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PERFORMANCE AUDIT REPORT

INDIA

**SECOND ANDHRA PRADESH IRRIGATION PROJECT
(Loan 2662-IN and Credit 1665-IN)**

June 27, 2001

*Operations Evaluation Department
Sector and Thematic Evaluation Group*

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Currency Equivalents (annual averages)

Currency Unit = Indian Rupees (Rs.)

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|------------------------|----------|----------|
| 1985 (Appraisal) | US\$1.00 | Rs. 13.0 |
| Average during project | US\$1.00 | Rs. 26.1 |

Abbreviations and Acronyms

| | |
|-----------|---|
| AP | Andhra Pradesh |
| APAU | Andhra Pradesh Agricultural University |
| APM | Adjustable Proportional Module |
| CADA | Command Area Development Authority |
| CADD | Command Area Development Department |
| CCA | Cultivable Commanded Area |
| CWC | Central Water Commission |
| GCA | Gross Commanded Area |
| GOAP | Government of Andhra Pradesh |
| GOI | Government of India |
| ICB | International Competitive Bidding |
| ICR | Implementation Completion Report |
| I&CADD | Irrigation and Command Area Development Department |
| LCB | Local Competitive Bidding |
| LMD | Lower Manair Dam |
| OC | Outlet Committee |
| OED | Operations Evaluation Department |
| O&M | Operation and Maintenance |
| OFD | On-Farm Development |
| PAP | Project Affected Person |
| PPM | Project Preparation and Monitoring Wing (of I&CADD) |
| PWD | Public Works Department |
| RAP | Resettlement Action Plan |
| R&R | Resettlement and Rehabilitation |
| RD | Revenue Department |
| RWS | Rotational Water Supply |
| SAR | Staff Appraisal Report |
| SIN | Structured Irrigation Network |
| SRBC | Srisailem Right Branch Canal |
| SRS | Sriramasagar |
| TMC | Thousand Million Cubic Feet |
| WALAMTARI | Water and Land Management Training and Research Institute |

Fiscal Year

Government: April 1 – March 31

| | | |
|---|---|-------------------------|
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The World Bank
Washington, D.C. 20433
U.S.A.

Office of the Director-General
Operations Evaluation

June 27, 2001

MEMORANDUM TO THE EXECUTIVE DIRECTORS AND THE PRESIDENT

**SUBJECT: Performance Audit Report on India
Second Andhra Pradesh Irrigation Project
(Loan 2662/Credit 1665-IN)**

The India Second Andhra Pradesh Irrigation project, supported by Loan 2662-IN for US\$131 million and Credit 1665-IN for SDR 127.5 million (US\$140 million equivalent), was approved in FY86. The entire loan was canceled: US\$90 million in December 1991 and US\$41 million in May 1993. SDR 40.8 million from the Credit was reallocated to help finance the Andhra Pradesh Cyclone Emergency Reconstruction Project for which the Bank also provided a Credit (2179-IN) and a Loan (3260-IN), which closed in FY94 with a satisfactory outcome. The remaining SDR 86.7 million of Credit 1665-IN was fully disbursed and the credit closed as planned in June 1994.

The two major objectives were to increase agricultural production over an area of 393,000 ha and raise farm incomes of over half a million people in 115,000 households. Because water availability was the major constraint, this was to be achieved through expansion of irrigated area and more efficient utilization of existing irrigation supplies in the Siramsagar Project (SRSP) and the Srisailem Right Bank Canal (SRBC). The project was also to complete the resettlement and rehabilitation (R&R) of 44,000 families resulting from the earlier filling of the Srisailem and Manair reservoirs.

The project failed to achieve its objectives because it was poorly designed. The government of Andhra Pradesh (GOAP) was slow to provide an acceptable Rehabilitation Action Plan which delayed effectiveness by 17 months. This was a demanding project crippled by contentious water allocation issues. Water allocation was agreed at loan/credit negotiations, the Bank subsequently questioned the basis of water allocation, creating animosity between the Bank and GOAP, and this stopped detailed design work of major portions of the project's canals, reversed some of the earlier Bank-imposed design changes at appraisal, and disrupted procurement.

Additional implementation problems arose from the Bank's recommendation in 1986 that the Irrigation Department take over the Command Area Development Department to form a new Irrigation and Command Area Development Department (ICADD). ICADD performed less efficiently than its individual parent organizations, particularly in planning. As a result, land acquisition was delayed, command area development did not take place, procurement became a major issue, and the cost of major works overran by 40-120 percent. While there were marked improvements in ICADD's performance at credit closure, no new or rehabilitated irrigation was operational because civil works were scattered and could not be connected to water supply

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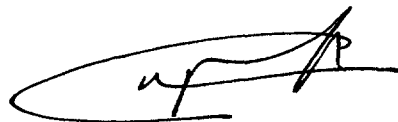
reservoirs, and only about 30 percent of the project's physical targets was achieved. The low rate of disbursement of the credit caused the Government of India to cancel the loan and reallocate part of the credit (to cyclone emergency reconstruction) without consulting GOAP, thus precluding project restructuring and extension. The project did not provide economic rehabilitation to the 45 percent of project-affected families who were above the poverty line and it omitted entirely those families affected by construction of project roads and canals under the subject project. Notably, a pilot of participatory irrigation management (using NGOs to facilitate the process) was successfully scaled-up in the follow-on project.

OED rates the project outcome as highly unsatisfactory, the same as the ICR. The audit upgrades the ICR's rating of institutional development to modest from partial primarily because the ICADD showed signs of increasing effectiveness in the last two years of the project, the seeds of farmers' participation and management planted by the project have rooted well and are beginning to blossom, and dam safety is firmly on the agenda. While ex-post participatory management and devolution of contracting to water users' groups is a step in the right direction, incentives to improve cost-recovery are not yet in place. In consequence, sustainability is rated as unlikely even though there has been substantial growth of irrigated area since 1995 in part of the project (Sriramsagar). Most of the systemic problems facing the irrigation sector – overstaffing, overprogramming and inadequate attention to operation and management of existing investments – remain and the issue of financial sustainability continues to be elusive.

The audit agrees with the ICR rating of Bank performance as unsatisfactory. However, it must be recognized that attempts to unilaterally redesign the project in mid-stream and use of arbitrary and informal suspension of disbursement damaged the Bank's reputation for fairness and created unnecessary conflict. The audit rates the Borrower's performance as unsatisfactory even though its performance improved substantially towards the end of the project.

Experience with this project confirms the following OED lessons:

- Inadequate appraisal followed by unilateral design changes in mid-project risks conflict over unresolved issues. Most of the water allocation controversy that damaged the Bank's reputation for objectivity and jeopardized smooth implementation of the project could have been avoided. The key was realizing the centrality of water allocation to project sustainability and resolving the issue with GOI and Government of Andhra Pradesh before the project started.
- Consistent Bank management requires a balance between technical and country development aspects – favoring one or the other creates problems. Good communications and timely, clear decision-making is a prerequisite. The poor Bank performance on AP II was eventually reversed with the appointment of a resident Country Director, the establishment of consistent Bank management of country programs, and the improvement of communications with GOI and state governments.
- Large-scale water development projects need to be designed within a river basin framework considering all water users to ensure efficient and effective water allocation using appropriate public and private sector instruments.
- Lack of sound operational plans, poor water management and inadequate feedback from monitoring and evaluation have large economic, financial and social costs.



Attachment

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This report was prepared by Mr. George Keith Pitman (Task Manager) who audited the projects in May 1999. Mr. William Hurlbut edited the report. Ms. Soon-Won Pak provided administrative support.

Principal Ratings

| | <i>ICR</i> | <i>PAR</i> |
|---------------------------|-----------------------|-----------------------|
| Outcome | Highly Unsatisfactory | Highly Unsatisfactory |
| Sustainability | Non-evaluative | Unlikely |
| Institutional Development | Partial | Modest |
| Borrower Performance | Deficient | Unsatisfactory |
| Bank Performance | Deficient | Unsatisfactory |

Key Staff Responsible

| | <i>Task Manager</i> | <i>Division Chief</i> | <i>Country Director</i> |
|------------|---------------------|-----------------------|-------------------------|
| Appraisal | A. Seager | C. Helman | E. Lerdau |
| Midterm | - | - | - |
| Completion | J. R. Malhotra | S. Barghouti | H. Vergin |

Preface

This is the Performance Audit Report (PAR) for the Second Andhra Pradesh Irrigation Project in India for which a combined loan (Loan 2662-IN) for US\$131 million and credit (Credit 1665-IN) for SDR 127.5 million were approved on March 20, 1986 and made effective on October 2, 1987. During the project period the loan was cancelled in its entirety and SDR 40.8 million from the credit was diverted to finance the Andhra Pradesh Cyclone Emergency Reconstruction Project (Credit 2179-IN). The credit was fully disbursed on August 24, 1994, about two months after the original closing date of June 30, 1994.

The PAR presents the findings of a mission by the Operations Evaluation Department (OED) that visited India in May 1999. The findings are based on the Staff Appraisal Report, Implementation Completion Report, project files, field visits to the project, and discussion with officials of the Government of Andhra Pradesh, respective department concerned with agriculture and irrigation as well as meetings with project beneficiaries, water user groups and people who were assisted by the resettlement and rehabilitation of the project. The author would particularly like to acknowledge the courtesy and facilitation of the Government of Andhra Pradesh's Irrigation and Common Area Development Department and Bank staff of the India Country Office in New Delhi. The PAR also benefited from country-wide discussion of the irrigation sub-sector which were conducted as part of OED's India Country Assistance Evaluation exercise which paralleled this PAR.

The audit was undertaken as part of OED's India Country Assistance Evaluation and because Andhra Pradesh has become the vanguard new generation of reformist Indian states. One objective of the audit was to see how the unsatisfactory performance of the Andhra Pradesh's irrigation sector related to this new state image. In addition, there was an unresolved safeguards issue on involuntary resettlement that needed review.

Following standard OED procedures, the draft PAR was sent to the borrower for comments before being finalized. No Borrower comments were received.

1. Introduction

1.1 Andhra Pradesh is India's fourth largest grain-producing state and agricultural activities provide two-thirds of the employment for its population of 66 million (1991). Irrigation, accounting for more than half of the cropped area, has always been a major focus of state government policy and budget, and the Bank has a long history of assistance to this sector.¹ Andhra Pradesh's irrigated canal command net area of about 1.7 M ha (the second largest in India) receives about 40% total state government investment. Since the late 1980s - and coinciding with implementation of the audited project - higher subsidy and budgetary allocations for welfare programs crowded out expenditure on physical infrastructure.

1.2 The two major objectives of the Second Andhra Pradesh Irrigation Project (AP II) were to increase agricultural production over an area of 393,000 ha and raise farm incomes of over half a million people in 115,000 households. Because water availability was the major constraint, this was to be achieved through expansion of irrigated area and more efficient utilization of existing irrigation supplies in the Siramsagar Project and the Srisailem Right Bank Canal. A third objective was to redress the resettlement and rehabilitation problems of 44,000 families involuntary displaced by earlier phases of water development in these two project areas (Box 1).

1.3 While not a project objective, the government, urged by the Bank, decided shortly before the start of AP II to merge the Irrigation Utilization and Command Area Development and Irrigation Departments to achieve management rationalization, better coordination and budget efficiency. The new Andhra Pradesh Irrigation and Command Area Development Department (ICADD) was charged with implementing the project. ICADD kept its former responsibility for all public investment and management of irrigation schemes larger than 2,000 ha, water resources planning, regional flood control and drainage, and construction of multi-purpose reservoirs. In addition it took responsibility for the Irrigation Utilization and Command Area Development Department which managed on-farm irrigation development below the canal outlet in the three of largest irrigation projects.² In other schemes, the ICADD continued to directly assist farmers

Box 1: AP II - Project Components

There were nine components:

- upgrading 146 km and extending by 281 km the main distribution canals from the Srisailem and Siramsagar reservoirs;
- undertaking irrigation development on 393,000 ha;
- improving water management and the recovery of O&M costs;
- providing telecommunications to facilitate canal operations;
- building 1,152 km of feeder roads;
- training farmers, professional and support staff to manage and operate the irrigation system;
- delivering effective monitoring and evaluation, technical services and assistance;
- studies of institutional upgrading and the planning of additional irrigation needs; and
- rehabilitation of and amenities for oustees from the Srisailem and Mannir Reservoir sites and other project works.

1. Previous Bank support for four irrigation projects has played a major role in the irrigation development of AP. These are: (a) Pochampad Irrigation (Cr.268-IN); (b) Godavari Barrages (Cr.532-IN); (c) AP Irrigation and Command Area Development Composite (API) (Ln.1251-IN); and (d) the subject of this audit - the Second Andhra Pradesh Irrigation (AP II) Project (Cr.1665-IN/Ln.2662-IN). In addition, the National Water Management (NWM) Project (Cr.2179-IN/Ln.3260-IN) included an AP component to demonstrate improved network designs in six medium schemes. In water resources development, a Hyderabad Water Supply Project (Cr.2115-IN/Ln.3181-IN), and hydrological data network improvement under the multi-state Hydrology Project (Cr.2774-IN) accounted for US\$91.35 M.

2. Nagarjunasagar, Siramsagar and Tungabhadra irrigation projects.

develop their own on-farm irrigation development as needed. Smaller-scale irrigation investments are undertaken by separate minor irrigation and rural development and agriculture departments. Private sector participation is limited to private funding of wells and small pump schemes.

2. Implementation Was Fraught With Difficulty

Project Design was Contentious

2.1 Design issues became increasingly contentious during implementation because of deficient appraisal. In the past, the Bank had limited itself to financing specific components of the semi-complete irrigation projects without getting involved in the detail. But since the mid-1980s, the Bank had become increasingly pro-active in placing its investment in the larger-scale water development scene and micro-managing the engineering of irrigation projects it supported. Part of this technical focus stemmed from the Bank staff's frustration at lack of access to Indian and State water policy table as discussed elsewhere (OED, 2001). This was not helped by the ICADD's exclusion of contentious engineering elements from the Bank project to make it more "bankable". A good example was the 16 km deep and difficult cutting across the Mitta Kondala Range at the head of the Srisailem canal which Bank staff feared would cause delayed water supply to the downstream works – it is still not finished.

2.2 To make matters worse, poor communications and management allowed things to get out of hand. In addition, there were several changes of Bank Task Manager each of whom held project design hostage to their own engineering preferences. Regrettably, this technical focus clouded their perception and timely action on other critical issues such as procurement, and resettlement and rehabilitation of *oustees*.

Srisailem Right Bank Canal

2.3 Located in Andhra Pradesh's poorest and most drought prone region, the Srisailem Right Bank Canal command area is fed from the multipurpose Srisailem reservoir on the Krishna River. Diversions from the Krishna are governed by inter-state agreements embodied in the Krishna Water Disputes Tribunal Decision of 1973 which allows Andhra Pradesh to use all unutilized flows until year 2000. At negotiations the GOAP confirmed, and the Bank accepted, that the Krishna Tribunal Decision guaranteed sufficient water to the Srisailem right bank canal project. Despite these agreements, the Bank later challenged the adequacy of the water allocation to the project thus creating conflict with GOAP and GOI's Central Water Commission.

2.4 Initially, Bank micro-management was confined to second-guessing the design of the main canal – despite the fact that the first round of construction contracts had been awarded – and this later expanded to include the whole project concept for both command areas. At appraisal the Bank unilaterally decided that two balancing reservoirs along the main canal (at Gorakallu and Owk) were not required. As a consequence of the Bank's changes, the ICADD proposed a siphon to cross the valley at Gorakallu. Under the initial design, the valley would have been dammed and the canal would have flowed into and out of the reservoir created. The redesign and contractual problems this new proposal posed for the ICADD appear to have been ignored. In the event, it took the Bank 29 months to approve the siphon design and GOAP a further 29 months to develop terms of reference and recruit supervision consultants.

2.5 Soon after completion of negotiations (January 1986), the Bank unilaterally commissioned a study of the Srisailem reservoir operating plan that further confused the design issues. Apart from throwing doubt about the adequacy of the water allocated to the project under the Krishna Tribunal, it indicated that there were *potentially* significant opportunity costs (lost power production) associated with maintaining reservoir levels high enough to feed the main right bank canal.³ This was compounded by a second internal Bank review in 1991 that, while affirming the magnitude of potential power generation losses, found the design command area “overly optimistic” and recommended provision of off-stream storage to mitigate this, a lower level canal and perhaps a booster pumping station – new design elements and a reversal of the design agreed at appraisal. Thus, in May 1991 the Bank informed GOAP that new contracts should not be awarded below the site of the Gorakallu bypass siphon until these design issue were resolved through eight additional studies.

2.6 Rather than resolving the design issues, the studies delivered in 1992 gave rise to new ones and further delays. While confirming the original ICADD concept of reservoirs at Gorakallu and at Owk, they revealed significant environmental impacts. In particular the Gorakallu reservoir required 1,400 ha of land and displaced 41 households, while that at Owk required 2,000 ha, submergence of a village and five factories, and involuntary displacement of 486 households involving 2,148 people. Regrettably, similar design problems plagued the Sriramsagar project.

Sriramsagar Project

2.7 The command area, served from the Sriramsagar Reservoir, was completed under an earlier Bank credit in 1979. The Lower Mannir Dam, constructed about 145 km below the main dam to create a storage and balancing reservoir, was completed independently by GOAP while the Bank’s AP I project (closed in 1985) assisted, *inter alia*, command area development of 33,500 ha in the upper part of the project.⁴

2.8 While the objectives for Sriramsagar were relatively straightforward, they proved difficult to achieve. Under the project, canal works up to 234 km were to be completed and extended to 284 km thus creating an additional 165,000 ha below the Lower Mannir Dam. But as in the Srisailem project, the Bank’s approval of construction contracts was made conditional on the ICADD’s progress on water allocation and regulation within the specified 31,500 ha under irrigation. Lending conditionality required rotational water supply, de-localization to ‘irrigated dry’ crops and raising water charges to cover at least full costs of operation and maintenance. Prior to the project, farmers in the head reaches of the main canal had had almost unlimited access to water for almost a decade while the lower parts of the canal command remained incomplete. Consequently, prudent water management was not practiced and one third of the eventual command area utilized 70% of the total supply.

3. The initial study indicated that 2.1 billion cubic meters of water could be available for annual power generation worth between \$22 and \$26 million while incremental investment costs were of the order \$10 million. Later revisions (in 1991) to the basic assumptions increased the volume available for power generation to 2.6 billion cubic meters but these benefits were partly offset by the need to pump water into the canals when the reservoir levels were low. A comprehensive cost-benefit analysis was undertaken to evaluate this alternative.

4. The Andra Pradesh Irrigation and CAD Composite project (AP I) when presented to the Board in 1976 was one of the largest Bank-supported projects (\$287 million including a Bank credit of \$145 million) and the largest irrigation project in India. The Project completion Report took five years to complete and was delivered to the Board in 1990. While the bulk of the project funding was devoted to the Narmadasagar project, poor contract management threatened project suspension and led to complete reformulation of the project in 1979. In addition, the project was extended three years to 1985. Insufficient attention to water allocation and management were the major issue affecting achievement of project objectives – most notably enforcing a change from irrigated wet localization to irrigated dry. The ex-post ERR estimated by the Region ranged from 0.5 to 6.5%.

2.9 The practicalities of introducing rotational water supplies and ‘irrigated dry’ water allocation when the works were not complete forced the Bank to accept a phased approach. Thus it was agreed that the whole of the 62,000 ha above the Lower Mannir dam should adopt an ‘irrigated dry’ regime by June 1993. However, the first GOAP Order to de-localize irrigated wet areas in Karimnagar without farmer consultation caused a backlash. Farmers successfully petitioned GOAP of the grounds of hardship and financial losses, and an expert GOAP committee in 1987 recommended a slow-down of the program to achieve 80% of the target by the last year of the project – but even that was not achieved.⁵

Water Allocation and Management Became Controversial

2.10 It became clear soon after the project started that the ICADD, as under the earlier project, would have great difficulty in regulating water supplies either through better water allocation and management or through increased water user fees. Despite pressure from the Bank in the first year of the project, government was unable to comply with the water charge covenant and three years later the Bank agreed to allow additional time to undertake studies across the state. At project closure the study was still not complete.

2.11 Provoked by a 1988 newspaper article - which reported that de-localization policy had been reversed by GOAP - the Bank adopted an increasingly aggressive stance on water management issues. This was fuelled not only by the Srisailem redesign controversy but by a newly created New Delhi Office Bank team supervising (and also micro-managing) the National Water Management Project which focused on a national program of operational improvements in the water management of major irrigation projects.⁶ Matters came to a head in the spring of 1991 when the Bank informed GOAP that it would not consider any new contracts within the Sriramsagar project or below Srisailem’s Gorakallu siphon until the water management issues were satisfactorily resolved.⁷ And by mid-June of 1992 an “informal suspension” of the credit was issued to GOAP from the New Delhi Office informing them that no further claims for reimbursement (other than for resettlement and rehabilitation) would be considered.

2.12 This provoked a swift response from GOI.⁸ At a tripartite meeting in New Delhi, the Central Water Commission and GOAP informed the Bank’s Regional Director that they had given the necessary assurances on water allocation issues at negotiations and that there was not an issue. Even though the Bank’s Director appeared to accept GOI’s position in the meeting, the outcome and next steps were unclear.⁹ Informal suspension was not lifted. And the Task Manager

5. This should not have come as a surprise to the Bank. The Project Completion Report for the AP I states: “It was assumed that GOAP would induce farmers already growing excessive paddy to convert to new patterns by persuasion and water rotation means. Regrettably this has not occurred, with GOAP taking no steps to correct the situation.”

6. This project implemented 1987-1996 was unsuccessful. See OED PAR

7. Even though river basin planning was an inter-state issue, the Task Manager’s Memorandum to Management (April 3, 1992) stated: “...suspend and get AP to do a proper water basin plan for the Krishna and determine allocation available for use...” and the rationale was... justification for current and future water investments be based on sound technical assumptions and current water usage...not computer guesses.”

8. The meeting was held on June 30, 1992.

9. The senior new Delhi Office staff at the meeting subsequently noted (July 2, 1992) “I am uncomfortable about the outcome and expressed concern at the meeting and afterwards...[to the Director]. Essentially, his position was the legal one...we went along with water availability issues at appraisal...they gave us assurances...we have to accept it.” Subsequently, Bank staff drafted minutes which stated that it was agreed that lifting of the informal suspension was made conditional on the Central Water Commission’s confirmation of the availability and allocation of water to Srisailem right bank canal project, along with the parameters adopted in CWC’s analysis, review of the scope of Sriramsagar project and confirmation that there would be sufficient water for the Madras Water Supply Project downstream.

continued to campaign for suspension on the grounds it is “better to stop a project in mid-stream whose conceptual base is not accepted by the borrower than accept a sub-optimal outcome where costs greatly exceed benefits”.

2.13 The issue came to a head at the Bank’s Annual meetings in the fall of 1992 when the GOI delegation again raised the issue. At this point a clear rift developed between the Bank staff in New Delhi and HQ. Firstly, HQ staff pointed out that an “informal suspension” was not a legally legitimate step and that the Bank could not question the sovereign word of its member governments. HQ also pointed out that suspension on the water issues was nebulous. Conversely, HQ indicated while there were legitimate grounds on the basis of poor management, contractual problems and many unfulfilled covenants, the Bank had foreclosed on this option by its focus on water issues. And to catalyze a decision, in early November India’s Prime Minister wrote to the Bank President Lewis Preston on the issue. In this letter, it was stated that “assurances given by Andra Pradesh GOAP and letter by the CWC confirming [the agreements] are...not being accepted by the Bank.”¹⁰ By mid-December 1992, the Bank formally revoked the idea of suspension and accepted GOI’s assurances on inter-state and project water allocation issues. Disbursement was restarted but serious damage had been inflicted on the project and to the Bank’s relationship with GOAP.

2.14 Only three months later, on the basis of the same water issue and poor implementation progress, the Bank gave GOI two options: either immediate project closure at GOAP’s request or continuation with no extension allowed. It took GOAP nine months to respond by which time the Bank was determined to close the project on schedule. Recognizing the difficulties this would cause with substantial procurement in-process, the Bank agreed to a third phase project – but only if GOAP completed a comprehensive review of water availability issues during pre-appraisal.¹¹

Procurement Was Also Fraught with Difficulties

2.15 Procurement was made difficult by poor definition of the Bank’s bidding and contract documentation requirements, deficient design, contract and tender preparation, and the Bank’s stop-go policy caused by the water controversy. The overall procurement process took place during the evolution of the Bank’s standard bidding documents for ICB and LCB, a process that was only completed for India in 1993 – and in that process the Bank sometimes changed its mind which made approvals and no-objections time-consuming.¹² This was not helped by the ICADD’s general inexperience with Bank procurement and their lack of awareness that Bank procedures were mandatory. Prequalification of contractors by GOAP was initially not in line with Bank standards, although this improved by the time the final batch of contracts were let. Retendering of failed contracts created considerable delays and disruption to an orderly work program. Induced by the water controversy, the Bank’s stick and carrot approach to approving contract award and disbursement made the already difficult contracting process chaotic. Paradoxically, the Bank expressed frustration at the piecemeal implementation of the works.

2.16 Outdated GOAP rate schedules also led to significant underestimation of actual construction costs. While the first package of contracts at the head of the distribution networks was 20% less than the engineer’s estimate, almost all the contractors failed to complete the works

10. The views of New Delhi staff were that letters had been exchanged but the assurances given were insufficient. The correspondence file clearly shows that the Task Manager wanted a full cancellation until a complete and satisfactory modeling study on the Krishna river basin demonstrated that the Bank’s projects were hydrologically viable.

11. Minutes on a meeting between the Bank and GOAP, October 26, 1993

12. “Procurement of Works”, drafted by a GOI Task Force, was approved by the World Bank in December 1993.

and had to be expelled. Subsequent contract packages were 67% and 109% more than was estimated and it took GOAP considerable time to accept that these higher rates were justified if good quality work was to be achieved. Government only realized how low its rates were when significant increases were required to induce contractors to bid for the works under the 1990 Cyclone Emergency Reconstruction Project.

2.17 The quality of engineering design was jeopardized by inadequate site investigation and changing design in response to Bank directives. Much of the project design at the start of the project was only at the feasibility level and detailed alignments and related ground conditions were uncertain. The design of over 1,100 km of road works was only finalized two years after project appraisal and physical work only started in 1991, five years later. Major difficulties were encountered in sequencing and coordinating the design inputs of the old Command Area Development staff with those of the ICADD – insufficient and inexperienced staff and GOAP's unwillingness to employ outside consultants amplified these problems. Additionally, Bank micro-management of some specifications – insisting, for example, on defining construction methods (rather than performance standards) for canal lining - limited competition and increased costs. Most of these problems were rectified by 1992 and the pace of work accelerated significantly in the last two years of the project.

2.18 Safety of the existing dams was successfully addressed by GOAP who established a state Dam Safety Review Panel which initiated major rehabilitation and flood conveyance works. The experience gained by the Panel was published by the ICADD as *Notes on Dam Safety and Sustainability* (1995) and *Dam Safety Assurance and Rehabilitation – Identification Report* (1996). Progress on other safeguard aspects was, however, poor.

Social Safeguards Were Inadequate

2.19 Issues surrounding mitigation of involuntary resettlement cast a pall over the project. Total land acquisition and the people affected by the project's two irrigation schemes since their inception is very large – over 52, 000 ha of land supporting more than 200,000 people. The AP II-financed works alone required over 9,700 ha and affected the livelihoods of 8,648 people.¹³ Yet this project-created involuntary resettlement was not foreseen at appraisal.¹⁴ Indeed, at appraisal the Bank accepted that involuntary resettlement could be avoided through detailed attention to canal and road alignments –but the heated debate on large-scale engineering and water allocation sidelined attention to social aspects of the project.

2.20 Even though the involuntary resettlement created before AP II predated the Bank's safeguard policy (OMS 2.33 of 1980), the Bank felt it had a moral obligation to follow-up and ensure just and equitable compensation. Part of this was driven by the adverse publicity arising from national press reports of the Srisailem resettlement actions in which “the government failed miserably...and acted in a most callous manner” and evictions were carried out “with much vigour and ruthlessness.”¹⁵ While not accepting any responsibility for creating the Srisailem involuntary

13. The construction of the Srisailem dam caused submergence of 81 villages and 30,979 families lost 21,037 houses and 34,756 ha of land. An additional 2,745 landless families were displaced. The Lower Mannir Dam affected 7,435 ha supporting 13,229 families (63,370 people) living in 26 villages. The proposed Owk reservoir affected one village and displaced 2,148 people. The roads and canals constructed under AP II affected 6,500 people in 308 villages. 121 lost their homes, 675 were rendered landless and 311 functionally landless. And land of 7,981 ha was required for project works.

14. Memo of 12 July 1985. “AP II will not impinge on existing settlement patterns...and will thus not create any new resettlement issues”. The Owk and Gorakallu reservoirs were eliminated during appraisal.

15. Economic and Political Weekly 16(52), 1981.

resettlement – which was associated with the GOAP’s engineering works – the Bank pressed GOAP to include a safety net component for the Srisailem oustees in the project and a full (but undefined) package for the involuntary resettlement created by the Lower Mannir reservoir as it was an integral part of Bank-financed works. An acceptable Resettlement and Rehabilitation Plan (RAP) was made a condition of Loan and Credit effectiveness.

2.21 The Bank offered little guidance on what was required mainly because there were few precedents and the Bank’s social-scientists had very limited participation.¹⁶ GOAP recruited the Centre for Economic and Social Studies (CESS) and its Bureau of Statistics to undertake surveys of the socio-economic status of the *oustees* – a major problem was that many could not be traced. It did not seek to establish a comprehensive Resettlement and Rehabilitation Policy for the state, rather it relied on existing (and outdated) legislation. In consequence, despite several iterations with the Bank’s New Delhi Office, GOAP was unable to produce a RAP acceptable to the Bank. When it became clear that the delay could extend beyond 30 months, the Bank converted the effectiveness covenant into a dated one – to produce the RAP four months after the date of effectiveness.

2.22 The RAP that was eventually submitted (February 1988) was welcomed in the New Delhi Office but found wanting on expert review.¹⁷ While its compensation elements were acceptable, its rehabilitation proposals were not: rehabilitation was designed to assist only those below the poverty line and HQ found its provisions “cannot be expected to restore living standards to pre-submergence levels” – the whole rationale for the Bank’s involvement.¹⁸ Eventually a compromise was reached and GOAP produced rolling annual RAPs for the period 1988-90 as more information became available, and finally a RAP covering 1991-93. Even then, the Bank’s resettlement specialist found that CESS’s report “points out serious lacunae in the implementation of the economic activity support programs..leading to negative impacts on the economic status of already poor households.”¹⁹ While Bank drew this to the attention of GOAP, the impression gained from the supervision reports is that Bank staff regarded the RAP as far less important than resolving the water and engineering issues.

2.23 The organization to implement these RAPs was complex and coordination was difficult. Overall responsibility was given to the ICADD who contracted CESS to undertake monitoring and evaluation of the program. Most other aspects were farmed-out to the District and rural administration agencies. District-level Committees supervised the RAP implementation and included representatives of the *oustees* community, state legislature and local NGOs. Implementation until 1993 was marred by poor coordination among the various committees and inadequate capacity of local banks to handle compensation payments. Ensuring adequate attention for rehabilitation for women, and girl’s education was particularly vexing.

In a notable initiative, GOAP eventually established *Lok Adalats* (People’s Courts) in each district to settle appeals for enhanced compensation that were clogging the local courts. Under this system, the District Collector assisted by members of the District Legal Aid Committee,

16. Most of this lack of attention was due to the turmoil created by the massive Bank reorganization of 1987.

17. The CESS surveys examined whether households purchased assets with the compensation received – sometimes as much as decade before - studied the changes in the socio-economic conditions after evacuation, identified deprived groups, suggested a plan for economic rehabilitation of the deprived groups and identified gaps in the socio-economic infrastructure provided by GOAP to the new settlements.

18. Memo of March 4, 1988.

19. Supervision report, December 17, 1991.

visited each *oustee* village and settled claims by negotiation. Subsequently, but only for the Srisailem *oustees*, GOAP made a final payment of all outstanding claims.

2.24 The ICR acknowledged the failings of the project in dealing with the involuntary resettlement issues. A retrofit RAP was prepared under the follow-on AP III project and is still under implementation (see paras 3.8 and 3.9).

3. Ratings

Outcome

3.1 *The outcome criteria takes into account the extent to which the project's major relevant objectives were achieved, or are expected to be achieved, efficiently.* The audit agrees with the ICR and rates the outcome of the project as **highly unsatisfactory**. The justification for this rating is described below:

Relevance: Were the Project Objectives Right?

3.2 *Relevance is the extent to which the project's objectives are consistent with the country's current development priorities and with current Bank country and sectoral assistance strategies and corporate goals.* AP II's emphasis on completing existing projects, attempting to rectify poor cost recovery and addressing water management was and is highly relevant. Budget resource allocated by the Irrigation Department traditionally emphasized starting new major and medium projects rather than completing or rehabilitating existing schemes, leading to time and cost overruns due to the spread of limited capital resources and upkeep of under-employed personnel. Insufficient funding for canal operation and maintenance created unreliable irrigation supplies and caused agricultural production to stagnate. Enabling predictable and equitable water allocation within the command area of the two component projects would redress the agricultural productivity issue, facilitate farmer's ability to pay increased water charges and enable improved operation and maintenance.

3.3 The emphasis on improved water management was correct. Traditionally, water delivery was proscribed by ICADD under local regulations that specified the classes of crops that could be grown in each season in order to spread the benefits of irrigation as widely as possible by banning water intensive crops.²⁰ Under a supply-driven and state-run system the localization concept was an attempt to ensure equity of supply. However, in practice most farmers preferred "irrigated wet" localization given the preference for rice cultivation and cash crops like sugar cane. Delayed completion of the distribution systems of most large irrigation projects – typically taking decades – reinforced this bias as river diversion and dam works were normally completed first thus making the full water supply available. As a result, at the head end of most irrigation systems,

20 An old concept, "localization" was introduced over a century ago (1865) and amended under the 1984 Irrigation Utilization and Command Area Development Act. Irrigated areas in AP are classified as "Irrigated Wet" (IW) and "Irrigated Dry" (ICADD) under a legal procedure known as "Localization". In IW designated areas (usually lighter soils), rice and sugarcane are specifically banned under the provisions of the 1984 Act because farmers in the canal head reaches would prevent water from reaching the tail-end areas. Section 24(2) of the 1984 Act allows GOAP to alter the Localization designation of an area if it wishes to advance the technology of land and water management practices.

“irrigated wet” became the practice even though project design may have been predicated on an “irrigated dry” water regime. AP II was to address both facets of this problem in the Sriramsagar and Srisailem Right Bank projects through attention to system design, sequential construction and firm management of water supplies to impose an ‘irrigated dry regime’. However, given these long traditions, reform of “localization” to improve water management and extending the water issue to include water allocation at the river basin level proved to be its Achilles’ Heel.

Efficacy: Did the Project Achieve its Stated Objectives?

3.4 *Efficacy is a measure of the extent to which the project’s objectives were achieved, or expected to be achieved, taking into account their relative importance.* The simple answer is “No”. Inadequate appraisal doomed the project from the start. No attempts were made to rid the newly reorganized implementation agency of its parents’ systemic management problems and initially the new organization’s performance declined. By the time these problems were recognized and overcome, it was too late to complete the project. Overall, about 45% of the Credit was disbursed and this enabled completion of 38% of the appraised civil works targets for the Srisailem Right Bank Canal and 21% for new construction on Sriramsagar. At appraisal, Bank consultants estimated it would take 10 years to completion, GOAP thought it could be done in 5, and the Bank finally adopted 7.5 years on the basis of historic disbursement profiles. Current estimates are that it will be completed by 2003 – or in 17 years.

3.5 The project had little impact on poverty alleviation by Credit closure apart from the temporary local employment generated by the civil works. Since 1994 some of the incremental irrigated areas has become operational and tangible benefits are beginning to be generated. Probably the most notable achievement under the project was government’s facilitation of a pilot NGO project that promoted participatory irrigation management with farmers who increased water use efficiency by 60% on a small distributary.²¹

3.6 There were varying levels of achievement of non-engineering components. Training efforts reached 7,088 farmers²² and over 440 engineers of ICADD and Dam Safety concerns were satisfactorily addressed. Important studies on groundwater and tank-based irrigation were successfully completed. Conversely, only six of 18 legal covenants were completed and there was no progress on the most important. Water allocation and management plans, including rotational supplies were not undertaken and became a major bone of contention that undermined the project. Recommendations to implement increased water charges to recover full operation and maintenance costs and a reasonable portion of capital costs were not made because the prerequisite studies were not complete. Measures to improve coordination of water management with the agricultural extension systems were not undertaken.

3.7 In a major departure from Bank policy, rehabilitation was limited only to those project-affected people under the poverty line. At completion, almost all the 43,979 families were awarded some form of compensation but only slightly more than half were rehabilitated and assisted to reestablish their livelihoods. It is unclear how many of the 24,126 families assisted relate to the original cohort of families under the poverty line. The amount actually spent on implementing the RAPs was about Rs. 39 million (\$1.7 million) – about half the amount

21. GOAP Order 316 of 1994 provide, for the first time, broad guidelines for participatory irrigation management. A local NGO, the Institute for Resource Development and Social Management, who were recruited by the ICADD, worked on the 1,250 ha Distributary 64 in the Sriramsagar project for two years. In that time they helped farmers manage an increase in irrigated area from 748 to 1095 ha and ensure water distribution included tail-enders.

22. This included 4,064 contact farmers and 3,032 outlet committee chairmen.

estimated at appraisal. Due to oversight, 6,300 people who were affected by AP II civil works were not included in RAPs.

3.8 Fortunately, the follow-up AP III project provided a comprehensive RAP for these *oustees*. In addition, a special remedial rehabilitation package was designed for the remaining 2,231 Srisailem *oustees* without houses. However, the Lower Manir Dam *oustees* fared less well on rehabilitation because of the absence of detailed surveys under AP II. Thus, while it was known that 778 people had not received their income-generating benefits, none of these people could be identified - a good case of "justice delayed is justice denied." In a judgement of Solomon, it was decided instead that the AP III income-generating program would target the poorest 778 families in the 23 resettlement villages.

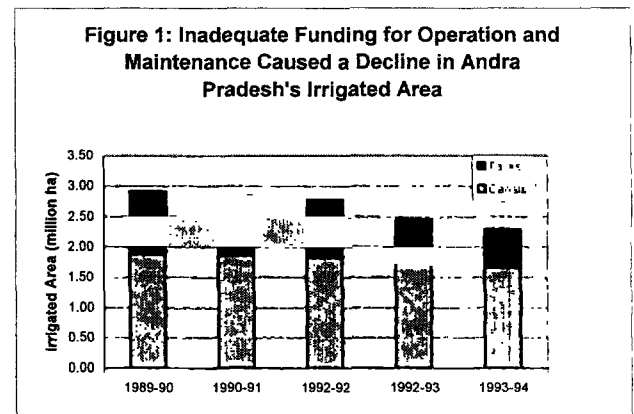
3.9 Government continues to drag its feet. Land acquisition, particularly for water distribution and drainage with the command area of Srisailem, is still a major problem. By February 2001 only 52% of compensation for land acquisition under AP II had been paid and only 1,238 families out of a targeted 1,619 families in Srisailem right bank canal area have been allotted house sites. Similarly, 449 Sriramsagar *oustees* families out of a total of 571 have been given house lots. Although the AP III project does not provide any assistance for construction of houses, the majority of those allotted house lots have accessed various GOAP schemes to completed construction.

Efficiency: Was the Project Cost Effective?

3.10 *Efficiency is a measure of the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared with alternatives.*

3.11 Slow progress of disbursement and devaluation of the Rupee led to cancellation of the \$131 million Loan (\$90 million in 1991, the balance in 1993). And \$55 million of the \$140 million Credit was diverted to finance the Andra Pradesh Cyclone Emergency Reconstruction Project in 1990. Due to oversight, neither the Bank nor GOI informed GOAP about the 1993 cancellation of \$41 million for some months and GOAP continued to let works. In addition, costs had been significantly increased by revised rates and inflation due to delays caused by the retendering process. Thus at the end of the project, GOAP was left with unplanned contractual commitments of about \$118 million.

3.12 As a result of cost overruns and delayed benefits, the audit estimates that overall the project ERR will be about 11% compared with 14% in the ICR and 22% at appraisal (Annex C). In addition, the audit's ERR takes into account likely infrastructure deterioration because of inadequate funds for operation and maintenance. In the past, this caused a contraction of canal irrigated area by about 3% a year, Figure 1. Under this scenario, the ERR of Sriramsagar is estimated at 14%, whilst Srisailem is 5%. Clearly, Srisailem is a bad investment from an economic perspective.



Institutional Development: Has The Project Led to Better Management of Human and Financial Resources?

3.13 *The rating for institutional development is a measure of the extent to which a project improves the ability of a country or a region to make more efficient, equitable and sustainable use of its human, financial and natural resources through better definition, stability, transparency, enforceability, and predictability of institutional arrangements.* Institutional development is upgraded from partial in the ICR to modest. Despite the very poor start, overall project planning and management by the ICADD improved markedly in the last two years of the project. Civil works contracting and procurement standards improved, significant progress was made towards participatory management of irrigation in the pilot distributary and the Dam Safety Panel was established and became effective.

Sustainability: Are the Projects Results Likely to Last?

3.14 *Sustainability is an indicator of the resilience to risk of net benefits flows over time* Sustainability is more difficult to rate particularly as the project is not yet complete. At project closure the ICR rated sustainability as “irrelevant” because the project never reached operational status while OED rated it as uncertain. Sirisailem right bank canal is still rated as unlikely as major civil engineering works remain incomplete (the Owk tunnel and the 16 km canal cut across the Mitta Kondala Range) and none of the irrigation blocks has received a water supply. The secondary and tertiary distributary and drainage systems is still far from complete and extensive work undertaken by NGOs to build irrigation water user groups will undoubtedly have to be redone as the lack of water will have undermined the rationale for group formation—a similar problem occurred on the Mahakhali Irrigation Project in Nepal.²³

3.15 The Sriramsagar project has become operational with a marked growth in irrigated area resulting from GOAP's efforts in promoting participatory irrigation management and simultaneously launching a program to reform the way the ICADD works with farmers was key to this new start. Participatory management, however, is only part of the sustainability equation - provision of adequate and timely funding for operation and maintenance continues to be a problem, and there are still too few incentives for farmers to cost recovery seriously. Despite a three-fold increase in irrigation charges in 1997 and the formation of water users' groups, the share of cost recovery through users' fees has declined from 4% of total expenditures in 1994-95 to 1.8% in 1999-2000. Even though there has been impressive increases in the performance of the Sriramsagar project, its long-term sustainability looks uncertain in the current budget setting. Given the status of the Srisailem project, the audit rates the overall project sustainability as unlikely.

Bank Performance

3.16 *This is a measure of the extent to which services provided by the Bank ensured quality at entry and supported implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of the project).* The audit agrees with the ICR rating of Bank performance as unsatisfactory. In particular, the Bank failed to take account of lessons from the failure of a previous project (Andhra Pradesh Composite Irrigation Project, Loan 1251-IN) and were deficient in appraisal and on social safeguard issues. Attempts to

23. OED PAR Report 18377. 1998. Narayani III Irrigation Project (Cr. 1715-NEP), Mahakhali II Irrigation Project (Cr. 1814-NEP), and Mahakhali Headworks Project (Cr. 2430-NEP)

unilaterally redesign the project in mid-stream and use of arbitrary and informal suspension of disbursement damaged the Bank's reputation for fairness and unnecessarily created conflict.

Borrower Performance

3.17 *Borrower performance is rated by the extent to which borrower assumed ownership and responsibility to ensure quality of preparation and implementation, and complied with covenants and agreements, towards the achievement of development objectives and sustainability.* The audit rates the Borrower's performance as unsatisfactory even though it increased substantially towards the end of the project. Most of the systemic problems facing the irrigation sector – overstaffing, overprogramming and inadequate attention to operation and management of existing investments – pervaded the project and remain. There is a still reluctance to tackle the issues of financial sustainability beyond raising irrigation fees, and adequate monitoring and evaluation is missing

4. Findings and Lessons

The AP II Experience has Catalyzed Reform

4.1 The Bank provided a credit/loan package of \$325 million for completion of the works under a third phase project, AP III, in 1997. During appraisal government resolved the water allocation issue which so dogged AP II. This revealed that some of the AP II irrigation works constructed at the tail-end of Sriramsagar are not viable with the water available and therefore a decision has been made to abandon them - they remain as a monument to government's over-ambitious water engineering plans. Almost all the carry-over works in Sriramsagar have been completed, the last in May 2000 (Annex B).

4.2 In the hiatus between the projects, the state government initiated a large-scale and state-wide reform program led by a new Chief Minister who was recently reelected for a second term. The irrigation sector has been a major beneficiary, and this has provided an opportunity for the Bank to reorient its assistance. The appointment of a Country Director has provided much needed leadership for the Bank's India operations and eliminated the communication problems that lay at the heart of much of the poor Bank management under AP II. From being an antagonist under AP II, the Bank has become a partner.²⁴ Gradually, the Bank's irrigation subsector work and investment is being brought within state-wide public expenditure purview under the Bank's Andhra Pradesh Economic Restructuring Package. To date, however, there has been little progress on unbundling the subsector to improve its governance, downsizing the state payroll and making it financially more accountable.

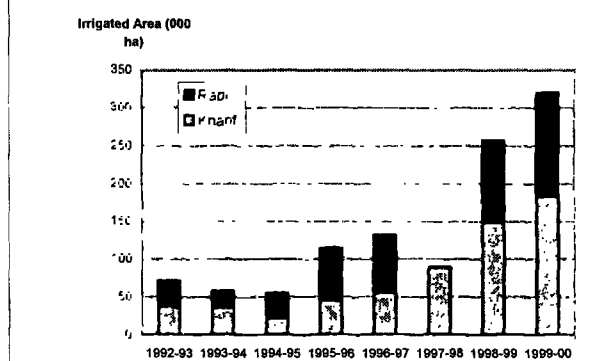
4.3 The Sriramsagar project has become operational with a marked growth in irrigated area that occurred shortly after AP II was closed and before AP III became effective, Figure 2. Government's efforts in promoting participatory irrigation management and simultaneously launching a program to reform the way the ICADD works with farmers was key to this new start.²⁵ By 1998 GOAP had created and empowered through the electoral process, 10,292 water

24. Oblitas, Keith and Peter Raymond. 1999. *Transferring Irrigation Management to Farmers in Andhra Pradesh, India*. World Bank Technical Paper No. 449.

25. Raymond, Peter 1999. *Water Users Association in Andhra Pradesh*. Forth National Conference on Participatory Irrigation Management, National Institute for Rural Development, Hyderabad.

users groups covering the entire state's irrigated area of 4.8 million ha. The Bank assisted GOAP's lead, initially as part of preparation activities for AP III and latterly in the preparation of the AP Economic Restructuring Project with timely inputs by the WBI and the Participatory Irrigation Management Network. The Irrigation and Command Area Development Department has devolved contracting to the new water user groups and this, in the main, is responsible for the completion of secondary and tertiary irrigation that led to expansion of irrigated area.

Figure 2: Growth of Irrigated Area in Sriramsagar Project



But Fundamental Problems Remain

4.4 Participatory management, however, is only part of the sustainability equation - provision of adequate and timely funding for operation and maintenance continues to be a problem. Despite a three-fold increase in irrigation charges in 1997 and the formation of water users' groups, the share of cost recovery through users' fees has declined from 4% of total expenditures in 1994-95 to 1.8% in 1999-2000. Worse, a recent expenditure review of the irrigation sector shows that typically more than 80% of the AP's "Non-Plan" expenditures on Major and Medium Irrigation that is supposed to cover operation and maintenance expenditures is being spent on interest payments against borrowings to finance capital expenditures.²⁶ And within the overall total expenditure, about 57% is spent of staff costs and interest payments, only 43% on works. Currently, ICADD has approximately 48,000 staff, comprising 8,300 engineers at all levels, 18,500 non-technical office staff and more than 21,000 lower-level staff. As the DFID report notes, the ICADD is in a debt trap. Despite this there is an ambitious program of 32 new medium schemes, 11 of which are under detailed investigation. In addition, 36 major, 42 medium and 636 minor irrigation projects are still under construction.²⁷

4.5 The current financial situation of the ICADD appears unsustainable. This could change if GOAP reduces the high overhead costs of the ICADD, curtails new commitments and implements proposals to make WUGs financially autonomous (with the authority to collect irrigation fees and use them for operation and maintenance). Even though there has been impressive increases in the performance of the Sriramsagar project, and the pace of work to complete the Srisailem component has accelerated, their long term sustainability looks uncertain in the current budget setting.

Lessons

- Inadequate appraisal followed by unilateral design changes in mid-project risks conflict over unresolved issues and may lead to redundant investment. Most of the water allocation controversy that damaged the Bank's reputation for objectivity and jeopardized smooth implementation of the project could have been avoided. The key was realizing the

26. Aikman, Ian et al., 2001. *Andhra Pradesh Impact and Expenditure Review – Irrigation Sector – Phase I Final Report to DFID*. Baktie Group Ltd, Glasgow, UK for DFID.

27. Government of Andhra Pradesh. 1999. *Swarna Andhra Pradesh Vision 2020*.

centrality of water allocation to project sustainability and resolving the issue with GOI and Government of Andhra Pradesh before the project started.

- Consistent Bank management requires a balance between technical and country development aspects – favoring one or the other creates problems. Good communications and timely, clear decision-making is a prerequisite. The poor Bank performance on AP II was eventually reversed with the appointment of a resident Country Director, the establishment of consistent Bank management of country programs, and the improvement of communications with GOI and state governments.
- Large-scale water development projects need to be designed within a river basin framework considering all water users to ensure efficient and effective water allocation using appropriate public and private sector instruments.
- Lack of sound operational plans, poor water management and inadequate feedback from monitoring and evaluation have large economic, financial and social costs.

Basic Data Sheet

INDIA SECOND ANDHRA PRADESH IRRIGATION PROJECT (LOAN 2662/CREDIT 1665-IN)

Key Project Data (amounts in US\$ million)

| | Appraisal estimate | Actual or current estimate | Actual as % of appraisal estimate |
|-------------------------|-----------------------|-------------------------------|--------------------------------------|
| Total project costs | | | |
| Loan amount | 271.0 | 118.0 | 44% |
| Cofinancing | - | - | - |
| Cancellation | - | 186.0* | 56% |
| Economic rate of return | 22% | - | - |

* The full loan of \$131 million was cancelled in two tranches. US\$55 million of the Credit was diverted for the AP Cyclone Emergency Project in 1990. The amount cancelled is larger than the amount difference because of appreciation of SDR.

Cumulative Estimated and Actual Disbursements

| | FY87 | FY88 | FY89 | FY90 | FY91 | FY92 | FY93 | FY94 |
|--|------|------|------|------|------|------|-------|-------|
| Appraisal estimate (SDR M) | 31 | 16.4 | 33.3 | 55.3 | 77.1 | 97.5 | 114.0 | 127.5 |
| Actual (SDR M) | 0.0 | 0.0 | 4.0 | 7.8 | 15.8 | 36.2 | 61.2 | 86.7 |
| Actual as % of appraisal | 0 | 0 | 12 | 14 | 20 | 37 | 54 | 68 |
| Date of final disbursement: August 24, 1994. | | | | | | | | |

Project Dates

| | Original | Actual |
|--------------------|-------------------|--------------------|
| Identification | | September 1984 |
| Preparation | | February 1985 |
| Appraisal | | March/April 1985 |
| Negotiations | | January 7-15, 1986 |
| Board approval | | March 20, 1986 |
| Signing | | May 28, 1986 |
| Effectiveness | August 1986 | October 2, 1987 |
| Project completion | December 31, 1993 | June 30, 1994 |
| Closing date | | October 31, 1994 |

Staff Inputs (staff weeks)

| | <i>Actual</i> |
|---------------------|---------------|
| Through appraisal | 155 |
| Appraisal – Board | 8.1 |
| Board-effectiveness | |
| Supervision | 229.5 |
| Completion | 1.9 * |
| Total | 394.5 |

* Not including FAO/CP ICR Mission.

Mission Data

| | <i>Date (month/year)</i> | <i>No. of persons</i> | <i>Staff days in field</i> | <i>Specializations represented</i> | <i>Performance rating</i> | | <i>Types of problems</i> |
|--------------------------------------|------------------------------|---------------------------|--------------------------------|--|---------------------------|---|------------------------------|
| Through appraisal | NA | NA | NA | A, E(3), EC(2), IDS, PR | - | - | - |
| Appraisal through Board approval | NA | NA | NA | NA | - | - | - |
| Board approval through effectiveness | NA | NA | NA | NA | - | - | - |
| Supervision | October 1987 | 8 | 16 | A,E(2), FA, LS, PR, RE, S | 3 | 2 | M.F |
| | June 1988 | 4 | 8 | E(3), RE | 3 | 3 | M.F |
| | February 1989 | 5 | 9 | E(3), RE, S | 2 | 2 | M |
| | Sept. 1989 | 7 | 8 | E(4), RE, S(2) | 2 | 2 | M |
| | February 1990 | 5 | 6 | A, E, FA, RE, S | 3 | 2 | M.T |
| | Sept. 1990 | 6 | 9 | A, E(2), PR, RE, S | 3 | 2 | M.T |
| | April 1991 | 7 | 9 | A, E(3), EC, PR, S | 4 | 3 | M.T |
| | Sept/Oct. 1991 | 6 | 9 | A, DE, E, EC, PRS | 3 | 3 | M.T |
| | Apr/May 1992 | 5 | 6 | E, EC, RE, SA, S | 3 | 3 | T |
| | July/Aug 1992 | 2 | 3 | E(2) | 3 | 3 | M.T |
| | May 1994 | 5 | 6 | A, E(2), RE, S | 2 | 3 | M.T |
| Completion | July 1994 | 3* | 23** | A, E, EC | - | - | - |

A=Agriculture, E=Irrigation Engineer, EC=Economist, FA=Financial Analyst, IDS= Institutional Development Specialist, LS=Land Settlement Specialist, PR=Procurement Officer, RE=Roads Engineer, S=Sociologist

M=Management, F=Financial, T=Technical

* Include both ICR work and pre-preparation of Andhra Pradesh Irrigation III Project

** Average of the five staff days in fields.

Other Project Data

Borrower/Executing Agency:

| <i>RELATED OPERATIONS</i> | <i>Credit/Loan no.</i> | <i>Amount (US\$ million)</i> | <i>Board approval</i> |
|--|------------------------|----------------------------------|-----------------------|
| Operation | | | |
| A.P. Cyclone Emergency Reconstruction | C2179/L3260-IN | 55 | 1990 |
| National Water Management Program | C1770-IN | 114 | 1987 |
| Third A.P. Irrigation Project (Irrigation component) | C2952/L4166 | 325 | 1997 |
| A.P. Economic Restructuring Project | C3103/L4360 | 543 | 1998 |

Statement Showing the Details of Works Spilled Over from AP II to AP III

Table 1. Irrigation-Civil Works at Srisailem Right Bank Project (RS. Million)

| <i>S.No.</i> | <i>Name of spill over component</i> | <i>Cost (Tender value)</i> | <i>Date of Award</i> | <i>Expenditure upto 6/94 (closing date of AP II)</i> | <i>Spill over cost of AP-II works as on 6/94</i> | <i>Final Cost of AP-II works completed in AP-III</i> | <i>Date of completion</i> | <i>Remarks</i> |
|--------------|-------------------------------------|----------------------------|----------------------|--|--|--|---------------------------|----------------|
| 1 | LCB Pckg.Km.0-10 | 169 | 14.6.93 | 110.37 | 58.63 | 177 | 8/97 | Work Completed |
| 2 | Reach I | 236.8 | 30.6.94 | --- | 236.8 | 242.02 | 8/98 | Work Completed |
| 3 | Reach II | 226 | 16.6.94 | --- | 226 | 262.74 | 5/2000 | Work Completed |
| 4 | Reach III | 181 | 27.6.94 | --- | 181 | 198.85 | 11/99 | Work Completed |
| 5 | Package VI | 961.4 | 21.6.93 | 574.4 | 387 | 1036.4 | 6/97 | Work Completed |
| 6 | Gorakallu Bypass | 161.4 | 25.5.94 | --- | 161.4 | 224.11 | 3/2000 | Work Completed |
| 7 | Package VIII | 566.8 | 9.7.93 | 253.62 | 313.18 | 591.5 | 7/96 | Work Completed |
| 8 | Package IX | 311.5 | 9.5.91 | --- | 18.26 | 329.76 | 6/94 | Work Completed |
| 9 | Package X | 464.2 | 9.7.93 | 193.58 | 270.62 | 505.3 | 4/97 | Work Completed |
| 10 | Package XIII | 235.7 | 8.5.91 | 118.73 | 116.97 | 334.1 | 9/95 | Work Completed |
| 11 | Block IV | 92.4 | 20.5.94 | --- | 92.4 | 98.57 | 6/96 | Work Completed |
| 12 | Block VIII | 23.5 | 27.5.94 | --- | 23.5 | 23.45 | 6/96 | Work Completed |
| TOTAL | | 3629.7 | | 1250.70 | 2086.38 | 4023.80 | | |

Table 2. Irrigation-Civil Works at Sriramsagar Project (Rs. Million)

| <i>S.No.</i> | <i>Name of spill over component</i> | <i>Cost (Tender value)</i> | <i>Date of Award</i> | <i>Expenditure upto 6/94 (closing date of AP II)</i> | <i>Spill over cost of AP-II works as on 6/94</i> | <i>Final Cost of AP-II works completed in AP-III</i> | <i>Date of completion</i> | <i>Remarks</i> |
|--------------|-------------------------------------|--------------------------------|--------------------------|--|--|--|-------------------------------|----------------|
| I | IRRIGATION WORKS | | | | | | | |
| a) | <u>Civil Works</u> | | | | | | | |
| i) | Package(H1-18) (DBM-22) | 19.50 | 19-1-1994 | 5.60 | 13.90 | 18.50 | 19-1-1996 | Work completed |
| ii) | Package(J4-02) (DBM-7B to 30) | 398.70 | 17-2-1994 | 22.00 | 376.70 | 453.99 | 17-2-1997 | Work completed |
| iii) | Package(C5-03) (DBM-31) | 295.80 | 17-2-1994 | 23.30 | 272.50 | 335.64 | 17-2-1997 | Work completed |
| iv) | Package(L6-14) (D83 part) | 325.90 | 23-4-1994 | 2.60 | 323.30 | 369.10 | 30-6-1998 | Work completed |
| | Total | 1039.90 | | 53.50 | 986.40 | 1177.23 | | |

Revised Cost-Benefit Analysis

**Table 1. ICR Cost- Benefit Stream: Srisailem Right Bank Project Values in 1994
Base Case from ICR (Rs. Million)**

| Project | Civil | Land | Land | Foregone | Irrigation | Roads | | | | | Incremental | |
|---------|-------|-------------|-----------|----------------|------------|-------|-------------|-----|------|---------------|--------------|---------|
| Year | Works | Other Costs | Levelling | Hydro Benefits | O&M | O&M | Total Costs | WOP | WP | Road benefits | Net benefits | Balance |
| 1989 | 136 | 17 | 0 | | | | 153 | | | | 0 | -153 |
| 1990 | 166 | 8 | 0 | | | | 174 | | | | 0 | -174 |
| 1991 | 141 | 29 | 0 | | | | 170 | | | | 0 | -170 |
| 1992 | 481 | 21 | 1 | | | | 503 | | | | 0 | -503 |
| 1993 | 439 | 32 | 3 | | | | 474 | | | | 0 | -474 |
| 1994 | 1126 | 25 | 7 | | | | 1158 | | | | 0 | -1158 |
| 1995 | 1360 | 69 | 12 | 0 | 0 | 2 | 1444 | 6 | 9 | 12 | 16 | -1428 |
| 1996 | 114 | 39 | 19 | 0 | 1 | 3 | 176 | 8 | 15 | 24 | 30 | -146 |
| 1997 | 1151 | 39 | 21 | 0 | 4 | 7 | 1222 | 22 | 40 | 53 | 71 | -1152 |
| 1998 | 800 | 21 | 21 | 1 | 9 | 1 | 862 | 55 | 97 | 66 | 108 | -754 |
| 1999 | 135 | 21 | 21 | 2 | 17 | 3 | 207 | 103 | 191 | 66 | 154 | -54 |
| 2000 | | 21 | 21 | 4 | 27 | 5 | 87 | 163 | 348 | 66 | 251 | 165 |
| 2001 | | 21 | 21 | 6 | 42 | 7 | 106 | 248 | 602 | 66 | 420 | 314 |
| 2002 | | 21 | 21 | 5 | 53 | 11 | 120 | 232 | 926 | 66 | 760 | 640 |
| 2003 | | 3 | 21 | 4 | 62 | 15 | 113 | 380 | 1258 | 66 | 943 | 830 |
| 2004 | | 3 | 21 | 2 | 99 | 19 | 153 | 421 | 1613 | 66 | 1258 | 1106 |
| 2005 | | 3 | 21 | 2 | 72 | 19 | 125 | 451 | 1907 | 66 | 1522 | 1397 |
| 2006 | | 3 | 21 | | 72 | 20 | 125 | 456 | 2114 | 66 | 1724 | 1599 |
| 2007 | | 3 | 21 | | 72 | 20 | 125 | 462 | 2241 | 66 | 1845 | 1721 |
| 2008 | | 3 | 21 | | 72 | 20 | 125 | 467 | 2310 | 66 | 1909 | 1785 |
| 2009 | | 3 | 21 | | 72 | 20 | 125 | 472 | 2340 | 66 | 1934 | 1810 |
| 2010 | | 3 | 21 | | 72 | 20 | 125 | 476 | 2343 | 66 | 1934 | 1809 |
| 2011 | | 3 | 21 | | 72 | 20 | 125 | 478 | 2345 | 66 | 1933 | 1808 |
| 2012 | | 3 | 21 | | 72 | 20 | 125 | 480 | 2347 | 66 | 1933 | 1808 |
| 2013 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2014 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2015 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2016 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2017 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2018 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2019 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2020 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2021 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2022 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2023 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2024 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2025 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2026 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2027 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2028 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2029 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2030 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2031 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2032 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2033 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2034 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2035 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2036 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2037 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |
| 2038 | | 3 | 21 | | 72 | 20 | 125 | 481 | 2347 | 66 | 1932 | 1807 |

ERR = 12%

Table 2. Cost- Benefit Stream : Srisailem Right Bank Project Values in 1994
Scenario: Effects of Delayed Benefits and Reduced O&M (Rs. Million)

| Loss Area (%) | Remaining Area (%) | Project Year | Civil Works | Other Costs | Land Levelling | Land | Foregone Hydro | Irrigation Benefits | Roads O&M | Total Costs | WOP | WP Road | Incremental Benefits | Net Benefits | Balance |
|---------------|--------------------|--------------|-------------|-------------|----------------|------|----------------|---------------------|-----------|-------------|-----|---------|----------------------|--------------|---------|
| | | 1989 | 136 | 17 | 0 | | | | | 153 | | | | | -153 |
| | | 1990 | 166 | 8 | 0 | | | | | 174 | | | | | -174 |
| | | 1991 | 141 | 29 | 0 | | | | | 170 | | | | | -170 |
| | | 1992 | 481 | 21 | 1 | | | | | 503 | | | | | -503 |
| | | 1993 | 439 | 32 | 3 | | | | | 474 | | | | | -474 |
| | | 1994 | 1126 | 25 | 7 | | | | | 1158 | | | | | -1158 |
| | 100% | 1995 | 1360 | 69 | 12 | 0 | | | | 1441 | | | | | -1441 |
| | 100% | 1996 | 114 | 39 | 19 | 0 | | | | 172 | | | | | -172 |
| | 100% | 1997 | 1151 | 39 | 21 | 0 | | | | 1211 | | | | | -1211 |
| | 100% | 1998 | 400 | 21 | 21 | 1 | | | | 443 | | | | | -443 |
| | 100% | 1999 | 400 | 21 | 21 | 2 | | | | 444 | | | | | -444 |
| | 100% | 2000 | 68 | 21 | 21 | 4 | | | | 113 | | | | | -113 |
| | 100% | 2001 | 68 | 21 | 21 | 6 | | | | 115 | | | | | -115 |
| | 100% | 2002 | | 21 | 21 | 5 | | | | 47 | | | | | -47 |
| | 100% | 2003 | | 3 | 21 | 4 | 0 | 0 | 2 | 30 | 6 | 9 | 12 | 16 | -15 |
| | 100% | 2004 | | 3 | 21 | 2 | 1 | 0 | 3 | 31 | 8 | 15 | 24 | 30 | -1 |
| | 100% | 2005 | | 3 | 21 | 2 | 4 | 0 | 7 | 37 | 22 | 40 | 53 | 71 | 34 |
| | 100% | 2006 | | 3 | 21 | | 9 | 1 | 9 | 43 | 55 | 97 | 66 | 108 | 65 |
| | 100% | 2007 | | 3 | 21 | | 17 | 3 | 9 | 53 | 103 | 191 | 66 | 154 | 101 |
| 3% | 97% | 2008 | | 3 | 21 | | 27 | 5 | 9 | 64 | 158 | 338 | 64 | 244 | 180 |
| 6% | 94% | 2009 | | 3 | 21 | | 39 | 7 | 8 | 79 | 233 | 566 | 62 | 395 | 316 |
| 9% | 91% | 2010 | | 3 | 21 | | 49 | 10 | 8 | 91 | 211 | 843 | 60 | 691 | 601 |
| 12% | 88% | 2011 | | 3 | 21 | | 54 | 13 | 8 | 99 | 335 | 1107 | 58 | 830 | 731 |
| 15% | 85% | 2012 | | 3 | 21 | | 84 | 16 | 8 | 131 | 358 | 1371 | 56 | 1069 | 938 |
| 18% | 82% | 2013 | | 3 | 21 | | 59 | 15 | 7 | 106 | 370 | 1564 | 54 | 1248 | 1143 |
| 21% | 79% | 2014 | | 3 | 21 | | 57 | 15 | 7 | 103 | 360 | 1670 | 52 | 1362 | 1258 |
| 24% | 76% | 2015 | | 3 | 21 | | 55 | 15 | 7 | 100 | 351 | 1703 | 50 | 1402 | 1302 |
| 27% | 73% | 2016 | | 3 | 21 | | 53 | 14 | 6 | 97 | 341 | 1686 | 48 | 1394 | 1296 |
| 30% | 70% | 2017 | | 3 | 21 | | 50 | 14 | 6 | 94 | 330 | 1638 | 46 | 1354 | 1260 |
| 33% | 67% | 2018 | | 3 | 21 | | 48 | 13 | 6 | 91 | 319 | 1570 | 44 | 1296 | 1204 |
| 36% | 64% | 2019 | | 3 | 21 | | 46 | 13 | 6 | 88 | 306 | 1501 | 42 | 1237 | 1149 |
| 39% | 61% | 2020 | | 3 | 21 | | 44 | 12 | 5 | 85 | 293 | 1432 | 40 | 1179 | 1094 |
| 42% | 58% | 2021 | | 3 | 21 | | 42 | 11 | 5 | 82 | 279 | 1361 | 38 | 1121 | 1038 |
| 45% | 55% | 2022 | | 3 | 21 | | 40 | 11 | 5 | 79 | 265 | 1291 | 36 | 1062 | 983 |
| 48% | 52% | 2023 | | 3 | 21 | | 37 | 10 | 5 | 76 | 250 | 1220 | 34 | 1004 | 928 |
| 51% | 49% | 2024 | | 3 | 21 | | 35 | 10 | 4 | 73 | 236 | 1150 | 32 | 947 | 873 |
| 54% | 46% | 2025 | | 3 | 21 | | 33 | 9 | 4 | 70 | 221 | 1080 | 30 | 889 | 818 |
| 57% | 43% | 2026 | | 3 | 21 | | 31 | 8 | 4 | 67 | 207 | 1009 | 28 | 831 | 763 |
| 60% | 40% | 2027 | | 3 | 21 | | 29 | 8 | 4 | 64 | 192 | 939 | 26 | 773 | 708 |
| 63% | 37% | 2028 | | 3 | 21 | | 27 | 7 | 3 | 61 | 178 | 868 | 24 | 715 | 654 |
| 66% | 34% | 2029 | | 3 | 21 | | 25 | 7 | 3 | 58 | 164 | 798 | 22 | 657 | 599 |
| 69% | 31% | 2030 | | 3 | 21 | | 22 | 6 | 3 | 55 | 149 | 728 | 20 | 599 | 544 |
| 72% | 28% | 2031 | | 3 | 21 | | 20 | 5 | 2 | 52 | 135 | 657 | 19 | 541 | 489 |
| 75% | 25% | 2032 | | 3 | 21 | | 18 | 5 | 2 | 49 | 120 | 587 | 17 | 483 | 434 |
| 78% | 22% | 2033 | | 3 | 21 | | 16 | 4 | 2 | 46 | 106 | 516 | 15 | 425 | 379 |
| 81% | 19% | 2034 | | 3 | 21 | | 14 | 4 | 2 | 43 | 91 | 446 | 13 | 367 | 324 |
| 84% | 16% | 2035 | | 3 | 21 | | 12 | 3 | 1 | 40 | 77 | 375 | 11 | 309 | 269 |
| 87% | 13% | 2036 | | 3 | 21 | | 9 | 3 | 1 | 37 | 63 | 305 | 9 | 251 | 214 |
| 90% | 10% | 2037 | | 3 | 21 | | 7 | 2 | 1 | 34 | 48 | 235 | 7 | 193 | 159 |
| 93% | 7% | 2038 | | 3 | 21 | | 5 | 1 | 1 | 31 | 34 | 164 | 5 | 135 | 104 |

ERR = 5.28%

Table 3. Cost- Benefit Stream - Sriramsagar Project Values in 1994
Base case from ICR (Rs. Million)

| Project Year | Civil Works | Land Other Costs | Land Levelling | Irrigation | | Roads | | Irrigation Benefits | | Road Benefits | | Incremental | |
|--------------|-------------|------------------|----------------|------------|-----|-------|-----|---------------------|------|---------------|-----|--------------|---------|
| | | | | WOP | O&M | WP | O&M | WOP | WP | WOP | WP | Net Benefits | Balance |
| 1989 | 1713 | 44 | | | | | | | | | | 0 | -1757 |
| 1990 | 206 | 44 | | | | | | | | | | 0 | -250 |
| 1991 | 182 | 44 | | | | | | | | | | 0 | -226 |
| 1992 | 303 | 49 | | | | | | | | | | 0 | -352 |
| 1993 | 332 | 52 | | | | | | | | | | 0 | -384 |
| 1994 | 426 | 56 | | | | | | | | | | 0 | -482 |
| 1995 | 595 | 14 | 61 | 1 | 0 | 0 | 12 | 682 | 0 | 0 | 97 | 97 | -585 |
| 1996 | 595 | 19 | 65 | 1 | 30 | 31 | 16 | 698 | 54 | 53 | 130 | 130 | -568 |
| 1997 | 988 | 35 | 65 | 3 | 30 | 32 | 20 | 1113 | 181 | 197 | 165 | 180 | -933 |
| 1998 | 898 | 40 | 65 | 5 | 30 | 35 | 20 | 1034 | 430 | 498 | 166 | 234 | -800 |
| 1999 | 1196 | 40 | 65 | 8 | 30 | 41 | 20 | 1340 | 802 | 1001 | 166 | 364 | -976 |
| 2000 | 1177 | 40 | 65 | 10 | 30 | 48 | 20 | 1331 | 1316 | 1763 | 166 | 614 | -718 |
| 2001 | 932 | 68 | 65 | 12 | 30 | 58 | 20 | 1125 | 1959 | 2801 | 166 | 1009 | -117 |
| 2002 | 1013 | 68 | 65 | 12 | 30 | 70 | 20 | 1218 | 2652 | 4076 | 166 | 1590 | 371 |
| 2003 | | 6 | 65 | 10 | 30 | 81 | 20 | 152 | 3355 | 5520 | 166 | 2330 | 2178 |
| 2004 | | 6 | 65 | 7 | 30 | 90 | 20 | 158 | 3879 | 6903 | 166 | 3190 | 3032 |
| 2005 | | 6 | 65 | 4 | 30 | 95 | 20 | 160 | 4208 | 8104 | 166 | 4062 | 3902 |
| 2006 | | 6 | 65 | 2 | 30 | 98 | 20 | 161 | 4327 | 8993 | 166 | 4832 | 4671 |
| 2007 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4400 | 9638 | 166 | 5403 | 5243 |
| 2008 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4437 | 10020 | 166 | 5749 | 5588 |
| 2009 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4470 | 10213 | 166 | 5909 | 5749 |
| 2010 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4498 | 10213 | 166 | 5881 | 5721 |
| 2011 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4519 | 10283 | 166 | 5930 | 5769 |
| 2012 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4534 | 10305 | 166 | 5937 | 5777 |
| 2013 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4541 | 10307 | 166 | 5932 | 5772 |
| 2014 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4547 | 10307 | 166 | 5926 | 5765 |
| 2015 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4549 | 10307 | 166 | 5924 | 5764 |
| 2016 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2017 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2018 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2019 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2020 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2021 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2022 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2023 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2024 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2025 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2026 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2027 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2028 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2029 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2030 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2031 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2032 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2033 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2034 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2035 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2036 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2037 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |
| 2038 | | 6 | 65 | | 30 | 99 | 20 | 160 | 4550 | 10307 | 166 | 5924 | 5763 |

ERR = 16%

Table 4. Cost- Benefit Stream - Sriramsagar Project Values in 1994
Scenario: Reduced Area due to Insufficient O&M (Rs. Million)

| Loss of Remaining Area (%) | Project Civil Area (%) | Year | Civil Works | Other Costs | Land Levelling | Land | Irrigation WOP | Irrigation O&M | Roads WOP | Roads O&M | Total Costs | Irrigation Benefits WOP | Irrigation Benefits WP | Road Benefits | Incremental Net Benefits | Balance |
|----------------------------|------------------------|------|-------------|-------------|----------------|------|----------------|----------------|-----------|-----------|-------------|-------------------------|------------------------|---------------|--------------------------|---------|
| | | 1989 | 1713 | 0 | 44 | 0 | | | | | 1757 | | | | | -1757 |
| | | 1990 | 206 | 0 | 44 | 0 | | | | | 250 | | | | | -250 |
| | | 1991 | 182 | 0 | 44 | 0 | | | | | 226 | | | | | -226 |
| | | 1992 | 303 | 0 | 49 | 0 | | | | | 352 | | | | | -352 |
| | | 1993 | 332 | 0 | 52 | 0 | | | | | 384 | | | | | -384 |
| | | 1994 | 426 | 0 | 56 | 0 | | | | | 482 | | | | | -482 |
| | | 1995 | 595 | 14 | 61 | 1 | 0 | 0 | 12 | | 682 | 0 | 0 | 97 | | -682 |
| | 100% | 1996 | 595 | 19 | 65 | 1 | 30 | 31 | 16 | | 698 | 54 | 53 | 130 | | -698 |
| | 100% | 1997 | 988 | 35 | 65 | 3 | 30 | 32 | 20 | | 1113 | 181 | 197 | 165 | | -1113 |
| | 100% | 1998 | 898 | 40 | 65 | 5 | 30 | 35 | 20 | | 1034 | 430 | 498 | 166 | | -1034 |
| | 100% | 1999 | 1196 | 40 | 65 | 8 | 30 | 41 | 20 | | 1340 | 802 | 1001 | 166 | | -1340 |
| | 100% | 2000 | 1177 | 40 | 65 | 10 | 30 | 48 | 20 | | 1331 | 1316 | 1763 | 166 | | -1331 |
| | 100% | 2001 | 932 | 68 | 65 | 12 | 30 | 58 | 20 | | 1125 | 1959 | 2801 | 166 | | -1125 |
| | 100% | 2002 | 1013 | 68 | 65 | 12 | 30 | 70 | 20 | | 1218 | 2652 | 4076 | 166 | | -1218 |
| | 100% | 2003 | 0 | 6 | 65 | 10 | 30 | 81 | 20 | | 152 | 3355 | 5520 | 166 | 2330 | 2178 |
| | 100% | 2004 | 0 | 6 | 65 | 7 | 30 | 90 | 20 | | 158 | 3879 | 6903 | 166 | 3190 | 3032 |
| | 100% | 2005 | 0 | 6 | 65 | 4 | 30 | 95 | 20 | | 160 | 4208 | 8104 | 166 | 4062 | 3902 |
| | 100% | 2006 | 0 | 6 | 65 | 2 | 30 | 98 | 20 | | 161 | 4327 | 8993 | 166 | 4832 | 4671 |
| | 100% | 2007 | 0 | 6 | 65 | 0 | 30 | 99 | 20 | | 160 | 4400 | 9638 | 166 | 5403 | 5243 |
| 3% | 97% | 2008 | 0 | 6 | 65 | 0 | 29 | 96 | 20 | | 158 | 4304 | 9719 | 161 | 5576 | 5419 |
| 6% | 94% | 2009 | 0 | 6 | 65 | 0 | 28 | 93 | 19 | | 155 | 4202 | 9600 | 156 | 5554 | 5399 |
| 9% | 91% | 2010 | 0 | 6 | 65 | 0 | 27 | 90 | 19 | | 152 | 4093 | 9294 | 151 | 5352 | 5200 |
| 12% | 88% | 2011 | 0 | 6 | 65 | 0 | 26 | 87 | 18 | | 150 | 3977 | 9049 | 146 | 5218 | 5068 |
| 15% | 85% | 2012 | 0 | 6 | 65 | 0 | 25 | 84 | 17 | | 147 | 3854 | 8760 | 141 | 5047 | 4900 |
| 18% | 82% | 2013 | 0 | 6 | 65 | 0 | 25 | 81 | 17 | | 144 | 3724 | 8452 | 136 | 4864 | 4720 |
| 21% | 79% | 2014 | 0 | 6 | 65 | 0 | 24 | 78 | 16 | | 141 | 3592 | 8143 | 131 | 4681 | 4540 |
| 24% | 76% | 2015 | 0 | 6 | 65 | 0 | 23 | 75 | 16 | | 139 | 3457 | 7834 | 126 | 4503 | 4364 |
| 27% | 73% | 2016 | 0 | 6 | 65 | 0 | 22 | 72 | 15 | | 136 | 3321 | 7524 | 121 | 4324 | 4188 |
| 30% | 70% | 2017 | 0 | 6 | 65 | 0 | 21 | 69 | 14 | | 133 | 3185 | 7215 | 116 | 4147 | 4013 |
| 33% | 67% | 2018 | 0 | 6 | 65 | 0 | 20 | 66 | 14 | | 131 | 3048 | 6906 | 111 | 3969 | 3838 |
| 36% | 64% | 2019 | 0 | 6 | 65 | 0 | 19 | 63 | 13 | | 128 | 2912 | 6597 | 106 | 3791 | 3663 |
| 39% | 61% | 2020 | 0 | 6 | 65 | 0 | 18 | 61 | 12 | | 125 | 2775 | 6287 | 101 | 3613 | 3488 |
| 42% | 58% | 2021 | 0 | 6 | 65 | 0 | 17 | 58 | 12 | | 123 | 2639 | 5978 | 96 | 3436 | 3313 |
| 45% | 55% | 2022 | 0 | 6 | 65 | 0 | 16 | 55 | 11 | | 120 | 2502 | 5669 | 91 | 3258 | 3138 |
| 48% | 52% | 2023 | 0 | 6 | 65 | 0 | 16 | 52 | 11 | | 117 | 2366 | 5360 | 86 | 3080 | 2963 |
| 51% | 49% | 2024 | 0 | 6 | 65 | 0 | 15 | 49 | 10 | | 115 | 2229 | 5051 | 81 | 2903 | 2788 |
| 54% | 46% | 2025 | 0 | 6 | 65 | 0 | 14 | 46 | 9 | | 112 | 2093 | 4741 | 76 | 2725 | 2613 |
| 57% | 43% | 2026 | 0 | 6 | 65 | 0 | 13 | 43 | 9 | | 109 | 1956 | 4432 | 71 | 2547 | 2438 |
| 60% | 40% | 2027 | 0 | 6 | 65 | 0 | 12 | 40 | 8 | | 106 | 1820 | 4123 | 66 | 2369 | 2263 |
| 63% | 37% | 2028 | 0 | 6 | 65 | 0 | 11 | 37 | 8 | | 104 | 1683 | 3814 | 61 | 2192 | 2088 |
| 66% | 34% | 2029 | 0 | 6 | 65 | 0 | 10 | 34 | 7 | | 101 | 1547 | 3504 | 56 | 2014 | 1913 |
| 69% | 31% | 2030 | 0 | 6 | 65 | 0 | 9 | 31 | 6 | | 98 | 1410 | 3195 | 51 | 1836 | 1738 |
| 72% | 28% | 2031 | 0 | 6 | 65 | 0 | 8 | 28 | 6 | | 96 | 1274 | 2886 | 46 | 1659 | 1563 |
| 75% | 25% | 2032 | 0 | 6 | 65 | 0 | 7 | 25 | 5 | | 93 | 1137 | 2577 | 41 | 1481 | 1388 |
| 78% | 22% | 2033 | 0 | 6 | 65 | 0 | 7 | 22 | 4 | | 90 | 1001 | 2268 | 37 | 1303 | 1213 |
| 81% | 19% | 2034 | 0 | 6 | 65 | 0 | 6 | 19 | 4 | | 88 | 864 | 1958 | 32 | 1125 | 1038 |
| 84% | 16% | 2035 | 0 | 6 | 65 | 0 | 5 | 16 | 3 | | 85 | 728 | 1649 | 27 | 948 | 863 |
| 87% | 13% | 2036 | 0 | 6 | 65 | 0 | 4 | 13 | 3 | | 82 | 591 | 1340 | 22 | 770 | 688 |
| 90% | 10% | 2037 | 0 | 6 | 65 | 0 | 3 | 10 | 2 | | 80 | 455 | 1031 | 17 | 592 | 513 |
| 93% | 7% | 2038 | 0 | 6 | 65 | 0 | 2 | 7 | 1 | | 77 | 318 | 722 | 12 | 415 | 338 |

ERR = 13.84%

