

**The World Bank**

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT  
INTERNATIONAL DEVELOPMENT ASSOCIATION

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May 20, 2009

Mr. K. S. Sripathy  
Chief Secretary  
Government of Tamil Nadu  
Fort St. George, Chennai  
Tamil Nadu, India

Dear Mr. Sripathy:

***Tamil Nadu Irrigated Agriculture Modernization and Water-Bodies Restoration and Management (TNIAMWARM) Project- Implementation Support Mission  
March 24-April 6, 2009***

Thank you for the assistance provided by the Government of Tamil Nadu (GoTN) to the latest Implementation support/supervision mission for the TNIAMWARM project. Please find attached the mission's aide memoire, the draft of which was discussed during the wrap up meeting held in Chennai on April 6, 2009 and chaired by PWD Secretary Mr. Audiseshiah.

I am pleased to hear of the good overall progress in project implementation across the various line departments, and would like to extend my congratulations to you and to the GoTN on the achievement of a major milestone under the project, viz the elections of more than 1200 WUA presidents under Phase I and Phase II sub-basins. I am confident that under your continued leadership, the project will work quickly on integrating the WUAs formed in the project and provide them with the necessary support and training. I would also like to take this opportunity to encourage the project to build on the momentum and the experience gained to complete the elections of all WUAs under the project, including those in Phase III sub basins.

I would like to bring the following critical points to your kind attention:

- **Timely completion of WRO civil works packages under Phase I-** I am informed that less than 50% of the planned civil works under Phase I sub-basins have been completed to date, with some regions achieving better results than others. I call on your support to ensure that all civil works packages for Phase I sub basins are completed on time, particularly in the two most lagging regions, Trichy and Madurai, which together represent 75% of the total value of phase I packages.
- **Agriculture Engineering Department (AED)** – The slow progress in the implementation of AED's activities, particularly the micro-irrigation system, remains a problematic area. We are hopeful that this problem may get resolved with the near completion of the procurement process. I am also informed by the mission that very productive discussions took place with the new secretary Agriculture and that he agreed to immediate action to rectify the situation, and that AED will expedite the preparation of its action plan to deal with this problem.
- **Monitoring and Evaluation** – The current status of the monitoring and evaluation activity under the project is affecting the proper recording, documentation, and analysis

of many of the project achievements and outcomes. Given the delay in finalizing the M&E consultancy, we recommend that an M&E specialist is recruited as early as possible at the MDPU level to help standardize the internal monitoring systems across the various line departments, and later on work with the external consultant, once recruited, to concentrate on the impact evaluation of project activities.

- **Project consultancies.** I trust that most of the pending issues around the remaining consultancies under the project have been worked out during the mission and that following the national elections, most of these consultancies will be on fast track for finalization (including EIMS, Construction quality, Decision Support, support organizations for WUAs). This would also ensure that Phase III, the largest phase under the project, proceeds in a well coordinated fashion.
- **Cooum sub basin.** I understand that the Bank team had provided technical and advisory assistance on aspects related to the cooum sub-basin, and facilitated the sharing of international experience in this area. We hope that these efforts have been beneficial. The challenges associated with the cooum are complex, multifaceted and cut across various jurisdictions, some of which are outside the scope of the IAMWARM project. The project provides some funds for activities in the cooum sub-basin, similar to other project sub basins, in addition to supporting studies, analyses, and consultancies. It is necessary, however, that these limited resources get leveraged by the GOTN in an effort to find other funding sources for the larger plans of the cooum clean-up and restoration.

Thank you for your kind attention and for your continued support to this important project. Please do not hesitate to contact Rabih Karaky (email: [rkaraky@worldbank.org](mailto:rkaraky@worldbank.org)) the Task Team Leader, or Anju Gaur (email: [agaur@worldbank.org](mailto:agaur@worldbank.org)) Water Resources Specialist, in our New Delhi office, for any questions or clarifications on this letter or on the attached aide memoire.

With regards,

Yours sincerely,



Roberto Zagha  
Country Director, India

Attachment: *Aide Memoire*

cc: Dr. Anup K. Pujari, Joint Secretary, Department of Economic Affairs  
Ms. Kavita Prasad Director (FB), Department of Economic Affairs  
Ms. U.N. Panjiar, Secretary, Ministry of Water Resources  
Mr. S. Manoharan, Additional Secretary, Ministry of Water Resources  
Mr. L. Rynjah, Advisor, (WR) Planning Commission  
Mr. Rajaretinam, Secretary to Chief Minister, Government of Tamil Nadu  
Mr. S. Ramasundaram, Principal Secretary, Public Works Department, Government of Tamil Nadu  
Mr. Gnanadesikan, Secretary, Finance, Government of Tamil Nadu  
Mr. K. Nanda Kishore, Secretary, Agriculture, Government of Tamil Nadu  
Ms. C. Muthukumarswamy, Secretary Animal Husbandry and Fisheries, Government of Tamil Nadu  
Mr. Vibhu Nayar, Project Director, IAM WARM Project  
Mr. Muniasamy, Engineer-in-Chief, Water resources Organization, Government of Tamil Nadu

**Aide-Memoire**  
**Tamil Nadu Irrigated Agriculture Modernization and Water-bodies restoration and**  
**Management project**  
**Implementation support mission – March 24-April 6, 2009**

<b>Project Data</b>		<b>Current Ratings and Flag</b>		
		<i>Summary Ratings</i>	<i>Last</i>	<i>Now</i>
<i>Board Approval Date</i>	01/23/2007	<i>Development Objectives</i>	S	S
<i>Effectiveness Date</i>	04/09/2007	<i>Implementation Progress</i>	S	S
<i>Closing Date</i>	03/31/2013	<i>Project flags</i>	None	None
<i>Original Loan Amount</i>	US\$485 million			
<i>Amount Disbursed</i>	US\$59.64 million			

## **I Introduction**

1. A World Bank implementation support mission<sup>1</sup> visited Tamil Nadu during March 24-April 6, 2009 to review the implementation progress of the TNIAMWARM project. Mr. Malhotra, the construction quality specialist on the team visited TN between April 6, 10. The mission initiated its work by participating in the joint Tamil Nadu-World Bank portfolio review meeting chaired by the Chief Secretary of GoTN.

2. Following a series of meeting in Chennai with the PWD secretary, agriculture secretary, Heads of Departments (HODs) of the various implementing agencies and MDPU, the mission split into small teams and proceeded to visit project sites. Based on the advice of the Project Director, the mission and MDPU worked out a field visit program that took into consideration the sensitivities during the run-up for elections period. For this purpose, large meetings at district levels were avoided, and sites were visited in smaller groups. The mission would like to convey its appreciation to all line departments, MDPU and WRO personnel for their hospitality and their time and efforts in facilitating its work by providing the information requested, and organizing field visits.

## **II. Implementation Progress**

### **Component A: Irrigation Systems Modernization in a sub basin framework**

3. There has been good progress in the irrigation infrastructure rehabilitation program. The mission is pleased to note that some of its technical recommendations from last Aide memoire have been adopted in the implementation of the WRO packages. Overall, there is an increased attention to quality of works, particularly in the sites visited by the mission in Manimuthar and Kottakkariayr subbasins. The mission commends WRO engineers who are making the effort to

<sup>1</sup> The mission consisted of Rabih Karaky (Team Leader), Joop Stoutjesdijk (Lead Irrigation Engineer), Anju Gaur (Water Resources specialist), R K. Malhotra (Construction Quality specialist- Visited Tamil Nadu between April 6-10), Anand Srivastava (Procurement specialist), Jagdish Anand (IT Specialist), B.S. Sathe (Livestock Specialist), M.C. Nandeeshha (Fisheries Specialist), Ben Obrien (Agricultural Specialist), Mohan Gopalakrishnan (Financial Management Specialist), Shankar Narayanan (Social Development Specialist).

ensure good quality of civil works and recommends that the effort be maintained and spread throughout all packages, across all sub-basins.

4. On the physical progress side, the mission was informed that 60 out of the 67 Phase I contracts, and 22 of the 43 phase II contracts are currently under implementation. These awarded contracts include infrastructure for 1826 WUAs, of which works at 931 WUAs are ongoing and works at 60 WUAs are completed. The total agreement value of these contracts, as reported, is approximately Rs. 453 crores of which Rs. 166 crores (or 37 percent) has been expended through February 2009 for both Phase I and Phase II.

5. Despite the good progress, the overall rate of work completion for Phase I sub basins packages remains below 50 %. Only 44% of the total value of Phase I packages has been disbursed to date. For instance work has not commenced yet in 37% of the tanks proposed for rehabilitation under Phase I (around 565 tanks). The progress in the Trichy region is still slow with only 35% of the value of phase I works expended. This is followed by Madurai region at 40%, Chennai at 61% and Pollachi region at 63%. It is noted that the value of the packages in Trichy and Madurai regions together represents 75% of the total value of phase I packages. The mission urges that special efforts be taken to address the problem of slowly progressing packages in these two lagging regions to speed up the implementation progress. The mission requests that non-performing contracts get reviewed for assessing adequacy of man-power, equipments and contract management issues. The mission was informed that a number of contractors have been fined for slow progress. It is expected that, now that the monsoon seasons is over, work completion and disbursement will increase at considerably faster rate and that all on-going Phase I contracts shall be completed within the 18 months contract period.

6. With respect to Phase II contracts, only 4% of the value of the contracts has been expended to date. This is understandable as these contracts have just recently been awarded. Nonetheless, the mission was pleased to see that some of Phase II sites visited (Therkar), work has nearly been completed in some of the tanks, but the payment to the contractor has not yet been made proportionately. The project director clarified that the reason for this is that the contractor has not yet submitted the bills. The mission recommends that physical and financial progress proceed in parallel.

7. The construction quality observed by the mission in various sites was mixed. While some good quality work was observed in sites visited in Manimuthar, Kottakkariayr and Therkar sub-basins, more attention to quality is needed in the sites visited in the Pollachi region. Please refer to Annex I on the specific packages visited by Mr. Malhotra and his detailed comments and notes on the construction quality of works in this area, along with his recommendations for improvement

8. Quality control of the civil works is provided by the Quality Control Units (QCU) of WRO. These units report directly to the Chief Engineers, which provides for reasonable independence from the EEs and AEs who are responsible for the design and direct supervision of the works. The mission was informed that quality control staff visits the tank sites on regular basis to inspect the works and also collect samples of materials. For example, in Madurai Region during the past 18 months, the mission learned that a total of 3,732 samples were collected and tested either on site or in QCU laboratories. The sampling includes 347 cement samples, 768 concrete cube samples, 1,209 coarse aggregate samples, and 540 soil compaction samples. The mission was shown various test reports which indicate that concrete samples normally exceed the required strength after 28 days. Compaction of soil is expected to reach 95 % density and once in

a while a density lower than that was encountered, which then would require the contractor to provide additional compaction before the next bund layer can be started.

9. During the field visits, the mission discussed with recently elected WUA management committees and farmers their involvement in the process to determine the infrastructure rehabilitation requirements. Even though WUAs were not in place at the time of the sub basins plans preparation and during field visits carried out by the AEEs, it became clear from the discussions that the water users were involved. They participated in walk-through surveys and meetings with engineers and subsequently had meetings to be informed about the proposed rehabilitation activities. Typical rehabilitation activities are bund clearing and strengthening, spillway and tank outlet structure repairs, and to a lesser extent selective canal lining immediately downstream of the sluices.

10. Water users are also actively involved in supervision of the works carried out by contractors. Representatives of the water users are on-site when the contractor is working and in most cases are signing off on the OK card. Almost all tank users met by the mission expressed satisfaction with the works and the support provided by the project to bring the tanks back to fully operational condition. The mission also found the completed works generally of satisfactory condition. There are some concerns about the compaction of the side slopes of the tanks, which contractors are trying to resolve by using the bucket of excavators.

11. The mission was pleased to find that the recommendations from last mission to place display boards outlining the activities, including relevant cross-section drawings have been carried out. The WRO staff should continue to do the same for all packages. The mission recommended that the agreement value of the packages vs the estimated value should be shown on the board.

## **Component B: Agricultural Intensification and Diversification**

### **Agriculture, Horticulture, Tamil Nadu Agricultural University**

12. During the mission visits were made to more than 50 sites in 11 sub-basins. Interactions were conducted with farmers, field level staff, officials and project management staff.

13. The DoA and DoH report to be on track to achieve current year physical and financial targets. Up to February 2009 TNAUs overall expenditure is reported to be approximately 48% of the budgeted amount. As the precision farming (micro irrigation) bid documents have now been approved, these activities will be undertaken in the coming months, and expenditure is expected to increase.

14. Between the DoA and TNAU a reported 29 000 ha of demonstrations has been conducted with more than 100 000 ha of impact area adopting the technologies, while the Horticulture Department report 14 600 ha of expansion area into horticultural crops. This represents a significant portion of the estimated 341 000 ha Ayacut area of the first and second phase sub basins. Independent monitoring and evaluation is urgently required to validate this data, document the impacts for dynamic project management and longer term sustainability. Nonetheless, it represents a considerable achievement and project staff deserves commendation. Many interventions are being undertaken, and to date have little feedback as to the impact or sustainability.

15. Reporting remains a weakness, the status report supplied for the mission gives no indication of the overall financial or physical progress of the project by the three implementing agencies. Further individual reports by agencies are not standardized.

16. Overall the quality of demonstrations observed has improved from the previous mission, in terms of demonstrating cropping intensity and diversification. A small portion of demonstrations were below standard. It is critical that all demonstrations are well presented and are of a high quality to convince farmers to take up the technology and to maintain the integrity of the project.

17. Many success stories were encountered on field visits, and some exceptional yields have been recorded by farmers as a direct result of project interventions, however comparisons of demonstration/impact yields against district averages and farmers previous history fail to capture the incremental gains of the farmers. The inclusion of a control area in a portion of demonstrations is recommended.

18. At present TNAU is conducting demonstrations that conventionally would be conducted by the respective line department. While both the TNAU and the line departments have benefited from this arrangement, the universities role in demonstration and impact areas should gradually decline over the life of the project, and their role in capacity building for the line departments should increase. TNAU should also focus on introducing innovative techniques supported by actual field measurements. TNAU can play major role in convincing the farmers by demonstrating comparison of control vs improved practices in the field. The control should be right next to the field with measurement facilities in both sites. During the comparison of indicators such as seed rate, water use, yield, the field day should be conducted. The harvest in sample plot (say 1m\*1m) can be done to demonstrate the comparison of yields.

19. There is a large gap in farmers knowledge of water use efficiency, farmers require capacity building in efficient irrigation practices such as matching crops with soil types, field leveling and drainage, and irrigation duration and scheduling methods. For instance, the adoption rate of MIS is poor or use of overly designed drippers is in practice. TNAU may want to demonstrate the water movement beneath drippers by installing soil moisture sensors and compare with different drippers to show whether water is staying in the root zone or percolating out of the root zone. They may develop pamphlets showing water absorption pattern in fruit trees to make farmers aware where to place the drippers.

TNAU has an important role to play in demonstrating innovative water management techniques such subsurface drip irrigation and low pressure drippers.

20. By definition Organic Farming requires certification, it is recommended that unless a farmer is certified organic, or in the process of obtaining certification the demonstrations should be called Integrated Pest Management (IPM) or Integrated Nutrient Management (INM). Vermiculture demonstrations were observed to be conducted in TNAU Silipaulin "Vermibags", this is a very good, low cost alternative and has a much higher potential for scaling up.

21. The benefits of IPM and INM are well known however discussions with farmers reveal that uptake of these interventions is variable. As these are intermediate outcome indicators for the project, it is advised that DOA concentrates more attention to these interventions, with a particular focus on soil testing and insect monitoring techniques by farmers.

22. During the mission Radhapuram tank in the Vaharandhi sub basin was visited. This tank is due to be taken up for activities in the third year of the project. Discussion with farmers

revealed a surprisingly low knowledge of the project despite numerous activities and demonstrations in nearby tanks. Project management need to reevaluate the value of IEC activities such as radio/television/wall paintings etc as these appear to be having little penetration in the wider community, particularly the poor. It is recommended that the project rationalize IEC activities and concentrate on capacity building of farmers.

23. The demonstration of Rice Fallow Pulses is an excellent demonstration of conservation agriculture. In other parts of the world conservation agriculture has solved many of the same problems farmers in Tamil Nadu face, water shortages, reduction in available labour, increase in cost of inputs and declining soil quality. TNAU report that previous efforts in CA in Tamil Nadu have failed. It is recommended that TNAU conduct a review of the previous attempts, seek out CA experiences from other areas with similar agro-ecological conditions to determine if another attempt is warranted. It would be ideal if TNAU could investigate and develop a conservation farming package based on cropping systems for irrigated agriculture in Tamil Nadu.

### **Agriculture Engineering**

24. The performance of the AED department under the project is unfortunately still lagging. AED's project activities include micro-irrigation systems, pressurized underground pipeline, farm ponds and mechanization. It was reported that until March 20, 2009, AED has completed 1719.9 ha against an annual target of 24051 ha for MIS and 707 farm ponds against annual target of 1100. Most of the achievement appear to have been at par in the Coimbatore area. Out of a total of 34 packages for MIS procurement, 10 major packages are meant to be installed in 22000 ha but the potential area has not been identified. The mission is concerned that with the current business as usual mode, there is a serious risk that the overall project target of about 100,000 ha to be brought under micro-irrigation system may not be achieved. There appear to be systemic problem in the promotion and installation of micro irrigation systems. The mission met with the Agriculture Secretary to discuss this problem, and the *Secretary promised that an assessment report would be conducted to identify the issues that are affecting AED's ability to perform in MIS installation and recommend appropriate actions. It was agreed that the report will be provided to the Bank by May 30, 2009.*

25. There appear to be systemic problem in the promotion and installation of AED components. AED activities require a close convergence of TNAU demonstrations on water management techniques with crop diversification, awareness on crop diversification and the most importantly, connection with value chain (marketing) so that farmers are sure of sale of their produce. Once they decide to diversify the crop, the adoption of MIS would be easy as it is long term investment. Therefore it would have been helpful to have DSS planning consultant to recommend most suitable practices in the command. In absence of actual water availability in the tank, topographic and cadastral information, it is quite challenging to plan the activities such as crop diversification, water management infrastructure (pipe network, and farm ponds).

### **Suggestions from the mission to improve performance of AED:**

- 1) More Canvassing of the famers to improve awareness. The mission has identified a number of interested farmers during site visits. AED needs to follow up on those requests.
- 2) Harmonize the efforts with the Horticulture department to provide a package to the farmers similar to TNAU.
- 3) Focus MIS in middle strip of Tamil Nadu where water is scarce and farmers are willing to diversify.



- 4) In paddy and other irrigated areas, the pipe network may be proposed to replace inefficient surface water conveyance from tank and provide MIS at the tail end.
- 5) Adopt some tanks to diversify land use connecting with value chain, possibly with the help of major drip irrigation suppliers.
- 6) Approach through WUA for identification of potential beneficiaries and diversification.
- 7) In Palar and Aliyar sub-basin, replace surface irrigation system from canal with existing dripper system in Coimbatore through buried pipe distribution network and appropriate methodology to supply water from canal.
- 8) Sprinkler irrigation system in Groundnut irrigated areas.
- 9) Reconsider Sugarcane target for MIS if Sugarcane industries are already taking care of it.
- 10) The mission visited the CANARA bank in Maduari to inquire about the possibility of microcredit loan to the farmers to cover their 50% contribution under the micro-irrigation activity. The mission met with the Senior Manager for the Agri-finance and Priority Credit section and was informed of the following:
  - i. The Bank has branches throughout the state of Tamil Nadu
  - ii. Short term loans are being extended to farmers at the effective annual rate of 7% rate of 10% with a subsidy of 3%
  - iii. No collateral is required for less loan of less than Rs. 50, 000 which is less than the farmer's contribution.
  - iv. AED may wish to follow up and inform the farmer about this existing channel.

#### **Dripper design:**

26. The major part of inefficiency of surface irrigation in Orchard has been overcome with the introduction of drippers. Yet there is a scope to improve the dripper system. Particularly, in orchards, the dripper should be designed to provide uniform irrigation by spreading multiple drippers with less discharge capacity around the tree instead of having large discharge drippers irrigating at single location (Refer to Annexure). AED may seek help from TNAU to demonstrate the onsite demonstration supported by soil moisture sensors.

#### **Pressurized pipe irrigation system**

27. It was indicated that the installation of underground pipe irrigation has been discontinued till the current systems were evaluated. In order to avoid further delays, it is recommended that AED proceeds with the installation of the new systems and seek professional assistance in doing so. The mission would also be willing to provide advice if needed

In Coimbatore, the canal water is supplied through flood irrigation while the same field with Coconut plantation are equipped to irrigate from groundwater through dripper systems. If same dripper system could be utilized to irrigate, there will be saving of almost 80% in the canal water. A pilot installation in an outlet ayacut of Veruvendampalayam Distributary in Palar Sub-basin recorded a saving of more than 70% over flood irrigation. This WUA is willing to expand the installation of buried pipe line network in the entire command of R-5 distributary. In lieu of their water savings, they demanded to extend water supply in their distributary from 4 months to 8 months or more. Fortunately their distributary takes off directly from the Paramabikulam main canal, and WRO should not face any problem to run the distributary for extended duration. MDPU may like to demonstrate this pilot project. This would serve as a pilot distributary for water management in canal irrigated areas. AED, WRO and TNAU were advised to investigate the options of facilitating irrigation from canal through dripper system for R-5 distributary and submit the preliminary assessment report by end of the April. The report should reflect options to

*convert the system, and possible water savings and estimated cost considering available infrastructure in the command (Refer annexure).*

If the entire canal command in Palar and Aliyar subbasins were irrigated by drippers, the majority of command could be irrigated by canal water. Based on lessons learned from the pilot project, the WRO may like to give due consideration to facilitate irrigation through drippers.

### **Farm Ponds**

28. Overall farmers are receptive of farm ponds. The mission would like to reiterate that farm ponds should not be drawing primarily on ground water for fish rearing. Instead they were to be installed as runoff ponds to provide supplemental water at critical production stages and incidentally derive additional positive effects from fish production. It is understood that the fisheries are not feasible in all project sub-basins. For instance Palar and Aliyar do not have sufficient water to sustain fish. Fisheries department and AED should coordinate with each other to understand the purpose of farm ponds and design the farm pond accordingly. The AED is advised to customize the design of farm ponds according to its purpose (Fisheries or only for water recycle) after discussing with Fisheries.

### **Farm Mechanization:**

29. AED wanted to revise equipments listed for handing over to WUAs, now that they are formed. The mission suggests that an official submission be made to the Bank with full rationale and design details for further consideration.

### **Animal Husbandry**

30. The progress report on AH program for the period 2007-08 and 2009 (up to 10th March 2009) for Phase I and Phase II sub basins showed that against the given targets, achievements were satisfactory made with regard to (a) AI; (b) area covered under fodder cultivation, (c) Farmers' training programs (d) Farmers' interactive meetings and (e) infertility and treatment camps including de-worming of animals. Since there was a paucity of Self Employed Veterinary Graduates (SEVGs), large part of the work had to be taken up by the DAH. The mission commends and appreciates the role played by the department and the additional efforts undertaken to achieve the physical targets. This is a considerable improvement from last mission.

31. As suggested during the last visit of the mission DAH also collected and analyzed the data on the yield of fodder, conception rate, calves born for 2007-08 for Phase I sub-basins. The effort of DAH is appreciated. Mission suggests that DAH may collect and analyze similar data for 2009-10 for all sub-basins of Phase I and II in next 2-3 months, since more such data will be desirable for presentation during the mid-term evaluation.

### **Non-availability of SEVGs**

32. Out of 65 SEVGs required in Phase I and II subbasins, 50 are in position, leaving a vacancy of 15 SEVGs . Therefore, it will be necessary to fill up 15 positions of SEVG in early part of 2009-2010. DAH may take necessary steps to fill up the vacant positions as early as possible. Till these vacancies are filled up, DAH may continue to take additional load of AI and other activities of in sub-basin veterinary units.

### **Green Fodder production program**

33. Mission suggests that farmers may be advised to follow line sowing rather than broadcasting for fodder cholam and maize and using legumes like Cow pea which will improve the protein content of fodder and also help to enrich the soil quality. Priority may be given to provide fodder slips of CO4 which has higher productivity than CO3.

34. Mission suggests that DAH may make necessary arrangements to produce required number of fodder slips in its own fodder farms (Chettinad and Chinnsalem- Villupuram) for supply to the farmers in the IAMWARM program. Mission also suggests that the work of collection of field level data on fodder production at farmer- level should be continued by DAH for all sub-basins.

35. During its field visits the mission heard increased demand from farmers for more fodder cultivation. The Mission suggests that wherever farmer demand for fodder cultivation exceeds the area allocated for fodder, the matter should be sorted out quickly by the concerned committee so that program can be revised according to the farmer-demand and more area is made available for fodder cultivation. The department of AHD may want to take the issue up with the Department of Agriculture to make sure that the gap area allocation takes into consideration farmers-needs.

### **Performance records required to analyze impacts and performance of project activities.**

36. As per the Project Appraisal Document the important performance parameters for Animal Husbandry that are relevant for the project analysis include increase in fodder production, improvement in milk production and rate of conception and decrease in calf/adult mortality and hybrid sterility. The mission underlines the need to recruit the monitoring and evaluation consultant to collect data on the above parameters and undertake the baseline studies. In the mean time, the DAH may continue to keep actual data on sample basis for its various key activities.

### **Fisheries**

37. Farm ponds have been utilized effectively in many places for fish culture activities and productions ranging from 350 to 600 kg and above have been obtained in various locations. Some of the farmers who have initiated the activity in the first phase are continuing the activity on their own. This reflects sustainability of this intervention. However, water being scarce commodity, the farmers should be educated and encouraged to take appropriate measures to prevent seepage and evaporation loss and improve the unit return through integration activities.

38. The problem of transfer of completed farm ponds to the fisheries department from AED continues to hamper initiation of aquaculture activity at the right time. It would be useful if the ponds are handed over on time to complete the planned activities in the fisheries sector.

39. Sustainability of the aquaculture activity in farm ponds would largely depend on the proper follow up support, monitoring and documentation of the outcomes with critical analysis. In the last mission manpower shortage was identified as the key issue and this continues to be the case. GoTN is requested to fill in the remaining vacant posts to ensure proper project implementation.

40. In order to increase production from farm ponds using species most appropriate for culture in such environments, it is suggested that improved strain of common carp available in Karnataka Veterinary and Fisheries University, Silver barb available with the Central Institute of Freshwater Aquaculture, Bhuwaneswar and the good strain of Nile Tilapia available with the Asian Institute of Technology, Thailand as well as the World Fish center, Malaysia may be introduced. Fish seed centers renovated under the project may be utilized for maintaining this stock of these species under bio-secure environment and produce quality seed to help the farmers.

41. Several of the seed banks have been completed. These seed banks will serve as an important source to supply quality seed to farmers. However, the capacity being small and the cost of construction being very high, it is essential to consider the establishment of earthen ponds with potential farmers to undertake seed nursing activity. This is a very important factor that needs to be considered to cope with the increasing seed demand, especially in phase III sub basins.

42. The irrigation tanks have been stocked with good size fingerlings. The impact of this stocking on fish production has to be captured by proper monitoring of the catch statistics. Many of these tanks have good potential to increase production further by encouraging cage and pen culture of high value species in such water bodies. Hence in the upcoming activities, suitable consideration may be given to explore cage and pen culture of fishes to produce table size fish in selected irrigation tanks. Further, in order to increase and sustain the productivity of these water bodies, cage nursing of seeds and stocking of such nursed seeds in the water bodies should be made as the integral part of the irrigation tank development activity.

43. Ornamental fish culture units established in the first phase has initiated the activity. This intervention requires high level follow up support and monitoring to understand the sustainability of the activity. In the upcoming year, suitable care must be given in providing good technical support and market access to ornamental fish culture units.

44. Good progress has been made in terms of establishing the kiosk, though at present only two kiosks have been given to the user groups. It may be wise to tie up with the Fisheries Development Corporation to ensure adequate supply of raw material to these kiosks in addition to marketing of fish captured in local area. Further the possibility of enhancing their activity through value addition may also be considered.

45. Capacity building for farmers should receive priority attention through proper planning. Farmer to farmer exchange of information would be very useful for the success of many of the interventions made in this sector.

#### **Department of Agriculture Marketing**

46. The activities of the Ag Marketing department would be looked at during the subsequent mission (in June 09) by the Ag marketing specialist on the team, who was unable to join the current mission.

#### **Agribusiness Development Facility**

47. One of the key activities that the GoTN requested Bank assistance in is the setting up of the Agribusiness Development Facility (ABDF). The ABDF which aims at developing and strengthening the small and medium agro-enterprise sector focuses on the following key areas :

(a) increasing access to finance, (b) increasing access to business development services, and (c) improving the business, legal and regulatory environment.

48. The mission held a meeting with representatives from the Tamil Nadu Industrial Investment Corporation (TIIC), Tamil Nadu Industrial Corporation (TIDCO), Tamil Nadu Small farmers agribusiness consortium, and CII to discuss the subject of ABDF, find out what area of operation these agencies are involved in, and explore the opportunities to stimulate the agribusiness sector in the state.

49. All representatives informed that through their interactions with farmers and producers, they are constantly asked to help provide the “buyers’ list” for the farmers’ products, and that commodity supply chains remain largely uncoordinated. They have also informed that APEDA, the GOI agency dealing with ag exports, has no presence in TN.

50. TIDCO is engaged in large joint ventures in multiple sectors and products including infrastructure projects, Specialized Export Zones, market watches (TITANS), and manufacturing projects. They operate on a very large scale.

51. TIIC is an investment corporation that extends financing to agro-industries ranging from 5 lacs to 20 crores (e.g. rice mills, cut-flowers, floriculture, fruits, etc..) however they do not provide any other business development services.

52. Tamil Nadu Small farmers agribusiness consortium is a small scale entity with headquarters in Delhi and one staff member present in TN looking after 26 venture capital agribusiness projects primarily in the areas of floriculture and mango processing.

53. CII is working on a cluster program with focus on quality, producers-groups formation, and working with MSU, TNAU under a USAID pre and post harvest development training program.

54. The mission also interacted with the new Head of the IFC office in Chennai and requested his support to help with the design of the ABDF and in facilitating the linkages between the Agribusiness clients of IFC in Tamil Nadu and project beneficiaries to increase their access to markets. IFC has set up a number of business development facilities around the World including China, Vietnam, and Eastern Europe. He promised to take up the subject with the advisory services group under IFC and revert back with concrete recommendations. The mission also informed the project that it intends to have a mission exclusively dedicated to the Agribusiness component of the project in mid-June and for this purpose a senior agribusiness FAO specialist will visit TN to help develop this activity further. *The mission requested however that MDPU recruits a qualified Agribusiness specialist as soon as possible to follow up on this activity and work with all concerned parties including future missions to advance this activity.*

### **Component C: Institutional Modernization in Irrigated Agriculture**

#### **Formation of WUAs – Phases I and II sub-basins:**

55. Of the total no. of 1,342 Presidents and 6,300 Territorial Constituency (TC) members to be elected for 1,342 WUAs that fall under the Phase I and Phase II sub-basins, 1,227 Presidents (91%) and 5,309 TC members (84%) have been elected since December 2008. The remaining could not be elected on account of a range of exigencies, including the lack of nominees and the notification of National Elections that has happened in the 1<sup>st</sup> week of March 2009. These

remaining posts of Presidents and TC members would be filled in through elections after the National Elections are completed mid-May 2009. Thanks to the concerted efforts made by the PIM Cell at the Engineer in Chief Office along with PIM Cells at the three Regional Chief Engineers' offices and WRO field staff, as well as the constant support and monitoring on the part of senior WRO officials supported by the Project Director and Secretary PWD, this important task of forming WUAs through elections as required under the TNFMIS Act has been largely completed for Phase I and II sub-basins. The mission congratulates the GoTN on the achievement of this important milestone.

### **Phase III WUAs:**

56. Similar support from the Project Director and Secretary PWD particularly in ensuring active involvement of district-level Collectors in helping WRO officials collate revenue records in the participating districts and close monitoring and support to PIM Cell both at E-in-C office and Regional CE offices will be critical for completing the WUA formation through elections for around 1,400 WUAs in Phase III sub-basins. The PIM Cell, based on the successful experience with conducting the recent WUA elections, has already prepared a detailed WUA establishment program that has begun from February 5, 2009 and is expected to be completed on July 5, 2009. During wrap-up meeting, Project Director informed that July 5, 2009 is probably too tight, and August 15, 2009 is a more realistic date for completion of Phase III WUAs elections. The mission requests that in order for the task to be completed on time, a concerted effort is needed from all parties including EIC and PIM cell, regional CEs, and District collectors with the direct support and guidance from Secretary PWD and PD. The mission requests that, similar to Phase I and Phase II election, a clear timetable and action plan is issued to all parties concerned to ensure that the various elections steps are completed sequentially with no delays.

### **Orientation of WUA Presidents and TC members:**

57. The Training Cell at MDPU and PIM Cell at E-in-C office through IMTI Trichy have organized around 18, 2 day orientation programs for WUA Presidents and TC members of 19 first and second year sub-basins. This joint effort of WRO, MDPU and IMTI seems to have given the right impetus to MDPU Training Cell and the PIM Cells at WRO to work on the detailed content of capacity building and training modules for WUA functionaries. The newly elected WUA Presidents and TC members sought answers to several of their problems and dilemmas that have helped outline the training needs for this group of functionaries.

### **Training and Capacity building of WUAs:**

58. It is clear from the mission's interaction with management committees and farmers that WUAs need intensive support during the next years to develop towards technically and financially sustainable organizations. The PIM Cell and MDPU Training Cell are now actively detailing the Training/Capacity building modules for WUAs. This is likely to require external expert inputs both from within Tamil Nadu as well as other parts of the Country. The mission discussed possible sources of support for preparing Training of Trainers modules, and Training on Participatory Approaches. Linkages with various Water and Land Management Institutes in the country (such as WALAMTARI Hyderabad, CWRDM Kozhikode, WALMI Anand, Gujarat etc.), and projects with innovative approaches such as the farmer-led training in the AP Farmer Managed Groundwater Systems Project (APFAMGs) should be sought. The Bank Task Team, if requested, would be ready to provide support by way of advising MDPU/WRO develop a strategy for Training/Capacity building of WUAs.

59. During discussions with WRO officials it was agreed that WUA support is a long-term activity, to be carried out especially by the Assistant Executive Engineers (AEE). As these AEEs have many tasks – for example, AEEs in Madurai Region have on average 50 tanks in their operational area as well as other irrigation systems – it was agreed that it was not possible to entrust AEEs with major training activities for WUAs. It was agreed, however, that AEEs and other WRO engineers would receive training to be prepared for future support to WUAs. WUAs have a responsibility to properly operate and maintain the infrastructure that has been entrusted under their management. WRO engineers will in future have to review the performance of WUAs. For this the project will at a later stage prepare simple template reports for the annual inspection of the tanks and appurtenant infrastructure. If it is found that WUAs are neglecting their responsibilities focused support can be provided by AEEs to such WUAs. .

### **Support Organizations:**

60. Support Organizations (SO) will be recruited to assist with the support and training to WUAs as the scale of activities during the next three years will be way beyond the capacity of government departments. The Terms of Reference along with the draft Request for Proposals (RFP) was reviewed in detail by the mission along with PIM Cell and MDPU colleagues involved with this activity. It is clear that:

- a. Given the budget limits for SOs, they need to be viewed as agencies that should deliver standardized training/capacity building modules to the nearly 2,500 WUAs and their management committees and farmer members spread over 68 sub-basins under the project. It was agreed that the PIM Cell, with consultancy support as needed (see above) will prepare standard training modules, rather than requesting each of the SOs to prepare training modules;
- b. To enable SOs undertake this task, the qualification requirements of the extension para-workers have to be redefined to ensure that they are local people with expertise in such topics as water management and management and governance of local level organizations, so that they can use their experience to effectively disseminate knowledge to the newly elected Presidents and TC members of WUAs as well as the farmer members;
- c. The professional staff of a SO would comprise a team of three Community Organizers - one each in the functional area of Social Development, Water Management/O&M, and Agriculture/Horticulture/Animal Husbandry/Fisheries/Agriculture Marketing. The SO Team would be headed by a Team Leader who is also a Training Coordinator. Four para-workers would be assigned to a group of 20 WUAs. The SO can propose that each of these para-workers has a specific discipline to assist the 20 WUAs such as general mobilization of communities, water management/O&M, agriculture, and support to management committees or that given the intensive interaction required with WUAs, the para-workers would each be responsible for 5 WUAs, in which case they need to have more diverse knowledge. As an example, for a sub-basin like Manimuthar in Madurai Region with 240 WUAs, there would be a team of 48 Extension para-workers spread across the sub-basin. The Team Leader/Training Coordinator would devolve some administrative coordination responsibilities to the 3 Community Organizers who in this particular sub-basin will manage/coordinate the activities of around 16 Extension Para workers, in addition to providing support in their respective area of functional expertise;
- d. MDPU Experts such as Social Development/Participatory Management Expert, Environmental Expert, Agriculture Marketing Expert, Agriculture Expert,

- Agriculture Engineering Expert, Water Resource Management Expert, Fisheries Expert, Horticulture Expert, Animal Husbandry Expert as well as the PIM Cell WRO officials would be expected to participate in developing **Training of Trainers'** modules for their respective areas of expertise that they are expected to deliver to WUAs, their management committees, and farmer members; and
- e. Once the Training modules are ready, these would be used to provide focused Training to the SO Teams to be able to effectively deliver required training/capacity building to WUAs, Presidents, TC members, and farmer members as per requirement.

### **Irrigation Research Fund (IRF)**

61. The mission has learned that the Government Order for the formation of the IRF has been issued. The mission was also informed by the Engineer in Chief that the research committee has met once. However no call for proposals has yet been issued due to the upcoming elections. The EIC promised the mission that this will be done right after the elections.

### **Component D: Water Resources management**

#### **SWARMA:**

62. There has been little progress achieved on the subject of SWARMA which is a legal covenant under the project with an overdue date of December 31, 2007. During last mission it was agreed that the draft act for SWARMA, which had undertaken thorough review at various government levels, would be presented to the assembly in December 08, if possible, or in Feb-March 09 session by latest. The bank also suggested that if legislative backing is not possible during those sessions, cabinet approval may be obtained for the draft act and forwarded to the Bank and in the meantime a chairman for SWARMA may get appointed to begin working on the institutional mechanics for integration modalities. The GoTN has recently informed the Bank that it is now opting to establish SWARMA as an agency by a GO, without the legislative backing for the moment, however, keeping a clear path for legislative backing in the future. A draft proposal was given to the mission, on the newly proposed structure for SWARMA, which the mission will review and revert back to the project with comments.

#### **Cooum**

63. A CSRSM office has been formed and is engaged in a number of activities including holding multiple stakeholders workshops and awareness campaigns, among others. The Bank has provided technical and advisory assistance to the GOTN, and shared international experience in the area of river restoration and management. Complete restoration of the cooum river is a major and complex undertaking, which covers a large number of issues, involves multiple agencies, and spreads across administrative boundaries and jurisdictions, and requires a substantial amount of resources. Resources from IAMWARM are naturally limited in size and scope, but could be leveraged by the Government to raise more funds for this activity.

### **Component E: Project management Support**

#### **Monitoring and Evaluation consultancy –**

64. There is an absolutely urgent need to finalize the M&E consultancy as soon as possible. The project has now completed its second year of implementation and is about to embark on the



largest phase yet (phase III with 38 sub basins). Many activities have been implemented, and success stories have been achieved. Though some documentation may be available at each department level, thorough and scientific capture of these impacts has not yet been realized primarily due to the significant delays in recruiting the M&E consultancy. Following review by RPM in the light of a complaint received, comments were sent to the project regarding consistency of scoring among evaluators on specific evaluation criteria and the methodology followed for evaluation. The mission discussed these points with MDPU and MDPU prepared a response that was sent back straight to the RPM for review. The mission emphasizes the importance of recruiting a Monitoring and Evaluation Specialist at MDPU to follow up on the results framework for the project and coordinate the monitoring activity across all implementing agencies, and work together with the external consultant, once the latter is hired.

## **Procurement**

65. The mission reviewed the status of the Procurement with GOTN and discussed pending issues with the line departments, Bank and MDPU and it was agreed that all concerned would expedite the processing/responding to the issues raised therein. The mission specifically advised MDPU to expedite their response on the queries raised by the Bank on M&E consultancy- which was done.

66. The mission reiterated that as per legal agreement between the Bank, Borrowers and Project, the Bank's procurement guidelines, methods, bid documents, RFP are to be followed for the procurement of works & goods and selection of consulting and non consulting services. Copies of all relevant guidelines, manuals and documents have been made available from time to time and are also available on the Bank's website with free access and reference.

### **Review and Updates of the Procurement Plan**

67. The mission and the Project reviewed the procurement status of major items planned for the financial year 2008-09 as per PP. The mission advised that single procurement plan should be maintained and should be annually updated instead of having different PPs for each year. Each contract package to be procured shall be provided unique id number in order to avoid any confusion. The Project agreed to provide the updated status of these packages planned for procurement during year 1 and 2 and add new packages to be procured in the standard procurement plan format, once ready.

### **Risk Mitigation**

#### **68. Bid documents and Bidding Process**

Mission expressed its satisfaction and noted that the Project is incorporating price adjustment clauses in the bid documents for the contracts with construction period beyond 6 months to mitigate risks related to volatility of prices of inputs. Mission suggested that all major input items and labor should be included in the price adjustment formula as per NCB works bid document (W2).

69. While price adjustment takes care of risk related to the price volatility during the implementation period, the gap between the current market price and the estimate prepared by the Project is not addressed. To address this risk, the following mitigation measures to be adopted

- Design of the works should be based on the actual field tests conducted such as soil tests for design of foundation
- **BoQ and Cost Estimate**

- BoQ should be more accurately estimated and reviewed by senior and experienced engineers to ensure greater accuracy
- Shivaraman committee had submitted its recommendation to the GOTN in 2004-05, however, the recommendations have only partly been accepted and the Government decision on the balance substantial part of these recommendations should be expedited. This is necessary so that future bids are invited on the realistic cost estimates based on the SOR revised close to date of issue of invitation of bid to include all the relevant factors in the data analysis (or rate analysis), particularly
  - the overheads of contractor; appropriate profit for contractors; all applicable taxes and levies etc. ; Updated current market rates of inputs (both material and labor)
- Till such time the above necessary change could be affected to data analysis, the fact that the above key cost elements are missing from the data analysis, should be taken into cognizance during decision making during the bidding process
- Efforts to be made to improve the existing bidding/contracting climate to enhance competition and improved deliveries and quality of works under contracts
- **Improving Competition**
  - The mission expressed its concern over poor response from bidders as in several cases even 5 to 6 rounds of re-bidding has also not resulted into receipt of bids and the project implementation is getting delayed. This is also a matter of concern that in several cases low numbers of bids are received. It was agreed that better publicity of the contract opportunities would be carried out and IFB would be published in a popular national daily and effectively publicized in all southern states. A contractor's workshop shall be conducted at Chennai and other appropriate locations in the state to discuss the reasons for the poor performance and genuine issues of contractors. This proposed workshop will also be used to make the contracting community aware of excise/custom duty exemption and availability of smooth and committed cash flow under the project.
  - Mission advised that timely award of contracts within the initial validity period of bids/proposals should be done. The Bid evaluation should be completed in time and the recommendations should be sent to the Bank within 45 days of receipt of bids.
  - Mission informed that after the bid has been submitted, no modification/alteration of bids (or negotiation of price) is accepted under the Bank funded contracts. A specific meeting was held with the PD and Chairman TAC-cum-Engineer in Chief of WRD on this matter and the Bank's guideline on this matter were clarified.
  - The high cost charged for bidding document could be inhibiting competition. This cost should be reduced to a reasonable level equivalent to the cost of reproduction of a copy of bid document, say Rs. 1000. Tsumai Project unit has already implemented this reduction in the price of bid documents. Project informed that the cost of bidding document is not an issue as bid documents can be downloaded free. Nonetheless the mission feels that it is likely that only computer savvy bidders may avail to this service, and for the sake of fairness, the cost of the bid documents should be reduced.
  - Mission informed that as per procurement guidelines Bank's prior no objection is required to be obtained for all rebidding in prior review cases as well as in all the post review cases.
- **Quality Assurance:**
  - The procurement cell of MDPU would provide quality oversight to all prior review procurement documents/ communications from all PIUs/line departments. MDPU will facilitate quality, uniformity and consistency of proposals/responses being forwarded to the Bank for prior review and adopt suitable quality assurance measures for those contracts under post review.

### Procurement Capacity and Quality Enhancement

- **Capacity of MDPU**

Head Procurement, MDPU informed that MDPU now has 6 members in team and the mission noted that MDPU has built a good team to support the procurement under the project. The mission, however, expressed its concern regarding the capacity of the line departments to undertake the procurement in line with WB methods and guidelines. Mission suggested that the MDPU capacity should be fully utilized to enhance procurement capacity of the line departments. It was agreed that the above 6 officers of procurement cell would be allocated adequate numbers of departments to facilitate, preparation of bid documents, advisory in carrying out bidding process and facilitation in preparation of bid evaluation reports.

- **Training of Heads of Procurement and MDPU Procurement officers**

The mission expressed its satisfaction on the ongoing 2 days training programs under which about 600 officers of the MDPU and line departments have been trained. Mission advised that all members of Procurement cell of MDPU, all heads of procurement of line departments shall be nominated for intensive training. It was agreed that the PD will seek ASCI/NIFM's help to conduct a tailor made training program of 7-10 days addressing specific capacity building requirements of TNIAMWARM and include detailed training in general overview and NCB works & Goods and Consultancy following World Bank methods of procurement. In each line department an officer, other than head of procurement, will also be provided intensive training to ensure continuity in case of transfers or rotation of job etc. becomes inevitable, however, the GOTN will ensure that the project team members are not transferred for the entire project period of or for at least 3 years.

### Post Review of Contracts Awarded during FY 2007-08

The mission informed that the post review of a sample of contracts awarded during 2007-08 under the project would start by mid April of 2009 and requested the MDPU and all line departments to provide all support for successful completion of the same by the Bank's Consultants M/s. GPCL engaged for this purpose. The MDPU and line departments assured full support and cooperation and PD advised that authorization letter affixed with photograph of the post review team (or identity cards for the purpose) will ensure smooth access for the post review team to carry out their work. Mission expressed that normally the letter of authorization should be adequate for this purpose, however, mission agreed to pass on this advice to GPCL. The mission shared the TOR of the post review consultants with the Project, as was requested by the Project Director.

### Efficiency and Administrative Issues

- Project and line departments agreed that Adjudicators fee of Rs.1000/- per day is quite low and shall be enhanced to reasonable levels to encourage competent professionals to accept adjudicatorship and rendering satisfactory service. With the present day's costs, a fee of say, Rs. 5000 per day is justified.
- A panel of professionals of good integrity and technical knowledge for being appointed as adjudicators shall be prepared.
- It is seen that in several instances, the certificate for claiming exemption of excise/customs duty by contractors is not issued in time. Bid document stipulates it should be issued in 60 days of signing of agreement. The powers of signing of these

certificates may be delegated to Secretaries of line departments instead of Finance Secretary alone to expedite matters, as in case of Govt. of Punjab.

- Abolition of measurement book had been agreed by GOTN and a GO was issued for implementing that in pilot projects in July 2005. WRD agreed to implement this GO and in TNIAMWARM and observe its impact on freeing-up time of the concerned Engineers for supervision.

### Other Consultancies

1. Construction Quality management and technical supervision: Comments were sent by the Bank on the RFP, Project to revise RFP accordingly and forward to the Bank for clearance.
2. Topographic and Cadastral Survey: The Bank has reviewed the technical evaluation report and some comments have been raised by the RPM on the consistency between scoring and the strengths and weaknesses section. These comments will be forwarded to the project for further clarifications.
3. Enterprise Information Management Systems: The mission held further discussions with the project team comprised of EE (IT Cell) and his team, team of MDPU, and team of ELCOT. The discussions led to a joint agreement on the Terms of Reference, the text of the RFP document and the estimated Costs of the Consultancy, in the presence of the PD MDPU. The final estimated cost of the consultancy that was agreed upon was **INR 138,380,000**, with the inclusion of a 2 years Annual Technical Support (ATS), as was requested by the project. The project is now requested to proceed to the next step to award this consultancy.
4. Support Organization for the mobilization and capacity building of WUAs. The TORs have been revised and agreed upon. The mission requested that they get incorporated in the RFP and that SEs circulate the RFPs.
5. Decision Support Systems The REOI has been cleared by the Bank but has not yet been published. REOI should be published as soon as a possible and a copy in word format should be forwarded to the Bank for publication with UNDB.

### Financial Management

**Disbursements:** The disbursement under the project is as under:

Financing from	IDA	IBRD	Total
Approved	149.21	335.00	<b>482.45</b>
Disbursed *	30.951	28.46	<b>59.52</b>
% Disb.	20.81 %	8.50 %	<b>12.29 %</b>

\* includes SA-Advance of USD 8.00 million under IDA and USD 17.00 million under IBRD.

1. The project has been timely in the submission of the quarterly IUFRRs and disbursements have been made for expenditures reported till quarter ended December 31, 2008. There is some difference in the quantum of grant released by GOI against the IDA credit (as

agreed during negotiations) and also some delays. It is suggested that the project finance staff and Bank have a joint meeting with CAAA to understand and resolve this issue.

2. **Budget & Funds Flow:** The budget proposed for the financial year 2009-10 is Rs 5330 million which adequate and compares favorably with the final budget estimate of 2008-09 which was Rs 33160 million. There are no constraints in funds availability with the various implementing departments, though the project is expected to face the normal lag in budget allocation in the first quarter of each financial year.
3. **Accounting, Financial Reporting and Internal Control:** the project is obtaining monthly reports from all the line departments and also getting the expenditure reports from the state AG (for the project account codes). The project expenditures reported by the line department and the state AG are being reconciled on a periodic basis and adjustments, if any, are being reflected in subsequent quarter's IUFR. As per the expenditure reported up to January 31<sup>st</sup> 2009 the aggregate difference is approx 1.2 % only. In order to streamline the approval process of IUFR it was agreed that (a) the contract-wise expenditure information (all contracts for WRO and AED and contracts over USD 100,000 (currently equivalent to approximately 50 lacs) for other line departments and MDPU will be submitted on a 6 monthly basis along as part of the project progress and; (b) comparison of sub-basin wise budget verses actual expenditure will be also submitted on a 6 monthly basis for WRO and annually for the other line departments, as part of the progress report.
4. The project shared the contract wise status (as of February 2009) including expenditure for all contracts in WRO was shared with the mission. The finance training handbook has also been translated in Tamil and will be provided to all sub-basin staff involved in the project.
5. **Internal & External Audit:** the preliminary draft of the first report of the internal auditors, covering 6 sub-basins was shared with the mission and a detailed discussion was held with the internal auditors and the project finance staff on the structure/presentation of the findings. The auditors are expected to submit the final report to the project by April 15, 2009 and the project will share the same with the Bank by April 30, 2009. The external audit reports for the project for the year 2007-08 (project and TNAU) was submitted with some delays and the first set of response on the audit review as also been submitted by the project. *In the audit report of TNAU for the year 2007-08 the auditors have identified certain issues relating to the institutional fee of 7.5% claimed by TNAU. Since TNAU is considered as an implementing entity, the eligibility of such fee for reimbursement needs to be reviewed by the Bank.*

#### **Environmental & Social safeguards**

1. There continues to be a delay in reporting on the project compliance with the Environmental and Social Safeguard requirements as per the legal agreements. According to the legal agreements, six monthly progress reports on compliance with social and environmental safeguards measures set forth in the ESA and the ESMF providing details of measures taken in furtherance of ESA and ESMF
2. There is also delay in the recruitment the environmental specialists (one in MDPU and one in charge of the regional environment cells). The Project Director has informed that MDPU already has a young engineer with Masters Degree as Environmental Specialist.

Efforts should be made to fill in the other post and recruit an environmental specialist for the regional environmental cells. The Environmental Specialist, at MDPU, should focus his/her efforts to facilitate the ESA implementation, appraise the sub-basin plans from an environmental perspective (with appropriate checklists for each package) and consolidate monitoring and reporting on environmental aspects across implementation agencies. The mission emphasizes that the primary function of the environmental cells is to track and document the environmental impact of project interventions as per the provisions of the ESA and ESMF of the project.

3. During field visits to each of the about 20 tanks that the mission undertook in Madurai region, the application of the provisions of the ESMF was reviewed. The documentation related to application of the ESMF provisions was not available at any of the sites. For instance, the socio-economic status of those whose encroachments were being removed are not being recorded. The agreed Environmental and Social Management Framework (ESMF) (*Chapter 7 titled Social and Environmental Management Framework of the report from page 211 to 290 and Annexures 6, 7 and 8 on pages A-275, A-290 and A-300*) for the project requires that all project affected people (such as those who lose assets or livelihoods or have to be resettled), including those who are being removed from "encroached" land due to a project intervention, should be provided adequate assistance to retain or improve their standard of living. The lack of title to the land is no bar for providing such assistance. In accordance with this provision in the agreed ESMF for the project, the project shall carefully document each case of such project affected people and ensure that the Resettlement Action Plan for each such Project Affected Person (PAP) is carefully developed and approved by the Bank before being implemented to ensure that the affected person is able to at least retain if not improve his or her standard of living. The provisions of the ESMF need to be rigorously followed and the Social Development and Environment experts at MDPU need to take a lead in first understanding these provisions and ensuring that all concerned WRO and other departmental officials are adequately trained and oriented to do so. Urgent action is required to ensure that all provisions of the ESMF are being rigorously observed in each of the sub-projects to avoid any unforeseen neglect of any of the agreed provisions. At the Wrap-up meeting the EIC informed that no encroachment has been evicted in the project.

**IEC spending:** While recognizing the importance of IEC spending to raise awareness to the project activities, among other ends, the mission recommends that some rationalization of these expenditures takes place, particularly on project memorabilia (caps, t-shirts, etc..) and photographs and albums, to optimize spending and avoid unnecessary overlaps.

**Phase III sub basin plans** At the request of the PD, the mission agreed to hold technical discussions on a number of phase III sub basin plans for some of the implementing agencies. It was agreed that 10 subbasin plans<sup>2</sup> (out of 38) will be reviewed by the Bank at this stage. The list of the subbasins selected by the project is included in the Annex. Discussions were held primarily for the ten sub basin plans with the Departments of Agriculture, Horticulture, and TNAU. The sub-basin plans for the DAH were not yet ready. Comments were given and the plans were to be modified and sent back to the Bank for further review/clearance. Similar discussions and preliminary review were held for the same ten subbasin plans for WRO with Mr. Malhotra (See

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<sup>2</sup> 1. Pambanar Varattar Subbasin; 2. Thuringalar Subbasin; 3. Gomukhinadhi Sub Basin; 4. Kanal Odai Subbasin; 5. Uthirakosamangai Subbasin; 6. Palar Subbasin; 7. Lower Gundar Subbasin; 8. Deviar Subbasin; 9. Hanumanadhi (Nambiyar) Sub Basin; 10. Salikulamer Sub Basin

Annex). Final clearance for these plans will be given by the Bank once the review process is completed. The mission informed that in the case of AED, it would wait until the department undertakes its situational assessment before further action is taken. Given the past poor performance record of AED, the mission felt that unless and until AED comes up with a clear strategy on how it intends to improve its performance, it would be counter-productive to keep increasing their targets when they are unable to deliver.

70. The mission would also like to underline the agreement reached during last mission that as the project gears towards preparation and implementation of phase III, the largest phase yet with 38 sub basins, it is essential that progress is concurrently achieved on a number of related activities to ensure smooth and successful implementation. These activities include: (i) initiating and making satisfactory progress on the formation of WUAs in phase III sub basins (expected by July 5, 2009); (ii) addressing the key challenges encountered in project implementation so far; (iii) factoring lessons learned (successes/areas of needed improvement) in phase III plans; and (iv) finalizing all key consultancies, essential for proper design, implementation, monitoring and evaluation, and quality management under the project. The mission therefore strongly suggests that progress gets realized on these issues as soon as possible for phase III to proceed well.

### Agreed Actions

S.No	Actions	Date by	Responsibility
1	Submit the IUFRR for the quarter ending March 31 <sup>st</sup> 2009 with the agreed QA mechanisms	May 31 2009	MDPU
2	Submit external audit report (Project & TNAU) for the year ended March 31, 2009	30-Sep-09	MDPU
3	Submit the contract wise expenditure details (all contracts in WRO/AED/MDPU) and contracts with the highest 10% value for other line departments as part of 6 monthly progress. The next report will be for the period ending Sept 30, 2009	30-Nov-09	MDPU (FM and procurement)
4	Submit sub-basin wise budget verses actual report (6 monthly for WRO and annually for other line departments) starting period ended march 31 <sup>st</sup> 2009 as part of the 6 monthly progress report	May31 2009	MDPU
5	Submit the internal audit report covering 6 sub-basins	30-Apr-09	MDPU
6	WUAs elections finalized for Phase III sub basins Detailed timetable to be developed and issues to all stakeholders and copy sent to the Bank	15-Aug-09 30-May-09	WRO, MDPU
7	EIC to provide an update on the status of the Bifurcation efforts	Every six months	EIC, WRO. MDPU to follow up
8	Develop a standardized reporting system for all project activities and have it in place	31 June 09	MDPU
	MDPU to appoint an Agribusiness Specialist to work with the Bank mission on Developing ABDF	30-May-09	MDPU
	MDPU to appoint an M&E specialist	30-May-09	MDPU
9	Installation of computers -	31 June 09	WRO/MDPU
10	DSS EOI Published	Immediately if possible or right after the elections	WRO
11	Award the Consultancy for Construction Quality Management and Technical supervision	May 30-09	WRO
12	AED to submit its action plan for improving the implementation of its activities	30-May-09	AED
13	AED to review performance of its staff under IAM WARM and make necessary adjustments.	30-May-09	AED
14	Assigning a full-time Superintendent Engineer level staff at WRO in charge of Regional Environment Cells to institutionalize mainstreaming of environmental considerations into WRO activities	31-Dec-08	WRO
15	Progress reports on Compliance with provisions of ESA and ESMF	Every six months, together with progress reports	MDPU/WRO



16	Evaluation study for checking the compliance of sub-basin plans with proposed measures in the ESA-	Urgent	Environment Cell
17	Non standardised reporting formats for supervision missions- Agree on and distribute	for next supervision mission	DoA, DoH, TNAU, (ag specialist has distributed formats)
18	Delayed PF demonstrations- Reported to be solved	50% completed by June 2009	TNAU
19	Revise strategy for IPM, INM and organic farming- Strategy to be revised	June, 2009	DoA, DoH
20	Poor knowledge of efficient irrigation methods by farmers- Devise a strategy for capacity building of farmers in irrigation management	June, 2009	DoA to lead
21	Impact areas of pulses and other crops lagging- revise Strategy	Aug-09	TNAU and DoA
22	Clarify strategy to achieve 25% Horticulture in Ayacut- review current situation and revise strategy	June, 2009	DoH

## Annex I

The following section includes the findings from Mr. Malhotra's visit to Varahanadhi sub basin and Pollachis region between April 6-April 10, 2009

**Packages specific observations and recommendation for improvement- For additional information and illustrative sketches please consult Annex IV.**

1. **Kadambur Tank in Package 6:** "Rehabilitation and Modernization of Anicuts, Flood Banks, Supply Channels and all Tanks covered under Varahanadhi Sub Basin in Vallam Block Gingee Taluk of Villupuram District".
2. **Thaiyur Tank in Package No. 7 :** "Rehabilitation and Modernization of Anicuts, Flood Banks, Supply Channels, and all Tanks covered under Varahanadhi Sub Basin in Vallam Block Gingee Taluk of Villupuram District".
3. **Thiruvampattu Tank in Package No.7 and**
4. **Kezpennathur Big Tank in Package No. 1:** "Rehabilitation and modernization of Anicuts, Flood Banks, Supply Channels, and all Tanks covered under Varahandhi Sub Basin in Kilpennathur and Thurinjapuram Blocks of Thiruvannamalai Taluk of Thiruvannamalai District.

### **Mission Observations**

- (a) **Cracks in Earthen Embankments of Tank Bunds.** *The mission observed fairly significant number of cracks on tank bunds.* In case highly clayey nature of soil( like CH / Black Cotton Soil ) is used in the earth fill for raising & strengthening of tank bunds, cracks occur in summer due to high temperatures which close during colder season. Cracks can occur due to differential settlement between adjacent lengths of embankment. Cracks also occur due to deficient and non uniform compaction( to its full width ) of the successive layers of earth fill.

*In the present case, the formation of cracks can be attributed to deficient and non uniform compaction of earth fill layers during the process of strengthening of tank bunds.* These being Phase I works, the Contractors were not fully geared and mobilized for undertaking compaction of earth fill through deployment of power rollers/vibratory power rollers.

**Mission Suggestions on Remedial Measures for Treatment of Cracks.** *The following measures are broadly suggested for treatment of cracks:*

- The cracks which occur near the top edges of the embankment are "**separation cracks**" and such cracks can cause large scale slippage of earth. These should be treated by removing all the earth fill above the "slippage plane", benching the back slope, and, there-after, placing new earth fill in suitable layers and compacting each layer to the specified density with earth rammer/hand rammer. **The other cracks may be treated in the manner mentioned below:**
- Find approximate depth of crack by excavating an inspection pit.
- Excavate the cracked reaches in the form of a trench up to the bottom of the crack.
- Fill each trench with suitable soil in layers of 10 cm thickness duly compacted manually with hand rammer or earth rammer. Compaction can be done even by persons by tamping with their gum boots put on their feet. The earth fill should have 2 to 3 % more moisture than OMC.

- In case the depth of cracks is substantial, say, 60 cm or more, “clay-cement-water mix” injection may be done. This is done by driving pipes into the cracks at about 60 cm spacing and manually pouring the fluid mix of clay-cement-water into pipes. The fluid mix be prepared in a bucket, stirred well, and then poured into pipes.
- Treatment of deeper cracks can be more effectively done by excavating trenches in the cracked reaches to a depth of about 60 cm, exposing the cracks at the bottom of trenches; and then filling the trenches with a solution of “bentonite”( a very fine clay powder easily available in market ) and water. Proportioning of bentonite and water may be in the ratio of 1:14,viz,1 part of bentonite powder and 14 parts of water. This mixture should be prepared in a bucket and thoroughly stirred and then poured into trenches. Gradually,the bentonite-water mix solution would penetrate into the cracks right to their bottom, filling these completely. When no solution is left in the trenches, suitable soil should be placed in layers in the respective trenches and each layer compacted with earth rammer/hand rammer right up to the top of embankment.
- It is more expedient to fill the shallow cracks by pouring a well stirred mixture of fine sand and water directly into the cracks. Proportioning of sand-water mixture may be kept as 1:5, viz one part of sand and 5 parts of water.

**The above listed treatment measures are illustrated in Sketches in the Attachment.**

- (b) **Stone Revetment in Model Sections in Tank Bunds.** It is suggested that the big gaps existing between the individual stones in the revetment be filled with angular spalls duly hammered & wedged in order to ensure a dense and uniform revetment.

**B. Field Visits to Canal Rehabilitation Works:** The mission made field visits to the selected works in the following 5 Packages, relating to the rehabilitation of distributaries / canals in Pollachi Region.

1. **Package No.22** “Rehabilitation of distys. off-taking in between LS 0/000 Km & 14/100 Km of Vellakovil Branch Canal”. (Agreement Value: Rs 57.37 million; Date of Start: Feb.27,2009; Tendered Completion Period: 18 months; Progress: Concrete Lining completed in 4 Km out of a total length of 83 Km proposed to be lined.)”.
2. **Package No.9** “Rehabilitation of left out reaches of PMC from LS 87.40 Km to 124.10 Km (Agreement Value: Rs.45.77 million; Date of Start: January’ 2008; Tendered Completion Period: 17 months; Progress: 45 % completed( physical) and financial expenditure of Rs. 19.20 million incurred)”.
3. **Package No.18** “Rehabilitation of left out reaches in Branch Canal and its Distys. off-taking in between Ls 89.41 Km and 115.7 Km of PMC ( Agreement Value:Rs.35.10 million; Date of Award / Start: March 02, 2009: Tendered Completion Period: 18 months)”.
4. **Package No. 5** “Rehabilitation of left out reaches in Distys. of Udumalpet Main Canal between reaches from LS 0.000 Km to 17.4000 Km( Agreement Value: Rs.26.55 million; Date of Award: February 28, 2009; Tendered Completion Period: 18 months; Progress( physical) 35 % )”.
5. **Package No.11** “ Rehabilitation of left out reaches in Poolankinor Branch Canal at LS 8.750 and Gomanglam Disty. At LS 21.120 Km of PMC (Agreement Value: 48.90 million; Date of Award: February 28, 2009; Tendered Completion Period: 17 months)”.

**Mission Observations / Comments and Suggestions.**

**Mission Observations** The activities relating to the preparation of sub grade and placement of cast-in-situ cement concrete lining in the channels were observed to be in progress in Package No. 22, Package No.18, and Package No.5. In respect of the sub grade preparation, manual compaction of the bed and sides of channels is done through wooden rammers; moistening of the sub grade is done by “fine spraying” of water through gardener’s cans ( as per technical specifications ) prior to placement of lining; and satisfactory workmanship( line;grade ) is being maintained during placement of lining.

In respect of the concrete lining operations involving production of concrete, placement of concrete, compaction of concrete, formation of contraction joints, and curing of concrete, it was observed that: mix design concrete mix was used; proportioning of mix ingredients was done through gauge boxes; mechanical mixers were used for production of concrete; concrete was placed on moistened sub grade in alternate panels of 3.0 m length incorporating 38 mm dia porous concrete plugs in lining; compaction of concrete was done with wooden rammers/planks and water- curing of the bed & side lining is undertaken. *Not withstanding encouraging implementation over all, some deficiencies observed in the concrete lining operations comprised:*

- Concrete Mix as discharged and placed on the sub grade was associated with significant “honey-combing”. The mix was observed to be not adequately cohesive.
- 3 mm thick plaster was being applied over the honey-combed surface/total lining surface for covering honey-combing, which is not a desirable feature.
- Contraction Joints of proper shape & dimensions, conforming to the technical specifications, were not being formed in the lining.
- Provision of porous concrete plugs ( as under-drainage arrangements ) was not in conformity with technical specifications.
- Manual compaction of lining concrete through wooden rammers/planks was not adequate to provide the needed consolidation to ensure uniform & dense concrete lining.
- Where as ponding of water on the bed provided fool-proof water-curing of bed lining, the side lining was cured by the Contractor’s personnel by manual spraying of water during day time and no curing arrangement existed for curing of side lining during night.

**Mission Observations on Construction Equipment Deployment by Contractors.** The mission observed that the respective Contractors had not fully mobilized and deployed the major construction equipment, as had been agreed to be deployed by them, as per Section 1, Clause 4.5 B (a) of the Contract Document. *Both the construction speed as well as construction quality can be substantially enhanced in case the agreed construction equipment is deployed by the Contractors.*

**Quality Control Tests on Concrete Lining.** *The mission noted that no quality control tests had been taken on the cast-in-situ lining placed and cured for 28 days so far. Casting of only concrete cubes from the concrete mix as delivered by the Concrete Mixer and determining their 28-day compressive strength is not a true indication of the quality of concrete lining as actually placed on the sub grade, actually compacted, and cured . As per Technical Specifications, incorporated in Section 5 of the Contract Document, cores from the lining have to be arranged to be taken by the Engineer- in- Charge to ascertain segregation/ honey combing in lining, thickness of lining, and the compressive strength of concrete to qualify for its acceptance as per Section 16.3 of Indian Standard 456:2000.*

**Mission Suggestions for Improvements in Cement Concrete Lining Operations**

*The following job-specific suggestions are outlined for meticulous implementation by the Contractors and Engineers in order to achieve long-term durability and sustainability of the cement concrete lining:*

- Fuel-operated/ Power-operated “Plate Vibratory Device” / “ Earth Rammer” should be deployed for compaction of sub grade instead of using wooden hammer/ wooden planks to achieve dense sub grade.
- The sub grade, besides being dense, is required to be smooth and free from surface irregularities, viz free from protrusions and depressions. Accordingly, this aspect should be strictly checked by a wooden template and any irregularities be rectified prior to placement of lining.
- Moistening of the sub grade ( through only fine spray of water by deployment of gardener’s cans ) be strictly enforced.
- The concrete mix produced by the Mechanical Mixers should be a cohesive mix. This can be achieved by using “graded aggregates”.
- Air-Entraining Agent( AEA ) should be used in the concrete mix of lining from consideration of “workability” and “durability” of concrete. Use of AEA is incorporated in the Technical Specifications of the Contract Document.
- Placement of concrete lining should be made continuous ( instead of the present practice of placement in alternate panels ) through deployment of 2 or more mechanical concrete mixers instead of the existing practice of using only one small mixer This shall not only expedite progress but shall also enable easy formation of simple contraction joints through “wooden templates” concurrently with the placement of lining. Presently, with the existing practice of lining placement in alternate panels, the contraction joints being provided do not at all confirm to the technical specifications and, thus, do not serve the intended purpose.
- Ensure making “contraction joints” of proper shape and dimensions indicated in the Sketch enclosed in Attachment. It shall be desirable to space these joints at a distance of not more than 36 times thickness of lining.
- Transverse contraction joints are to be provided throughout across the canal section at the above mentioned spacing. However, longitudinal contraction joints are to be provided on the slopes in case the slope length exceeds 4 m.
- Proper compaction of the sub grade and the concrete being key to the durability of lining, it should be accomplished through deployment of fuel-operated/ power –operated plate vibrator. This simple device comprises clamping of a needle vibrator on to a steel plate. This device is illustrated in the coloured Photo Copy enclosed in Attachment. *This can be very effectively deployed for compaction of both the sub grade as well as the concrete lining.*
- The existing under-drainage arrangement of lining through provision of 38 mm diameter porous concrete without any graded filter at the end does not confirm to the Technical Specifications incorporated in the Contract Document both in terms of the diameter and the graded filter. It is better to cast at least 75 mm dia porous concrete plugs( in 1:4 cement-coarse aggregate ratio with minimum water and without any sand ) and be used with graded filter at their ends.
- It should be made mandatory for the Contractors to arrange adequate “hessian cloth rolls” which should be placed on the side lining, duly saturated with water, to ensure curing of the side lining during night through slow evaporation.
- Quality control tests on concrete lining, placed and cured for at least 28 days, through random coring, must be introduced to fulfill the requirements of Technical Specifications incorporated in the Contract Document. All Contractors

should be apprised of these quality control requirements and be told that the acceptance of lining would be governed by its fulfillment of the “acceptance criteria” as per Indian Standard IS 456:2000.

- Plastering of lining to conceal honey-combing should be discouraged/rather stopped.

All the above points were explained in detail by the mission to the team of concerned engineers in a technical session organized on April 10, 2009 at Pollachi IB, duly participated by the Chief Engineer and the concerned field engineers as well as by the MDPU engineer and the representative engineer of EIC, Chennai. Quality Control testing procedure by “coring” was also explained through an illustrative example, which is again outlined in the Attachment for understanding and perusal by all concerned. The principal objective of listing all these points is to effect improvements in construction procedures, wherever warranted, and fulfill the requisite technical specifications & quality control requirements specified in the technical specifications to ensure long-term durability and sustainability of canal rehabilitation works.

**Package No.9.** Water was running in PMC at the time of mission visit. However, the transverse contraction joints provided in the lining were observed to be not in conformity with the technical specifications in terms of shape and dimensions. Provision of proper contraction joints is vital to the durability of lining.

It should be ensured that, upon resumption of lining work during the next closure period, proper contraction joints ( as indicated in the Sketch enclosed in Attachment ) are provided. Also, all points listed above ( for Packages 22;16; 5 ) should be meticulously implemented.

#### **Package No.11 Mission Observations & Suggestions.**

This Package envisages placement of pre-cast M15 grade cement concrete lining. The mission inspected the casting of pre-cast slabs in the central casting yard. It was satisfying to observe that mechanical concrete mixer had been deployed for production of concrete mix and that “vibrating table” was being used for vibration/compaction of concrete mix cast in the steel moulds. However, improvement is needed in the production of cohesive mix. Accordingly, it is suggested that graded aggregates be used and AEA ( air-entraining agent ) must be added in the concrete mix for better workability & finish of concrete as well as for enhanced durability of concrete.

The mission was apprised that that the Poolankinor proposed to be lined in 4 Km reach passed through swelling black cotton soil ( BC soil ). In this context, the sub grade shall need proper CNS treatment prior to placement of pre-cast slab lining. Following suggestions are outlined for advance planning of the needed pre-requisites :

- Representative soil samples from the 4 Km reach ( proposed to be lined ) be taken and got tested for the swelling pressures both from the project laboratory as well as from the reputed polytechnic/engineering college testing laboratory. 2 samples from every 500 m reach would be adequate.
- Based on the swelling pressures, the thickness of CNS soil to be provided on the sub grade should be determined from the Table given in Indian Standard , IS 9451:1994.
- Action should be initiated to identify the “borrow areas” for getting the needed quantity of CNS soil. Suitability of CNS soil (as per IS 9451:1994) from the identified borrow areas should be ascertained through laboratory testing.

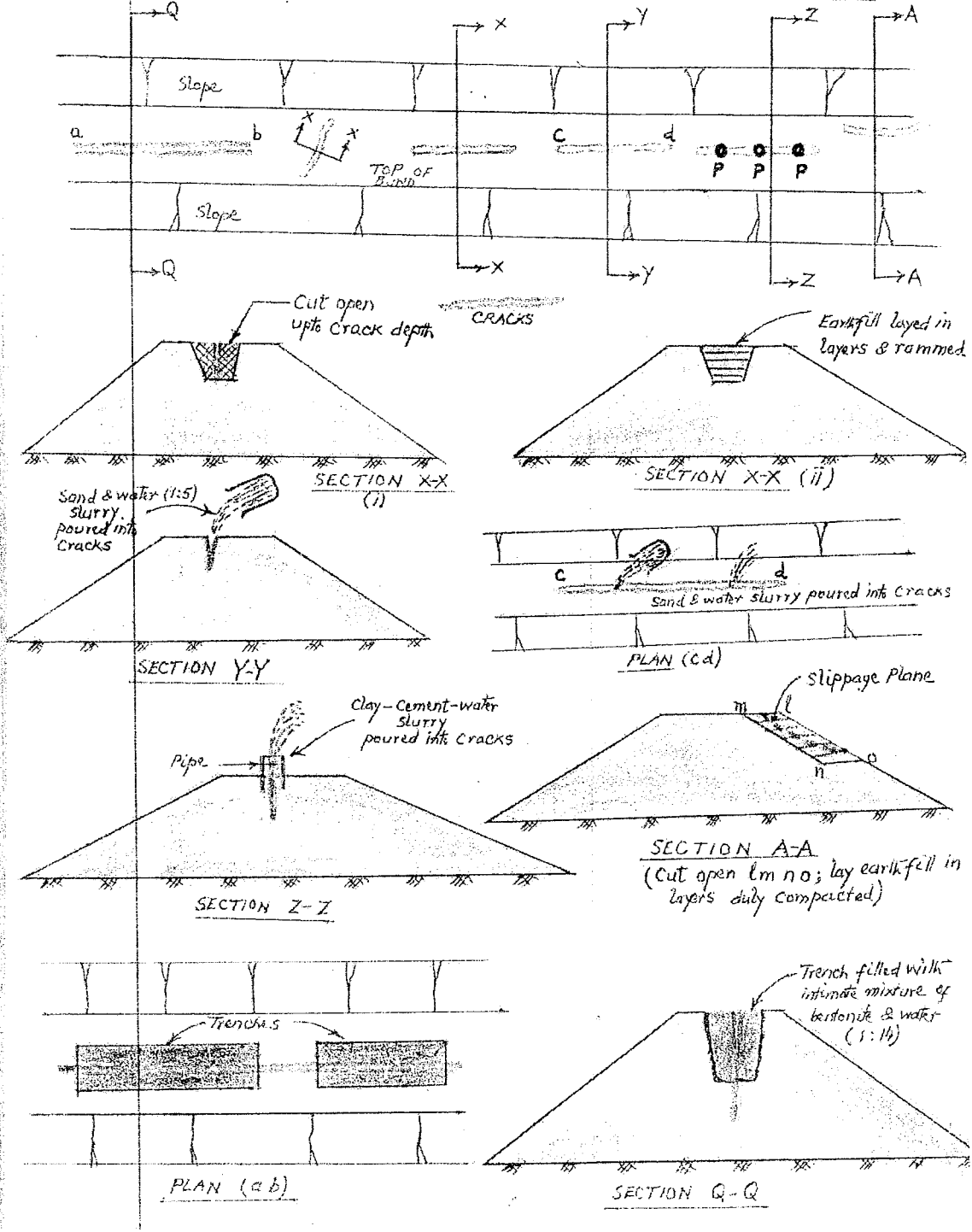
## Annex II

### ATTACHMENT

1. **Treatment of Cracks in Earthen Embankments of Tanks.**  
( Illustrative Sketch )
2. **Contraction Joints in Cast-in-Situ Cement Concrete Lining.**  
( Dimensioned Sketch of Contraction Joint Groove )
3. **Photo Copy of Fuel-Operated Plate Vibrator Device.**  
( for compaction of sub grade & consolidation of concrete lining )

R.K.Malhotra  
April, 2009

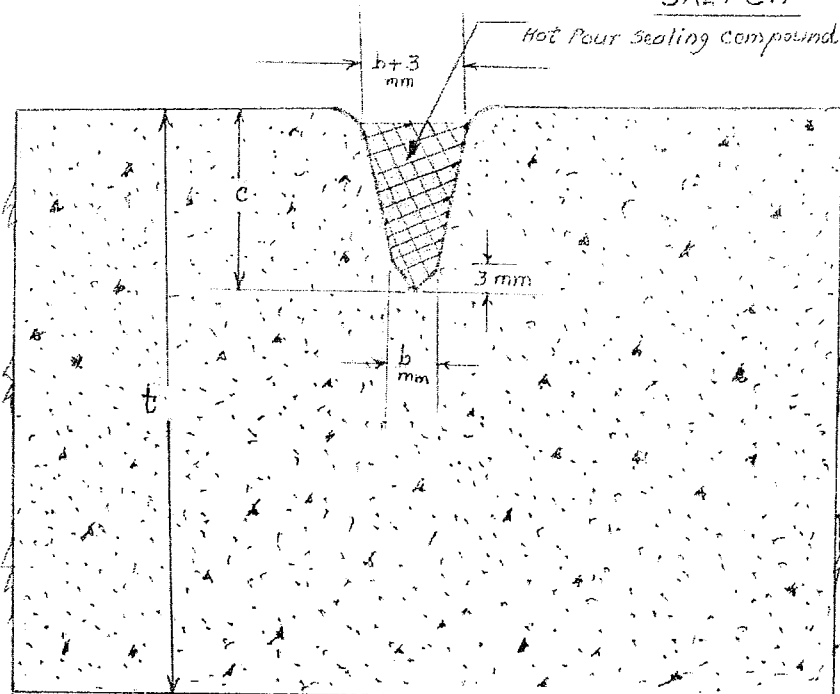
TREATMENT of CRACKS in Earthen Embankments of TANKS





CONTRACTION JOINTS GROOVES

SKETCH



$t$  : thickness of Cast-in-situ cement concrete lining

$t$	$b$	$c$
65-70 mm	9 mm	27 mm
75-100 mm	11 mm	33 mm
More than 100 mm	11 mm	$t/3$ mm

Note :  $c$  should not be more than  $t/2$  ;  
 $c$  should be minimum  $t/3$  .

**DEVICE FOR CONSOLIDATION OF SUBGRADE AND CONCRETE**



**1. DIESEL OPERATED NEEDLE VIBRATOR**



**2. NEEDLE VIBRATOR CLAMPED ON STEEL PLATE**

### Annex III

#### WRO - Preliminary Review of Third Phase Sub Basin Plans on Engineering Aspects -

The following Sub Basin Plans furnished to the Mission were broadly reviewed with the concerned field Executive Engineers and their team of Engineers on April 6 and April 8, 2009.

Mr. S. Rajagopalan,

Mr. R. Venkatasubramanian and Mr. K. Venkateswarlu of MDPU also Participated in the review and discussions:

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#### Chennai Region:

1. Pambanar Varattar Sub Basin
  2. Thuringalar Sub Basin
  3. Gomukhinadhi Sub Basin
- 

#### Madurai Region:

4. Kanal Odai Sub Basin
  5. Uthirakosamangai Sub Basin
  6. Palar Sub Basin
  7. Lower Gundar Sub Basin
  8. Deviar Sub Basin
  9. Hanumanadhi (Nambiyar) Sub Basin
  10. Salikulamer Sub Basin
- 

#### OBSERVATIONS

The restoration / rehabilitation works proposed to be undertaken in these 10 Sub Basins have been duly identified by the respective Executive Engineers. These comprise: raising & strengthening of earthen tank bunds through additional earthfill placement, duly compacted to specified density through power rollers and fulfilling the free-board requirement;; repairs to sluice structures, re-construction of damaged sluices associated with leakages; repairs to the anicut structures; repairs to the body walls of sluices associated with leakages through concrete skin wall treatment; repairs to weirs; reconstruction of severely damaged weirs; de-silting and re-sectioning / strengthening of supply channels to the designed sections; provision of bed bars / model sections / profile walls in supply channels at specified intervals;

construction of concrete dividing dam / dams for proper regulation of water; re-setting of settled rip-rap on upstream slope of tank bunds; provision of measuring devices (cut-throat flume) in the irrigation infrastructure.

The specific identification of the above listed works in the proposed rehabilitation of the respective Sub Basins is considered to be a positive step towards the process of cost estimation.

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#### COMMENTS & SUGGESTIONS.

- (a) Raising & strengthening of Tank Bunds: With the exception of Hanumanadhi Sub Basin Plan tanks, the requirement of additional quantity of earthfill needed to bring the tank sections (of a large number of tanks) to the designed profiles in the respective sub-basins has been based on the cross sections actually taken on only few representative tanks only. The earthfill quantity per metre length of the tank, so calculated, has been taken to determine the quantity of earthfill needed for raising / strengthening of the balance tanks in the respective sub basins. As for example: (i) cross sections on 3 tanks were taken out of the 50 tanks proposed to be strengthened in Deviar Sub Basin; (ii) cost estimates of 44 tanks proposed to be strengthened are based on the sections

observed in 2 tanks in Kanal Odai Sub Basin (iii) Sections taken on 4 tanks for determining the earthfill requirements (and the cost there-of) for 109 tanks proposed to be rehabilitated in Uthirakosamangai Sub Basin (iv) sections taken on 1 tank to determine (on pro-rata basis) the earth fill needed on 68 tanks in Gomukhinadhi Sub Basin; (v) sections taken on 4 tanks to determine the earthfill requirement for restoration of 44 tanks to the designed sections in Lower Gundar Sub Basin; and so on for the other Sub Basins as well.

- (b) **Supply Channels:**The earth work quantity in respect of de-silting & re-sectioning of a large network of supply channels in the respective Sub Basins has also been calculated based on pro-rata basis through actual observation of cross sections in few representative channels on the pattern of tank bunds outlined above.
- (c) **Repairs to Anicut Body Walls through Concrete Skin Wall Treatment:** 43 Anicuts have been proposed to be repaired through provision of concrete skin wall. The body walls are of different heights. However, the cost for the provision of skin wall against the body wall of only one Anicut (of 1.30 m height) has been worked out and this cost has been applied on pro-rata basis on the balance 42 anicuts for working out the total cost. Similar is the case in some of the other Sub Basins.
- (d) **Re-Construction of Irrigation Sluices:**A very large number of irrigation sluices have been proposed to be re-constructed, being reportedly damaged and associated with leakages:

<b>Sub Basin</b>	<b>No. of Irrigation Sluices proposed for reconstruction</b>
Gomukhinadhi	50
Uthirakosamangai	252
Palar	50
Lower Gundar	62
Kanal Odai	56
Deviar	27
Hanumanadhi	27
Thurinjar	9

- Here also, the cost estimate has been actually worked out in only few sluices in the respective Sub Basins and then applied on pro-rata basis on the other sluices for working out the total costs.

## **SUGGESTIONS**

The respective cost estimates of the above important rehabilitation items, worked out on pro-rata basis, are, thus, tentative and approximate / ad-hoc and may serve the purpose of “broad estimation” of costs only.

It shall however, be essential to work out the actual costs of these items by the respective Executive Engineers for requisite incorporation in the B.O.Q and the Bid Documents, and, thereafter furnishing the same to the Bank for final review and clearance.

## **Other COMMENTS & SUGGESTIONS**

Based on the Mission review of the respective Sub Basin plans, following comments & suggestions are offered:

- M20 grade concrete (1:1.5:3) should be adopted for all reinforced concrete works instead of M15 grade concrete (1:2:4). This is as per Indian Standard IS 456 : 2000.
- For all earthen tank bunds of up to 5.0 m height, both the water side and rear side slopes should be 2(H):1 (V). This is as per Indian Standard IS 12169 : 1987. An exception may be where the existing rip rap (viz stone revetment) on the water side is intact and no strengthening is needed on this slope.
- Re-construction of Irrigation Sluices. The April 21-25, 2008 Guidelines stipulated cutting the embankment to 4(H):1(V) slope on either side of the sluice. However, some Executive Engineers have adopted a slope of 3(H) : 1 (V). It is again re-iterated to adopt 4(H) : 1 (V) slope.  
Also, provision of NP3 Hume Pipe (as the sluice barrel) be considered as against the construction of concrete barrel from consideration of overall quality, speed, and ease of construction.  
This may be critically examined. Also, the barrel size be standardized to 0.9 m height for ease of post construction maintenance.
- Tanks reportedly associated with frequent breaches:  
The Mission was apprised that 12 tank bunds in the Lower Gundar Sub Basin, proposed to be rehabilitated, are associated with swelling black cotton soils (BC soils) and that breaches occurred frequently in the vulnerable reaches of these tanks. Likewise, 5 tank bunds in the Salikulamer Sub Basin, in BC soils, reportedly experienced frequent breaching. The Executive Engineers of the respective Sub Basins have proposed provision of concrete retaining walls in the “vulnerable reaches” for minimizing the occurrence of breaches. This does’nt seem to be a permanent solution.  
**Following suggestions are made:**
  - (i) Swelling pressures of representative soil samples from these tank bunds be got determined from the Project Central Laboratory and intimated to the Superintending Engineer, Designs.
  - (ii) Superintending Engineer (Designs) / CE, DRCS should be approached to visit the sites of these tanks, and based on the “Swelling pressure” results formulate permanent remedial measures.
  - (iii) The cost estimate should, then, be determined based on the remedial measures formulated by CE, DRCS. (The mission also discussed this with SE Designs and broadly outlined the possible remedial measures.) These would, however need to be confirmed by SE, Designs.
- Reconstruction of Weirs: Good quality dimensioned drawings, approved by CE, Planning should be included while submitting the Bid Documents / BOQ for clearance by the Bank.
- Measuring Devices: The cost of proposed measuring devices (like concrete cut-throat flumes) should be specifically included in the B.O.Q / Cost Estimate instead of making ad-hoc provision.
- Repairs to Body Walls of Anicuts through Concrete Skin Wall Treatment: Proper & dimensioned sketches should be included in the B.O.Q / Cost Estimate, with due provision of grouted anchors (of lengths depending upon the thickness of body wall) for achieving effective bond between the skin wall concrete and the masonry body wall of the anicuts proposed to be repaired. The mission review indicated that the April 21-25, 2008 Guidelines were not strictly followed by some new EE’s of the Sub Basins.

*Based on the above inputs / suggestions, the final Cost Estimates and B.O.Q. along with the packaging plans be prepared by the Executive Engineers of the respective Sub Basins and furnished to the Bank for final review and clearance.*

R.K. Malhotra

## Annex IV

### TAMIL NADU IRRIGATED AGRICULTURE MODERNIZATION AND WATER-BODIES RESTORATION AND MANAGEMENT PROJECT

#### Component B: Agricultural Intensification and Diversification

#### COMMON ISSUES

Monitoring and Evaluation. The project has some very specific goals that need to be achieved for the full benefit of the project to be realized. While it is essential that the M and E consultancy is executed as soon as possible the AD, DOH and TNAU have obligations for collection of data and the frequency and type of collection is detailed in Annex 3 of the PAD. Further to this specific assumptions have been used for the Economic and Financial Analysis (PAD Annex 9) as listed below in Figure 1. Project staff need to review is table and ensure that annual achievements are heading toward these targets at the close of the project.

The field level staff have been cited by the farmers as being a major reason for their decisions to take up the new technology through their persistence and assistance through the cropping period. The efforts of these staff were appreciated by the mission.

It would be a useful tool for each of the implementing agencies to produce gross margins to compare the financial costs and benefits of the technologies the project is promoting over farmers traditional practices. It would also be a useful exercise to compare the return from each crop per unit of water.

**Figure 1. Assumptions used for the Economic and Financial Analysis (PAD Annex 9).**

<b>Project Impacts</b>	<b>Unit</b>	<b>All Project Sub-Basins</b>
<b>Agriculture Intensification</b>		
<i>Increased cropping intensity</i>	%	17%
<i>Increased crop area</i>		
Paddy (SRI)	ha	66500
Coconut/Sugarcane/Fruits (Drip with fertigation)		52500
Vegetables/groundnut (Micro irrigation)		51250
<b>Agriculture Diversification</b>		
<i>Increased crop area</i>		
Maize	ha	28400
Oilseeds		29000
Fruits and Vegetables		12000
Sugarcane		10800
<b>Increased Crop Productivity</b>		
Paddy/Cotton/Sugarcane	%	30%
Maize	%	100%
Coconut	%	40%
Groundnut	%	50%
<b>Increased Income</b>		
Directly benefiting farm households	Number	677650
Increased Rural Farm employment	Jobs/year	49750
Incremental farm income	Rs/year	12700
Farm households to go above poverty line	Number	55550

## **AGRICULTURE DEPARTMENT**

To date DoA reports that it has achieved over 91% of the financial budgets to date, however this represents a large under spending as overall approximately 8% of the cost estimate has been realised. Project management have identified this and have taken remedial steps, namely increasing the density of demonstrations for SRI and pulses.

Considerable progress has been achieved in reaching targets for demonstrations and impact areas. 5 675 ha of SRI demonstrations have been conducted and nearly 31 000 ha of impact area has adopted the technology, this represents a considerable achievement. In maize 6 571 ha of demonstration and 32 992 ha of impact, pulses 4 859 ha of demonstration and 16 711 ha of impact and for other crops 2 293 ha of demonstration and 12 147 ha of impact area. This amounts to 19 938 ha of demonstrations and 82 945 ha of impact area covered by the department.

### **Observations**

The Department of Agriculture has had a focus on reaching its area targets for demonstrations and impact areas, and would appear that in general are able to meet these targets. There is some slippage of impact areas into the subsequent year, however this is expected as impact farmers are likely to want to observe the results of the demonstration before they commit.

The packages that have been delivered to farmers have concentrated on the inputs provided by the project. The project now needs to ensure that the farmers are given the appropriate training so that they are able to ideally continue to increase productivity. Capacity building is required in the following areas, irrigation management, integrated pest management and integrated nutrient management. It was observed that farmers were very much reliant on field level staff for assistance with insect control and nutrient management. Farmers can be given some very simple training, particularly in insect identification and economic thresholds, that would reduce the reliance on Department staff, who cannot serve all farmers.

The concept of the farmers field school (FFS) has been very successful in other Indian states and other countries. The DoA should investigate if there is a possibility to dovetail with Agriculture Technology Management Agency (ATMA) FFS. If not there would be considerable scope to introduce some FFS, particularly as a tool to scale up the activities in impact areas. A FFS could be focussed on the demonstration farmer while the impact farmers would become members. Further ATMA is reported to have compiled Strategic Research and Extension Plans (SREP) for each district, and these should be reviewed while compiling Phase 3 sub-basin plans.

In the previous mission it was noted that some farmers were forming SRI interest groups, this initiative could be replicated and scaled up under the IEC activities to promote the project in new basins.

While target impact areas for paddy and maize are being realized, the targets for pulses and other crops are lagging. Of the 73 000 ha of target for pulses and other crops, approximately 19 000 ha has been covered. Although there is a trend toward diversification there still appears to be a large number of farmers that are mono-cropping. The benefits of rotational crops, particularly when cereal can be rotated with broadleaf crops, has many advantages, for soil health, pest and disease control, and productivity. As diversification is one of the expected incremental impacts of the project a more concerted effort needs to be given to alternative crops.

As previously mentioned DoA are realizing major savings and have initiated investigations to determine where budget could be allocated that would have considerable impact on project beneficiaries, these may include organic farming, increases to capacity building activities, and seed expansion activities. Activities that promote seed production and distribution within villages



have been shown to have excellent results, examples of this are seed exchange programs or community seed funds.

There have been requests from MDPU for distribution of inputs for SRI impact farmers. Discussions with impact farmers has revealed that they have been able to adopt the technology without subsidized support from the project, and as impact areas are being met, and the intensity of demonstrations is increasing this is not supported. The department could however explore methods to increase the adoption rates of pulses and other crops, possible through increasing the number of demonstrations.

### **HORTICULTURE DEPARTMENT**

The Department of Horticulture has covered approximately 14 600 ha with their expansion activities and reports to be on target to reach the budget target for this year. The target the Department of Horticulture has set for itself is 25% of the registered Ayacut, which amounts to over 80 000 ha for Phase 1 and Phase 2 sub-basins.

### **Observations and recommendations**

The Department of Horticulture (DoH) has achieved solid results in the field. Expansion areas are generally well managed, and, particularly in the case of new plantations, several examples were observed where farmers had gone to extra measures to ensure success.

The current expansion area covered is approximately 10% of the target DoH has set for itself for Phase 1 and Phase 2 sub-basins. Using the current rate of expenditure as a guide the Department have the potential to cover approximately 55 000 ha with the resources available, which will represent about 10% of the estimated Ayacut of the overall project. To determine if 25% is a realistic target DoH need to calculate the existing area under horticulture crops, the gap area and the area that will be covered by expansion activities.

Many of the horticultural crops observed would benefit from the installation of micro-irrigation systems. While it is reported that Agricultural Engineering Department (AED) has been informed of the expansion area this has not translated into action. The DoH may need to take a more proactive stance and encourage farmers to seek out AED and at every opportunity taking AED staff on field visits.

As with the agricultural crops it was observed that farmers knowledge of irrigation management for efficiency, IPM and INM is low. DoH should coordinate with TNAU to ensure training and capacity building programs focus on these topics.

It is common practice in many countries to use mulch around the base of seedlings to reduce surface evaporation and to assist in control of weeds. It is recommended that the project promote the use of natural mulches (rice straw, etc) in new plantations, particularly where the irrigation is conducted using pots. As this is a low cost intervention and considered to be a new technology for the farmers it could be covered by the project.

The Department of Horticulture has been promoting the establishment of intercrops (with both horticultural and agricultural crops) in new plantations in some areas, this needs to be expanded and collaboration may be required with TNAU and DoA for field crops. The Department should also investigate suitable crops that can serve as mulch in older plantations. A mulch crop would be one where that majority of the crop stubble is left in the field and covers the soil surface.

It was observed in the field that the banana was an excellent choice of crop for breaking weed life cycles, and could be included into an integrated weed management program. This would be most useful where perennial weeds are a pest, particularly those such as nutgrass that have an

underground rhizome, and there is few effective control options (apart from herbicide solutions). This control should also include canals to prevent reinfestation of fields.

#### **TAMIL NADU AGRICULTURAL UNIVERSITY**

Up until the 21<sup>st</sup> Feb 2009 TNAU have incurred approximately 48% of the budgeted expenditure for the first two years of the project. The under expenditure is largely due to the delays in approval of bid documents for use in precision farming demonstrations. TNAU report that approval was granted approximately four months ago, subsequently beneficiaries have been identified for 1610 ha and estimate preparations are now underway. It is expected that significant headway will be made in the next two months. Further savings have been realized as TNAU have not been able to fill all Senior Research Fellow posts.

TNAU have conducted demonstrations on 9 661 ha and convinced more than 20 000 ha worth of impact farmers to take up these technologies. This is a considerable achievement and deserves commendation.

#### **Observations and recommendations**

TNAU are continuing to set a high standard in the field and the senior research fellows deputed to the field have had a profound impact on farmers. In conducting demonstrations and promotion of the impact areas, TNAU is covering ground that is traditionally the domain of the Line Departments, however rather than being an antagonistic relationship, it has proved to be completely opposite. The University are getting direct exposure to farmers needs and the challenges that face the Department staff in terms of extension of the Universities technologies. However the Universities role in demonstrations and impact areas should gradually decrease over the life of the project, and their role in the capacity building for the line departments should increase. This should be reflected in DPRs for Phase 3 sub-basins.

Presently TNAU are reporting financial data sub-basin wise rather than by activity. When reviewing progress it would be useful to have financial data presented by activity and it is recommended that this be prepared for the next supervision mission.

TNAU are conducting Improved Production Technology demonstrations for a variety of crops such as cotton, rice fallow pulses, sunflower and onion. While these farmers are achieving higher yields it is somewhat largely due to the intensive supervision of the SRFs. An important part of these demonstrations should be IPM and INM principals. It is not clear how much of this knowledge has been transferred to the farmers.

Many farmers are reporting to use simple methods for scheduling irrigations, mostly by observing plant conditions, early signs of moisture stress such as leaf wilt are the signal to initiate an irrigation. While some crops give a positive yield response to moisture stress, other crops suffer yield suppression. This can also change during different stages of the plants development. While it is understood that irrigation scheduling and training is the domain of the DoA it is recommended that TNAU investigate modern irrigation scheduling tools that may be applicable for mass adoption. This would require the technology to be relatively cheap, and easy to use. A good place to start would be the review of "Soil Water Monitoring an Information Package", 2005, 2nd edition, by *P. Charlesworth* CSIRO/CRC Irrigation Futures (which can be downloaded from the internet). Of particular interest may be the "Full Stop", which would be very useful for scheduling irrigations in tree crops with drip.

The demonstration of Rice Fallow Pulses is an excellent example of conservation agriculture and water saving technology. In other parts of the world conservation agriculture has solved many of the same problems farmers in Tamil Nadu face, water shortages, reduction in available labour,

increase in cost of inputs and declining soil quality. TNAU report that previous efforts in CA in Tamil Nadu have failed. It is recommended that TNAU conduct a review of the previous attempts, seek out CA experiences from other areas with similar agro-ecological conditions to determine if another attempt is warranted. It would be ideal if TNAU could investigate and develop a conservation farming package based on cropping systems for irrigated agriculture in Tamil Nadu. It is likely that one of the limiting factors is planting technology. It is recommended that TNAU develop a strategy starting with a concept note for CA, that would include a review of available planters (locally and internationally). Further it was noticed in field visits that vegetable crops and cotton planted into flat ground where hills are formed after plant establishment appear to suffer from water logging/or denitrification, these systems may also benefit from CA techniques.

Currently crop water requirements are calculated using an estimated system efficiency of approximately 50%, meaning that only 50% of the water reaches the field, if there are further inefficiencies in the application method the efficiency of use is even lower. Small increases in system efficiency will relate to more available water. To determine where gains are likely to be made a water balance would be required for the system. There are numerous software and hardware packages in circulation that would be suitable for the assessment of the efficiency of tank systems. It is suggested that TNAU write a concept note on the procedure, costs and methodology of conducting a water balance for a sample of project tanks.

One farmer reported that he was hesitant to grow SRI on salt effected lands, however for most of the same reasons that SRI performs better on normal soils should hold true for salt effected lands. It is therefore recommended that TNAU investigate the performance of SRI on salty effected soils.

## **Documents**

The following documents and information were provided over the duration of the mission:

- Sample gross margins, available from <http://www.dpi.nsw.gov.au/agriculture/farm-business/budgets>
- of "Soil Water Monitoring an Information Package", 2005, 2nd edition, by P. Charlesworth CSIRO/CRC Irrigation Futures  
<http://www.precirieg.net/documentacion/soilwater.pdf>
- Example formats for reporting of physical and financial information for each of the implementing agencies
- List of GPS coordinates of the approximate location of the sites visited.

## Annex V- AED/TNAU

### Project Strategy

Currently the project is being conceptualized at Subbasin level which is large and all the line departments are spread over with no opportunity/reason to converge. On the contrary some departments, try to stay away to avoid competition. There is need to divide sub-basin into tank units and proceed strategically so that the impact is visible and easy to monitor:

- 1 There is no topographic survey done for the tank. It means actual capacity of the tank is not available.
- 2 The strengthening of tank structures is based on old estimates (based on certain constants) of minor irrigation. The current situation has not been verified with the actual hydrology.
- 3 It is critical to understand the hydrology of the tank. Unless the water availability is known, it is difficult to plan for interventions in the command. The minor irrigation department estimates assumes certain filling pattern and accordingly assumed water availability. There is no rainfall runoff analysis done.
- 4 The current performance of a tank system is unknown. It means the required site specific interventions can not be planned. No gap in supply demand has been worked out.
- 5 Knowing the water availability and current cropping pattern, one can plan for crop diversification and hence plan for required intervention such as efficient irrigation system and marketing needs.
- 6 There is need to have DSS planning consultancy to plan required interventions for each unit.
- 7 Till then TNAU could work as coordinating cell. They could study water balance of selected tanks and develop interventions to allow all the line departments to synergize.
- 8 In absence of topographic and cadastral survey, it is difficult to plan physical interventions in the tank command.

#### 1. Low rate of Micro Irrigation System adoption

Following issues were shared by AED:

S. No.	Issue	Possible Solution
1.	Problem with diversification in paddy irrigated areas.	<p>There did not seem sufficient junior engineers to make farmers aware.</p> <p>Humid areas: Diversification will be difficult Try to modernize water conveyance system so that farmers have freedom to diversify and water savings could be available for tail command where MIS would be welcomed by the farmers.</p> <p>Semi-humid Areas: If paddy is in partial holding, Converge with the concerned line departments including marketing, horticulture, and agriculture</p>

		to diversify the agriculture.
2.	Competition with Sugarcane industry	Drop Sugarcane areas and let it be implemented by sugarcane industries.
3.	Lack of communication (with the farmers) skills in staff	Train the staff, seek help of TNAU for onsite training and update the staff with more frequently queries inquired by farmers.
4.	Farmers not ready to diversify in potential areas	Need more canvassing, aim for potential areas on larger scale and outreach the beneficiaries with the support of WUA and MIS supplier along with the value chain.  Now bids are due to be awarded to major MIS supplier/s, employ their help to canvass farmers.
5.	Competition with inexpensive low quality dripper system	Demonstrate the implication of using low quality drippers alongwith the selected supplier for that area.
6.	Different subsidy and benefits from different line agencies	Need to harmonize to avoid undue expectation of farmers, adopt strategic approach, let TNAU demonstrate the best practice for crop diversification and water management practices, Follow the introduction of new varieties through horticulture and thereby introduce water management practices.

For instance, the Poney basin seemed a potential site for diversification and adoption of MIS. The farmers were willing to adopt diversification as long as marketing was assured. Those tanks with limited water supply are great opportunity to converge horticulture, marketing and AED. A farmer with large holding of 50 acre with in same ayacut was an example of diversification to Mangoes and other horticultural crops who had connected himself to buyers of produce from Chennai. Same could be applied to group of farmers in Vellur. It can happen only by targeting a group of farmers in a tank command.

Horticulture is claiming impact areas in the range of 14600 ha. AED should coordinate and find out the potential for MIS in these areas.

## 2. Water Use Efficiency

There is a large gap in farmers knowledge of water use efficiency, farmers require capacity building in efficient irrigation practices such as matching crops with soil types, field leveling and drainage, and irrigation duration and scheduling methods.

Though drippers have been introduced to manage the water, there is a scope to improve the dripper system in fields. The farmers tend to use tap drippers with a discharge of 32 lps and use it more frequently. Particularly, in orchards, the drippers should be designed to provide uniform irrigation by spreading multiple drippers with less discharge capacity around the tree instead of having large discharge drippers irrigating at single location.

***The TNAU should demonstrate water management technique in order to achieve efficient and uniform application of water using innovative techniques and supported by onsite measurements.***

TNAU may like to consider following while planning the demonstrations:

**a. Evidence oriented field demonstration:**

The farmers need to be demonstrated water flow beneath the soil to demonstrate that they might be loosing through deep percolation with the current high pointed discharge rate of drippers. It may require to develop effective presentation material and conduct demonstrations in the field. The experiments need to be customized to provide more evidence for water savings and uniform irrigation techniques. It may require to install soil moisture sensors (if not possible in the field than in the experimental farms). Sometimes, it may require to take soil cores to demonstrate the movement of water. The farmers should be demonstrated where maximum root absorption (particularly in orchards) takes place and accordingly where to place the drippers for different crops/orchard.

**b. Drippers discharge**

During the field visits, it was observed that even in heavy soils, the discharge rate for dripper were 8 lph in Sugarcane or any other crop which I believe is very high. In the bid documents also, it was noticed but it was presumed that the actual design would be customized according to soil hydraulic properties and other parameters. It seems it requires proper canvassing to the farmers so that he does not demand for higher discharge drippers than required. It can be achieved by providing trial system only in one lateral so that he could measure/judge by himself with moisture probe or other devices.

There is scope for improvement in frequency of irrigation. The farmers like to see soil saturated which is not necessary. For instance in orchards, the soil moisture in deeper soils is more extractable and it may not require to wet upper soil.

**c. Placement of sensor for automation and measurements**

The sensors for automation should be installed considering the maximum root zone absorption and frequency of irrigation. As advised in the article (Vidhana Arachchi L. P. 1998) that the moisture stored in the 20-120 cm depth range was found to be highly extractable by the coconut tree. It means the sensors should be placed around 50 cm depth and at around 80 cm distance from the trunk of cococut. For more details refer:  
[http://www.fullstop.com.au/HTMLfilesv2/030\\_Placement/010\\_Drip/Drip.html](http://www.fullstop.com.au/HTMLfilesv2/030_Placement/010_Drip/Drip.html)

**d. Innovative techniques**

In orchards, the maximum root absorption is in subsurface. It means **subsurface drip irrigation system** would be most effective with less evaporation losses orchards.

In surface irrigated areas such as canal and tank, the **low pressure drippers** may suit. The TNAU should explore the possibility of using such systems.

### **3 Facilitation of Dripper irrigation in Canal irrigated areas in Coimbatore**

The WRO, AED and TNAU need to collaborate to prepare feasibility report for selected distributary in Coimbatore canal irrigated command. The baseline information should include current irrigation practices in the selected system such as flood irrigation or dripper irrigation through well recharge. In addition the current cropping pattern, canal schedule should be studied to understand crop water requirement and gap in supply.

While investigating options for facilitation of dripper system from canal supplies, following may be explored:

1. Use of available infra-structure in each outlet such as open well for sump.
2. Implications/economics of pumping directly from canal
3. Network of tubewells in areas
4. Use of Solar pump for shallow pumping from sump
5. Canal operation: reduced discharge with regulated structures or on/off canal schedule

The report should lead to answer following:

1. Available water from canal
2. Current crop pattern and water requirement
3. Total amount of water saving
4. Is saving enough to provide water for entire year through canal?
5. Preliminary cost estimates for different options.