment Area

4.4.1 The major civil works carried out in the catchment area are the rehabilitation & repair of the feeder channels and construction of new or repairs to the existing silt arresting structures. One of the important elements contributing to the higher inflows into the tank is the rehabilitation of the feeder channels to facilitate free flow of water from the catchment area to the tank. Table 4.2 indicates the cost of feeder channel rehabilitation and their impact. Feeder channel rehabilitation included de-weeding/ jungle clearance and channel resectioning & desilting. The cost of feeder channel rehabilitation varied from Rs.12000 to 27000 per tank except in case of Bidar. This variation was due to the total number of feeder channels repaired per tank. Based on the feed back given by the Tank User's groups (TUGs) and also through field observation, it was recorded that

Table 4.1

60 to 90 per cent of the tanks have been benefited with higher inflows into the tanks. The impact was more evident in the tanks of the Haveri Taluka (NTZ zone), where many of the tanks are in cascade and most of them have reported increased & unhindered inflows into the tanks. However the TUGs reported that the feeder channel rehabilitation works need to be undertaken over larger lengths of the channel till the edge of the catchment as against limited length near the tank boundary.

TABLE 4.2 : FEEDER CHANNEL REHABILITATION

SL. NO.	ZONE	NUMBER OF TANKS	NUMBER OF TANKS COVERED	NUMBER OF FEEDER CHANNELS	NUMBER OF FEEDER CHANNELS TREATED	COST OF FEEDER CHANNE TREATMENT (RS.)	NUMBER OF TANKS REPORTING ENAHANCED INFLOWS **	% TANKS BENEFITED
1	CDZ	40	29	87	67	788158 (27177)	27	93
2	EDZ	89	72	270	208	1320991 (18347)	63	87
3	NDZ	21	5	55	33	300861 (60172)	3	60
4	NTZ	21	12	22	17	293120 (24426)	11	91
5	NEDZ	12	11	22	20	139767 (12706)	10	91
6	NETZ	4	2	23	11	199157 (99578)	2	100
7	TOTAL	187	131	479	356	3042054 (23221)	116	89

(Figures in parenthesis refer to cost per tank)

Note: Feeder channel rehabilitation included de weeding/ jungle clearance and channel resectioning & desilting.

** As reported by the Tank User's Group

4.4.2 Another aspect that has adversely affected the storage potential of the tanks in the past has been the ingress of silt into the tank. The prevention of silt flow into the tanks has been achieved through construction of new and repair of old check dams, boulder checks and vegetative checks. They have been constructed at various locations on the feeder channels. Table 4.3 indicates the status of check dams and their impact on the tank system. Costs of these interventions vary from tank to tank depending on their size & location. The quantum of silt captured in these tanks, as reported by the TUG members and measured at site at selected tanks, varied between 10 cu.m to 30 cu.m per tank. The use of this silt by the community has not been extensive because of uneconomical quantity, inaccessible locations of check dams and poor quality of silt. In some of the tanks where the catchment has hilly terraine & steep slopes (eg. Somlara, Nandikeshwar etc) these silt traps have not been effective in arresting silt because of high velocity of flows. In Suledagudda tank (Raichur) check dam construction on feeder channel has resulted in over bank flows inundating the neighboring farms and farmers themselves have damaged / removed the check dams.

TABLE 4.3: PREVENTION OF SILT INGRESS INTO THE TANKS

SL. NO	ZONE	NUMBER OF TANKS	NUMBER OF TANKS COVERED	NUMBER OF CHECK DAMS/ BOULDER CHECKS/ VEGETATVE CHECKS	COST OF SILT RETENTION STRUCTURES (Rs)	QUANTITY OF SILT ARRESTED (CU.M)	NUMBER OF TANKS BENEFITED	% TANKS BENEFITED
1	CDZ	40	24	58	1577582	300	24	100
2	EDZ	89	51	112	1061323	1912	38	75
3	NDZ	22	10	16	418444	355	10	100
4	NTZ	21	9	10	73940	31	7	78
5	NEDZ	12	3	1	30000	0	0	0
6	NETZ	4	4	12	157158	125	3	100
7	TOTAL	187	101	209	3318447 (32856)	2723	82	81

(Figures in the parenthesis indicate cost per tank)

4.5 Civil works in the Tank bed Area

4.5.1 Two main activities carried out in the tank bed are the afforestation in the foreshore area and desilting the tank bed. Of these desilting from the tank bed is of more importance because it was undertaken to restore the original storage capacity of the tanks. The desilting of tanks was carried out by the empanelled agencies with earthmoving equipment. The cost of desilting has been presented in Table 4.4. Quantity of silt removed varied significantly from tank to tank depending on the size of the tank, volume of silt accumulated and demand for silt by the community. The average quantity of silt removed with lead across all the zones has been 5980 cu.m. The cost of desilting with lead has come down from Rs.33/cu.m to Rs.22/cu.m from batch I tank to batch V tank respectively. Farmers have been major users of silt to improve the fertility of the farms. Use of silt by the farmers for agricultural use has increased during the project period. Desilting without lead increased from an average of 5300 cu.m per tank from Batch I tanks to 10490 cu.m per tank in Batch V tanks. The cost of desilting without lead has remained between Rs.17 to Rs.18 per cu.m over the project period. There have been instances where farmers have requested for extra desilting over and above that was planned in ITDP (eg. Matagudda-Bagalkote) and was approved by JSYS. At some locations there has been unplanned removal of silt beyond safe limits for use in brick kilns ((eg. Yeshwantapura-Malur).

4.5.2 As indicated in Table 4.4 the volume of silt removed through desilting process is less than 7% of the total storage of the tanks. From this it is difficult to conclude that the storage potential of the tanks has increased significantly. Moreover in the absence of a post project contour survey it is difficult to quantify exact increase in the dead or live storage potential of tanks. However based on the feed back from TUGs, field observations and discussions with CFT members it was observed that major benefits of the desilting works appears to be (i) increase in water storage for fisheries, (ii) increase in water availability for

Table 4.4

domestic & cattle use, (iii) increase in recharge to ground water. Considering the fact that desilting works is one of major components of the tanks improvement work accounting for a major portion of ITDP cost, it is necessary to rethink on the objective of the desilting works and to formulate appropriate guidelines to fix the extent of desilting for individual tanks. During the implementation stage it would be beneficial if proper procedures and methods are followed for desiltation instead of desilting in an haphazard manner.

4.6 Foreshore Plantation

Foreshore plantation has been taken up as a part of afforestation programme in the tank foreshore area. Table 4.5 indicates the investment in this activity. About 0.17 million saplings have been planted in 135 tanks at a cost of Rs.3.8 million. The growth of these saplings was observed during periodic field visits and on site observations. This aspect was also discussed with TUCs in selected villages. The results of afforestation have been mixed, with survival of saplings varying from 10% to 70%. The major factors adversely affecting the survival of saplings have been,

1. Planting of saplings during dry weather or when soil moisture is low,
2. Lack of protection from grazing,
3. Lack of adequate maintenance of the plantation.

TABLE 4.5 FORESHORE PLANTATION

SL.NO	ZONE	NO.OF TANKS	NO.OF TANKS COVERED	NUMBER OF SAPLINGS	TOTAL COST (RS.)	COST PER UNIT (RS)
1	CDZ	40	27	40750	714781	17.5
2	EDZ	89	59	71023	1571696	22.0
3	NDZ	21	17	21840	498907	22.8
4	NTZ	21	20	23771	602866	25.4
5	NEDZ	12	9	7550	225990	29.9
6	NETZ	4	3	5500	185000	33.6
7	TOTAL	187	135	170434	3799240	22.3

4.7 Bund strengthening works

4.7.1 The rehabilitation of bund system comprised mainly of bund strengthening, repairs to old revetments or provision of new revetments as and where required grass turfing on the side of the bund. Table 4.6 indicates the status of bund strengthening works and its impact. Bund strengthening work involves cutting grip trenches, laying & compaction of fresh layers of soil on the bund to achieve desired cross section of the bund. Bund strengthening cost varied from Rs.78000 per tank to Rs.122000 per tank depending upon the length and physical condition of the bund. This works out to be Rs.40 to Rs.45 per cu.m of earthwork. The cost of the revetment work varied from Rs.23000 per tank to Rs.70000 per tank with average cost being Rs.36000/tank. The variation in the cost is both due to laying fresh size stones along with resetting of existing revetments. Cost of turfing varied from Rs.17000 to Rs.34000 per tank. The average cost has been Rs.19800/tank. The cost of turfing varied from Rs.4/sq.m to Rs.10/sq.m. with average being Rs.5.8/sq.m

4.7.2 The bund strengthening helps to arrest seepage of water, if any and increases the period of water availability beyond rainy season for irrigation during Rabi season. It should also lead to extend the period of water availability for domestic & cattle use beyond Rabi season. The status of water storage in the sample tanks was monitored twice, once during November 2007 and again at the end of February 2008. Also based on the feed back from TUGs, the extended period of water availability was assessed and was presented in table 4.6. The situation was compared between sample & control tanks. It can be observed from the table that extra months of water availability in sample tanks for Rabi irrigation varied from 3 to 5 months depending on rainfall conditions. In control tanks however it was about 2 to 3 months. This was attributed to the losses from the tank through leakages/seepage and also inability to store water up to full tank level. The extended period of water availability for domestic & cattle use were similar for both sample & control tanks and varied between 2 to 3.5 months. In the

Table 4.6

absence of real time monitoring of water storage status in various tanks through water gauge observations, this was, perhaps, the best possible estimation of the impact of the bund strengthening.

4.7.3 During the field survey it was observed that out of 167 tanks reporting, 138 tanks (83%) have expressed satisfactory about bund compaction work. Out of 143 reporting tanks 117 tanks (81%) reported good revetment work. However about 48 tanks (29%) out of 165 reporting tanks reported adequate bund turfing. Through interactive sessions with the members of TUGs, many factors were identified which reduced the positive impact of the bund strengthening works. Firstly, in many tanks the bund strengthening work was not carried out efficiently. The quality of soil compaction was unsatisfactory. This was mainly attributed to lack of adequate technical guidance from CFT engineers, non availability of soil compaction equipment for the desired duration, adverse weather conditions etc. This has led to top & sides of the earthen bund developing fissures, rain cuts, and rill formation. Secondly many tanks indicated poor revetment work due to shoddy workmanship and/or non availability of adequate quantity of size stones. Lastly the turfing of the side slopes of the bund was unsatisfactory due to the non germination of 'Hemata' seeds which were sown in the side slopes of the bund. Lack of adequate maintenance of the tank bund (especially in batch III,IV & V tanks) also led to the deterioration in the quality of bund components. In order to over come these deficiencies there need for better supervision by the CFT & DPU engineers need to take a proactive role in supervision and use of quality material and other technical aspects.

4.8 Rehabilitation of canal system

4.8.1 The rehabilitation of canal water distribution system included repairs to the existing sluices to make it efficient & water tight, repairs or installation of control gates on the sluices (plug & rod arrangement), and resection & lining of canals. The lining of canals was carried out through cement masonry, size stone masonry, and burnt stone slabs. In addition, a number of diversion boxes, cross drainage works like siphons, aqueducts & culverts were provided on the canal system. It was expected that due to these works the water distribution within the command area would be efficient and the canal water would be available to the tail end farmers.

4.8.2 The status of canal water distribution system and its impact has been presented in Table 4.7. The cost of sluice repair varied from Rs.7900 per tank to Rs.49000 per tank. The cost variation is due to site specific repairs undertaken in these tanks. The cost of sluice repair increased from Rs.10293 per tank in batch I tanks to Rs.27000 per tank in batch V tanks mainly due to increase in input material costs.

4.8.3 The cost of fabricating and installing flow control mechanism at the sluice (plug & rod system) varied from Rs.2300 per tank to Rs.11000 per tank with the average cost being Rs.5250 per tank. This variation is again due to site specific conditions, number of sluices in the tank system and the design features of control mechanism. The unit cost of plug and rod arrangement has remained constant over the project period, around Rs.4000 per tank across all batches of the tanks.

4.8.4 The canal lining was done with variety of materials and varying lengths which has led to variations in its cost. The cost of lining varies from Rs.84000 per tank to Rs.240000 per tank. The unit cost of lining with stone slabs with pointing in cement mortar varied between Rs.180/sq.m to Rs.320/sq.m. The cost of canal lining in cement masonry varied between Rs.1000/sq.m to Rs.1200/sq.m.

4.8.5 One of the impact indicators of the rehabilitation of canal water distribution system is the availability of water for the tail end areas. This information was recorded through interactive sessions with the farmers within the command areas and field observation of canal system till tail end at selected tanks. A separate agricultural survey in the head, middle and tail end areas of the

Table 4.7

command was also carried out. The surveyed tanks were categorized based on the extent of tail end area suffering, viz. less than 10% of the command area, 10 to 25% and more than 25%. The actual command areas of these tanks were multiplied with these fractions to arrive at the extent of tail end area suffering.

4.8.6 The table indicated that the level of irrigation as a percentage of command area was equal for both sample & control tanks. However, the extent of tail end area suffering as a percentage of aggregate command area varied from 5% to 13% in case sample tanks while it varied between 30% to 40% in case of control tanks. On an average, about 9% of the command area located in the tail end in the sample tanks did not get irrigation water, while this percentage was 30 in case of control tanks.

4.8.7 During the field survey it was observed that out of 154 tanks reporting sluice rehabilitation works 121 tanks (79%) reported satisfactory work. Out of 142 tanks reporting canal rehabilitation works 115 tanks (81%) have achieved satisfactory results. During the interactive sessions with the farmers of TUGs and field inspections many deficiencies in the works carried out were highlighted which adversely affected the canal water distribution. One of the important deficiencies was inadequate length of canal lining. TUG members admit this occurred due to (i) constraint on the size of ITDP, (ii) lack of proper assessment of lining requirements at the time of planning & finalizing the ITDP, (iii) local conditions and non availability of stone slabs. Further, poor design of canals wherein some of the canals had adverse longitudinal slopes was also seen as one of the deficiencies. Poor quality of workmanship from local labour also contributed to the inefficient functioning of the canals. These deficiencies could be overcome by (i) better supervision by the CFT & DPU engineers, (ii) use of topographic maps wherever possible, (iii) curtailment of canal lining at critical sections of canal only, (iv) selection of appropriate materials for canal lining. However there were no complaints regarding the distribution of water to individual farmers from the canal through Neerganti (Canal water supervisor) or by individual farmers themselves.

4.9 Ground water regime in the command area

4.9.1 Tank rehabilitation and consequent increase in the storage of tanks & irrigated area in the command area has resulted in increased recharge to the ground water. This has led to increase in the yield of the wells and consequent increase in the area irrigated. Also the there has been a significant rise in the ground water levels. In the absence of periodic measurement of water level during the pre project and post project periods and also lack of concurrent hydro-geological measurement of wells yields, feed back from the farmers in the command area has been recorded. Based on this feed back the impact of the tank rehabilitation programme on the ground water regime has been assessed. A separate survey of agricultural situation in the command of bore wells has been conducted to ascertain the status of the agricultural productivity under bore well irrigation.

Table 4.8 indicated the extent of changes in the ground water regimes in both sample & control villages. It can be observed from the table that there has been slight decrease in the number of bore wells and open wells in Kolar & Chickballapur (EDZ) and Raichur (NEDZ). The increase in the area irrigated by the open wells does not appear to be significant. The area irrigated by bore wells increased from1085 ha to 1943 ha in sample tanks while it was from 188 ha to 278 ha (in three zones) in control tanks.

4.9.2 There is significant rise in the ground water table in both open wells and bore wells. The rise in the water level in open wells has been in the range of 0 to 36 meters. The rise in the water table in the bore wells has been in the range of 19m to 39 m. During the monsoon season 2007-08 the Northern districts falling under NDZ, NEDZ, NETZ, NTZ, have received substantial rainfall after a decade of low rainfall. This has resulted in higher storage in the MI tanks leading to

Table 4.8

substantial increase in the water table conditions. Rainfall has been above normal in certain talukas of CDZ & EDZ leading to more inflows into tanks in certain pockets only. In these villages the rise in ground water table has been substantial.

4.9.3 In the absence of scientific estimates on the ground water levels through piezometers, farmers who own bore wells and other knowledgeable persons in the village were interacted with about the ground water levels during the reference year for the study, apart from information gathered during focused group discussion. The depth from the surface to ground water level, as told by the respondents, based on their observations, has been recorded.

4.10 Perceptions of Tank User's Groups

4.10.1 During the field survey detailed discussions were held with the members of Tank Management Committees (TMC) as well as individual farmers to ascertain their perceptions regarding the tank rehabilitation programme and the problems faced during the implementation. The results of these interactive discussions have been presented in Table 4.9. It can be observed from the table that most of the TMCs were satisfied with the programme because the works were carried out as per the requirement of the community and the quality of works was satisfactory. However a significant number of TMCs have expressed their dissatisfaction at the entire programme for the following reasons.

- lack of co-operation & timely guidance from CFT & DPU staff
- community lacks interest & involvement
- difficulty in mobilizing the farmer's contribution
- factionalism with in the community
- lack of adequate funds

There have been instances where the community involvement with the works was minimal or negligible. Especially committees which were formed to supervise the implementation of the programme were either not functional or absent. There was lack of transparency regarding maintenance of records related to quantum of works completed and payment to various contractors.

4.10.2 The TMCs also highlighted the difficulties faced during the implementation of the programme. They were

- change of CFT and weak facilitation
- withdrawal of funds and delay in resanctioning
- lack of interest from the community and their non involvement in implementation
- inadequate visits & guidance by CFT & DPU staff
- inadequate guidance due to low staff strength & heavy work load for CFTs
- interruption due to rains
- contribution (3%) not mobilized
- frequent changes in the staff
- delay in measurement of works by engineers
- delay in release of LOAs

4.10.3 Further it was reported by the TMIs that there have been significant deviations from the proposed ITDP at various stages of implementation. At planning stage itself there has been curtailment of plans at the time of ITDP approval. The items removed include length of canal lining, quantum of desilting etc. During the implementation some items of approved works were withdrawn during the process of funds withdrawals and resanctioning. Sometimes adverse weather conditions/ Unseasonal rains also have forced the TMIs to abandon or curtail some of the works.

4.11 Recommendations for improved civil works implementation

1. **Improved interaction** between TUGs,CFTs and DPU personnel **during planning phase** to achieve appropriate ITDP estimates.

2. **Opportunity** to be provided to TUGs **for review of ITDP during implementation phase** for possible mid course correction.

3. **Proper supervision** by CFT engineers of earthwork compaction is required and the final output to be reviewed by the DPU engineers.

4. The concept of TUG subcommittees and OK cards are not functioning effectively. There is **need to involve CFT/DPU engineers as well as committee members** for better monitoring of quality of civil works.

5. **Timely release of funds** for various civil works needs to be carried out coinciding with working seasons.

6. **Carrying out maintenance of tank system post implementation stage** especially **during period of scanty rainfall** where in the tank system may fall into disuse.

7. Efforts should be made **to improve the collection of real time hydrological data** especially with regard to gauge readings with regard to the tank storage.