



Concept Paper

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Proposed Multitranche Financing Facility India: Climate Adaptation through Sub-Basin Development Investment Program

Asian Development Bank

CURRENCY EQUIVALENTS

(as of 1 August 2012)

Currency unit – Indian rupee/s (Re/Rs)

Re1.00 = \$0.01795

\$1.00 = Rs55.71

ABBREVIATIONS

ADB	–	Asian Development Bank
GOTN	–	Government of Tamil Nadu
IWRM	–	integrated water resources management
MFF	–	multitranches financing facility
NAPCC	–	National Action Plan on Climate Change
NWM	–	National Water Mission
PPTA	–	project preparatory technical assistance
ha	–	hectare

NOTE

- (i) In this report, "\$" refers to US dollars.

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I. THE PROJECT

A. Rationale

1. Climate Adaptation through Sub-Basin Development Investment Program (the Program) aims to establish institutions and systems in the State of Tamil Nadu to help local communities adapt to climate change with advancement of integrated water resources management (IWRM) and knowledge base. The Program follows a multitranche financing facility (MFF) modality. Support will be provided to conduct surface water, groundwater and coastal modeling, improve drainage and flood control infrastructure, and support policy, legislative, and institutional changes requirement for IWRM and efficient and sustainable water use of scarce water resources.¹

2. The Program supports the implementation of Government of India's National Action Plan on Climate Change (NAPCC) of 2008 and its National Water Mission (NWM). The NWM identified five main strategies to combat possible impacts of climate change on water resources: (i) formulation of comprehensive water database in the public domain and assessment of the impact of climate change on water resource; (ii) promotion of citizen and state actions for water conservation, augmentation and preservation; (iii) focused attention to over-exploited areas; (iv) increasing water use efficiency by 20%; and (v) promotion of basin level IWRM. Under the earlier TA7417: Support for the NAPCC,² Asian Development Bank (ADB) prepared a sub-basin profile and a strategic framework for climate change adaptation in the Cauvery Delta sub-basin in the State of Tamil Nadu. The Cauvery Sub-Basin provides a good demonstration site for NWM objectives and the Government's water resources reform agenda because it represents a sub-basin where IWRM can address the complex resources issues of groundwater exploitation and salinity ingress exacerbated by climate change, and since freshwater availability is restricted, there is potential to increase water use efficiencies.

3. Tamil Nadu is one of the most water stressed states of India. It has a mean annual rainfall of about 911.60 millimeters of which 48% is through the northeast monsoon (October to December), and 32% through the southwest monsoon (June to September) and a per capita availability of water resources of only 900 cubic meters per year³. The Cauvery River Basin (CRB) is 5.8 million hectares (ha) and spans the states of Karnataka, Tamil Nadu, Kerala, and the Union Territory of Pondicherry. The outlet of the CRB is the Cauvery Delta with an area of 560,000 ha which is irrigated and drained by four main canal systems: (i) Lower Coleroon Anicut (53,000 ha), (ii) Cauvery (200,000 ha), (iii) Vennar (190,000 ha), and (iv) Grand Anicut (121,000 ha). Historically, the delta⁴ was a major agriculture production area of India having about 1.5% of the nation's cultivation area. The highly fertile soil, good rainfall, and surface water flows were well suited to rice production.

4. Currently the northeast monsoon can bring erratic but intense rains which give rise to flood and drainage problems, while there is limited surface water during the southwesterly

¹ A project preparatory technical assistance (PPTA) to prepare the Program is proposed for \$1,140,000 and is described in Appendix 4.

² ADB. 2009. *Technical Assistance to India for Support for the National Action Plan for Climate Change*. Manila. This TA (TA7417-IND) focused on three basins to assess three distinct climate change impacts/issues: (i) Sutlej, Punjab for glacial and snow-fed systems; (ii) Kshipra, Madhya Pradesh for groundwater dependent systems; and (iii) Cauvery, Tamil Nadu for coastal systems.

³ Water stress is defined as per capita water endowment of less than 1,700 cubic meters annually.

⁴ The main districts of the Cauvery Delta are Nagapattinam, Tiruvarur and Thanjavur, and have a total population of about 4.8 million. Of this, about 73% are considered rural whose main livelihoods are farming and fishing.

monsoon. There are issues of saline intrusion near the coast, and low-lying land has poor drainage. Groundwater is extensively used to supplement the lack of surface water and now there are issues of overexploitation and salinity. Climate change is expected to exacerbate these problems.

5. There is already empirical evidence for changing rainfall patterns, both spatially and temporally. Government and communities report greater intensity and shorter duration of monsoon rains and increased frequency of cyclones. Further changes in local rainfall and sea level rise are expected. While the mean annual rainfall is expected to remain unchanged, the southwest monsoon rainfall may decline by about 10% and the northeast monsoon rainfall will increase by about 10% to 20%. Sea levels are also expected to rise by about 30 centimeters by 2050.⁵ These phenomena will have significant impacts on the delta region, calling for holistic planning, management, and adaptation systems with community involvement:

- (i) **Groundwater depletion and saltwater intrusion.** During the dry season farmers rely on groundwater to supplement surface water irrigation. Increased groundwater use has resulted in saline intrusion in a coastal strip of about 20 kilometers. Attempts have been made to reduce abstraction but saline intrusion continues and will increase under conditions of sea level rise. With no significant projected change in annual rainfall, groundwater recharge will be largely unchanged. In fact groundwater demand will likely increase to compensate for the weakening of the southwest monsoon. Overextraction of groundwater will increase saline-affected areas and may also exacerbate natural ground settlement compounding the impact of rising sea levels.
- (ii) **Sea level rise and coastal changes.** Some areas of the lower delta are already below sea level and are impacted by natural beach processes that cause water logging as well as salinity problems. Keeping drainage outlets open to the sea is a continuing major challenge. The expected sea level rise will increase the overall area below sea level, increasing both saline-affected areas and flood problematic areas as drainage becomes more congested. Extreme tides and storm surges may also increase coastal flooding.
- (iii) **Flooding.** The northeast monsoon brings heavy rains and cyclones and the delta becomes fully congested with inundation resulting in damage to standing crops⁶ and land salinization. The expected increased monsoon rainfall intensity and sea level rise will exacerbate flooding with an increased number of areas affected by more frequent and longer duration floods. Transportation in the area is also severely affected because riverbank protection works also serve as community roads.⁷ Floods especially affect women by limiting their ability to trade fish and fish products.

6. The Government of Tamil Nadu (GOTN), building on the recommendations of the NAPCC and NWM, is proposing an adaptation program to address these impacts in the delta, through targeted investment in drainage improvement, flood control and irrigation structures, as

⁵ ADB. 2011. *Final Report to Technical Assistance 7417-IND: Support for the National Action Plan on Climate Change Support to the National Water Mission*. The rainfall projections are based on the HadCM3 A1B scenario downscaled with PRECIS while the projected sea level rise is based on IPCC AR4 upper projections.

⁶ In November 2010, 25,000 ha of crops were lost. Impacts include reduction in incomes of agricultural laborers, the majority of whom are female.

⁷ The Government of Tamil Nadu has proposed significant flood control and drainage works as documented in the Cauvery Delta Modernization Project (2008). The major components to be supported under the Project are: (i) strengthening of river banks, (ii) improvements to the drainage channels and their network, and (iii) rehabilitation and provision of new tail end regulators.

well as through institutional and policy development and capacity building for IWRM to enhance climate resilience of the water resource system and communities. Improved projections of climate and sea level, based on the latest climate science, will be developed and applied to the design of the infrastructure.⁸ Appropriate indicators for monitoring progress and effectiveness of adaptation measures will be designed into the Program.

7. Also in support of NWM objectives, the GOTN seeks to establish IWRM in the Cauvery sub-basin and maximize the value of water use and improve allocation decisions both within and between sectors. To support this initiative and to help address the inter-temporal variability of water availability within the sub-basin expected from climate change and depletion of groundwater reserves, a holistic IWRM plan for the sub-basin is required. It must address conjunctive use of the combined surface and groundwater systems in order to optimize resource use and minimize adverse effects of relying on a single source. Conjunctive management requires capacity building of institutions in IWRM.

8. Under this Program, the GOTN seeks to proceed with the implementation of the recommendations defined under TA7417. The Program is fully in line with ADB's country strategy for India,⁹ Strategy 2020, Water for All Policy, and Water Operational Plan 2011-2020. The MFF modality is preferred because: (i) the sub-basin must be studied systematically to address surface water, groundwater, and coastal processes holistically but with phased implementation across the four canal systems sequentially; and (ii) a higher quality Program deliverables can be expected by committing new tranches based on the performance and lessons of the previous and ongoing tranches. The Program adheres to the MFF constituents appropriate for concept clearance.¹⁰ Then a policy framework and roadmap for the Program will be prepared under the project preparatory technical assistance (PPTA) building on the existing framework¹¹ and the State's willingness for advancement.

B. Impact, Outcome, and Outputs

9. The Program's impact will be improved resilience to climate change by communities in the Cauvery delta, with gender sensitive features. Its outcome will be improved IWRM in the Cauvery delta. The outputs will be: (i) integrated programs and infrastructure for management of groundwater, surface water and salinity are implemented; (ii) policies, systems, and institutions for IWRM are strengthened; (iii) sustainable agricultural systems to support higher water-use efficiency, productivity and incomes of male and female farmers are implemented;¹² and (iv) efficient multi-disciplinary program management system is established.

10. Project 1 will modernize the surface water, groundwater and coastal drainage system in the Vennar system of the delta. Subsequent tranches will extend to other areas of the sub-basin.

⁸ This will be achieved through additional analyses, using data from the latest simulations performed with general circulation models and regional climate models, as well as from other downscaling procedures, and credible scenario analysis methods and tools.

⁹ ADB's agricultural and natural resources sector strategy has been in place since 2003 and covers the following key areas: (i) agribusiness infrastructure development; (ii) modernizing irrigation systems; (iii) advising and piloting new approaches in water sector planning and reforms, especially in light of climate change; (iv) holistic flood and erosion risk management; and (v) sustainable coastal protection and management.

¹⁰ See Supplementary Appendix 1 for justification of use of the MFF modality.

¹¹ See Supplementary Appendix 2 for a summary of GOTN's policy framework.

¹² See Supplementary Appendix 3 for the preliminary scope of Program investments.

C. Investment and Financing Plans

11. The envisaged costs and financing plans of the Program and its Project 1 are shown in Table 1, which will be further developed under the PPTA. ADB will finance part of the Program and Project 1 cost from its Ordinary Capital Resources.

Table 1: Tentative Financing Plan

Source	MFF Program		Project 1	
	Amount (\$ million)	Percent of Total	Amount (\$ million)	Percent of Total
Asian Development Bank	210	70	100	80
Government	90	30	25	20
Total	300	100	125	100

MFF = multitranche financing facility.

Source: Asian Development Bank estimates.

D. Indicative Implementation Arrangements

12. The Water Resources Organization of the Public Works Department (PWD), GOTN, is the Program's executing agency (EA). A Program Management Unit will be established in the EA. Collaborating departments and institutions include the Departments of Agriculture, Fisheries, and Environment, state disaster management authority, and offices of the district collectors. A Program Steering Committee (PSC) will also be established to review Program progress at least every 6 months and provide strategic direction and guidance on policy matters. The PSC will be chaired by the Chief Secretary and comprise the Secretaries to Government of Departments of Planning, Agriculture, Fisheries, and Environment, with the Secretary of PWD as the Member Secretary. A smaller subset of this committee will be constituted as an empowered committee with government approval to expedite decisions on all procurements and administrative aspects of the Program and subprojects. Other important stakeholders will be non-governmental organizations and civil society organizations, and irrigation (i.e, WUAs) and water supply users groups. Participation of the private sector will be sought, especially in promoting water saving technologies.

II. TECHNICAL ASSISTANCE

13. The need for capacity development in IWRM at the sub-basin level will be assessed during PPTA implementation, and whether additional TA is needed to supplement Program resources.

III. DUE DILIGENCE REQUIRED

14. The Program preparation will require the following due diligence assessments, which will be undertaken:

- (i) **Technical, Economic and Financial.** Project 1 subprojects will be assessed in technical, economic and financial feasibility, including long-term sustainability with operation and maintenance cost recovery, and viability of any new technological options.
- (ii) **Governance.** Analysis will cover generic (financial management, anti-corruption, and procurement) and sector agendas (policy framework, investment plans, and institutional setup and capacities) and undertakings to meet MFF requirements.
- (iii) **Implementation Arrangements.** Given past experience in the sector, strict attention will be given to readiness for implementation.
- (iv) **Poverty and Social.** Assessments will cover appropriate strategy to enhance poverty reduction and social development impacts, and a gender action plan to mainstream gender elements in line with the State's priorities and actions.

- (v) **Safeguards.** Resettlement analysis will include impact and scope of relocation of embankment squatters and other land acquisition, and preparation of budget and framework for the Program and resettlement plan for Project 1. An environmental assessment and review framework will be prepared. For Project 1, three initial environmental examinations will be prepared, each covering sub-projects in the participating districts.

IV. PROCESSING PLAN

A. Risk Categorization

15. The Program is financially small and is anticipated to have safeguard categorizations other than A, and the state executing agency has reasonable capacity as demonstrated by their implementation of a World Bank-funded project.¹³ However, IWRM projects in India are new, their implementation may be expected to be more complex, and the state has yet to prepare and implement an IWRM plan for the sub-basin. The Program therefore may be categorized as *complex*.

B. Resource Requirements

16. Four ADB staff will be involved in project preparation for a total of 12 person-months (indicative). The proposed PPTA requires 21.5 person-months of international consultants and 48 person-months of national consultants (see Appendix 4).

C. Processing Schedule

17. Major milestones up to loan effectiveness are listed below:

Table 2: Proposed Processing Schedule

Milestones	Expected Completion Date
Concept Paper Clearance	Sep 2012
PPTA Implementation	Jun 2014
Loan Fact-Finding Mission	Jan 2014
Management Review Meeting	Feb 2014
Loan Negotiations	Apr 2014
Board Consideration	Jun 2014
Loan Effectiveness	Sep 2014

PPTA = project preparatory technical assistance
Source: Asian Development Bank estimates.

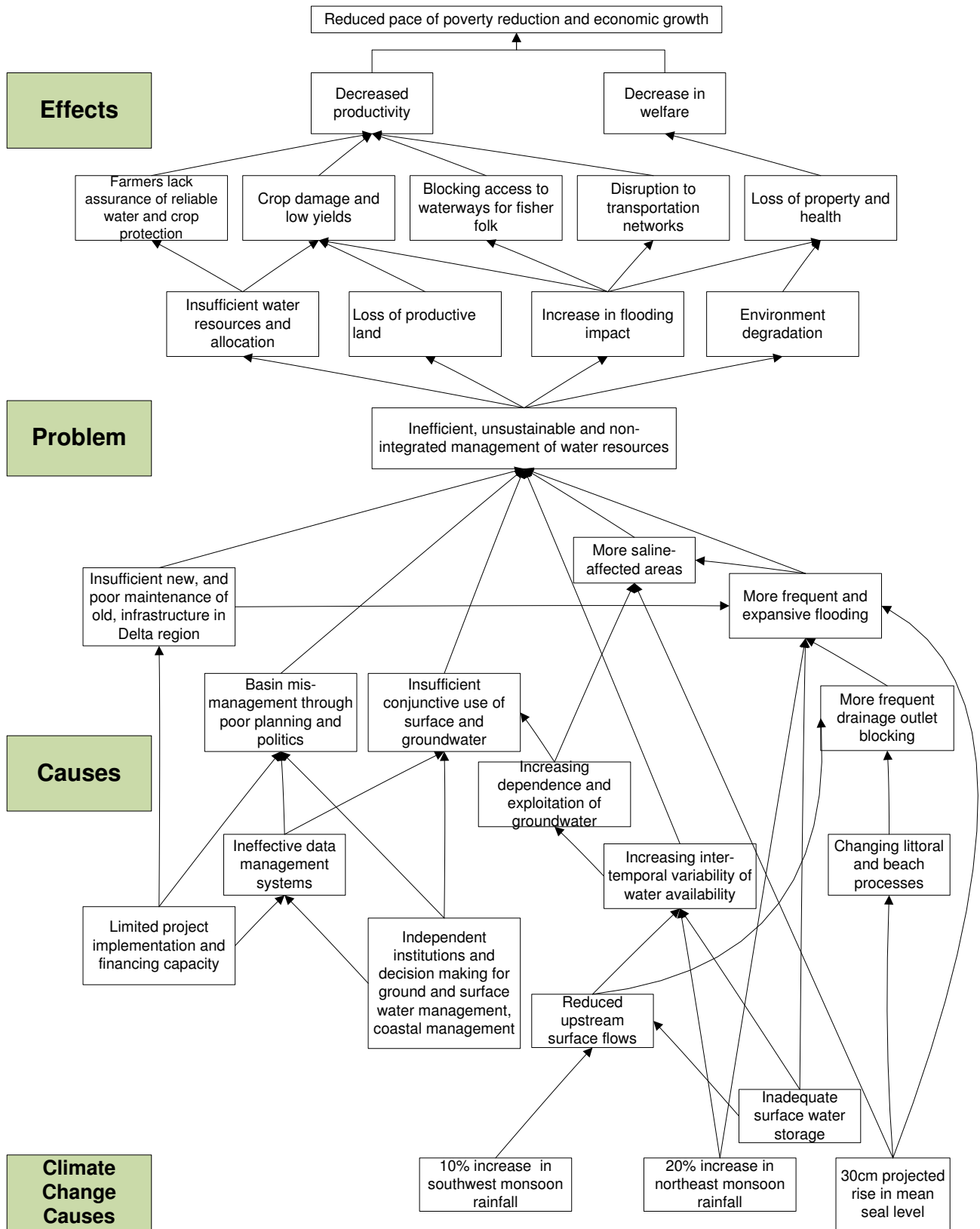
¹³ World Bank. 2006. *Project Appraisal Document on a Proposed Loan and Proposed Credit to India for a Tamil Nadu Irrigated Agriculture Modernization and Water-Bodies Restoration and Management Project*.

BASIC PROJECT INFORMATION

Aspects	Arrangements
Modality	Multitranche Financing Facility (with appraised subprojects in individual tranches and a list of candidate schemes meeting the set technical, economic, financial, and social and environmental safeguards criteria)
Financing	ADB financing will be based on investment plans for holistic water resources management, to be confirmed during the PPTA stage. Envisaged ADB financing from its Ordinary Capital resources is \$210 million for the entire MFF program and \$125 million for Project 1.
COBP/RCOBP Classification	<p>ADB. 2011. Country Operations Business Plan: India (2012-2014) Sector (subsectors): agriculture and natural resources (irrigation, drainage and flood protection, water-based natural resources management, land-based natural resources management)</p> <p>Themes (subthemes): Environmental sustainability (natural resources conservation), economic growth (widening access to markets and economic opportunities), capacity development (institutional development), and social development (disaster risk management)</p> <p><i>Climate change: adaptation</i></p> <p>Targeting classification: Targeted intervention: geographic dimension of inclusive growth (TI-G)</p> <p>Gender mainstreaming category for Project 1: Effective gender mainstreaming</p> <p>Location impact: Rural (high)</p> <p>Safeguards for Project 1: Environment - B, Involuntary Resettlement - B, Indigenous Peoples - C</p>
Risk categorization	Complex
Partnership(s)	To be determined during PPTA implementation
Use of a PBA	Yes
Parallel PIU	No
Department and division	South Asia Department/Environment, Natural Resources, and Agriculture Division (SARD/SAER)
Mission leader and members	Cindy Malvicini, Senior Water Resources Specialist, SAER/Mission Leader Nishanthi Manjula Amerasinghe, Environment Specialist, SAER Shanny Campbell, Social Development Specialist, SAER Arnaud Cauchois, Senior Water Resources Specialist, SAER Harish Kumar Varma, Senior Project Officer (Natural Resources and Agriculture), INRM

ADB = Asian Development Bank, COBP = country operations business plan, INRM = India Resident Mission, PBA = programmatic based approach, PIU = project implementation unit, PPTA = project preparatory technical assistance, RCOBP = regional cooperation operations business plan. Department

PROBLEM TREE



**PRELIMINARY DESIGN AND MONITORING FRAMEWORK
FOR THE INVESTMENT PROGRAM**

Design Summary	Performance Targets and Indicators with Baselines	Data Sources and Reporting Mechanisms	Assumptions and Risks
<p>Impact Communities in Cauvery delta have improved resilience to climate change</p>	<p>By 2023:</p> <ul style="list-style-type: none"> Reduced saline areas by x% and flooded areas by x% (baseline: x units and y units in 20xx). Crop yields increase by x% for male and female farmers in project area (baseline: x units in 20xx) 	<ul style="list-style-type: none"> WRO annual reports Department of Agriculture annual reports 	<p>Assumption Improved land is put into agricultural production</p>
<p>Outcome Improved integrated water resource management (IWRM) in the Cauvery delta</p>	<p>By 2020</p> <ul style="list-style-type: none"> Comprehensive and accessible database and information systems in place IWRM nodal agency set up with key stakeholders including XX% women 40% reduction in work days lost to women due to village and crop area flooding (baseline: x units in 20xx) Flood damages to infrastructure reduced from XX (baseline-in 20XX) to XX (target) Salt water intrusion along the coastal strip reduced from 20 km (baseline) to xx km in 20XX (target) Guidelines for climate-resilient drainage updated 	<ul style="list-style-type: none"> WRO annual reports WRO annual reports Project ex-post evaluation surveys against sex-disaggregated baseline WRO annual reports CGWB and TNGA annual reports WRO annual reports (based on M&E systems) 	<p>Assumption Sufficient leadership and stakeholder support is maintained to put into operation reform measures.</p>
<p>Outputs 1. Integrated programs and infrastructure for management of groundwater, surface water and salinity are implemented</p>	<p>By 2020:</p> <ul style="list-style-type: none"> Drainage capacity of channels enhanced by xx%, with 50% unskilled laboring jobs done by women (baseline: x units in 20xx) XX tail-end regulators are constructed or rehabilitated XX groundwater recharge systems are installed and operational 	<ul style="list-style-type: none"> WRO annual reports (based on M&E systems), Contractor employment records WRO annual reports (based on M&E systems) WRO annual reports (based on M&E systems) 	<p>Assumption Strong support for conjunctive surface and groundwater management.</p>

<p>2. Policies, systems, and institutions for IWRM strengthened</p> <p>3. Sustainable agricultural systems to support higher water-use efficiency, productivity and incomes of male and female farmers are implemented</p> <p>4. Efficient multi-disciplinary Program management system established</p>	<ul style="list-style-type: none"> • XX coastal outlets are stabilized and managed <p>By 2020:</p> <ul style="list-style-type: none"> • Gender-sensitive institution in the sub-basin is formed and targeted capacity strengthening programs implemented • Gender-responsive disaster management plans implemented <p>By 2020:</p> <ul style="list-style-type: none"> • XX new conjunctive water-use programs are operational • Improved productivity of water by RsXX/m³ (baseline: x units in 20xx) • 60% of delta farmers cultivate two paddy crops/annum (baseline: 40% in 20xx) • XX hectares of rice fields under water-saving cultivation techniques (baseline: x units in 20xx) • Xx% of WUAs participate in drainage system planning and O&M <p>By 2015:</p> <ul style="list-style-type: none"> • PMU effectively guiding Program activities • Feedback mechanism for lessons and best practices is developed and integrated to the system/policy • Project implemented on schedule and within budget 	<ul style="list-style-type: none"> • WRO annual reports (based on M&E systems) • State basin sub-basin plan and M&E system • Disaster authority reports • Dept of Agriculture annual reports • Records of community meetings • Dept of Agriculture annual reports • Annual Tamil Nadu season and crop Reports • WRO annual reports (based on M&E systems) • WRO annual reports (based on M&E systems) • WRO annual reports (based on M&E systems) • PMU progress reports 	<p>Assumption Department officials encourage strong inter-sectoral coordination</p>
<p>Activities with Milestones</p> <p>1. Integrated programs and infrastructure for management of groundwater, surface water and salinity are implemented (mm/yyyy)</p> <p>1.1 Implement new design guidelines for the drainage system</p> <p>1.2 Implement structural improvements to the drainage system</p>	<p>Inputs ADB: \$210 million Government: \$90 million</p>		

<ul style="list-style-type: none"> 1.3 Conduct 3-D groundwater modeling for the delta 1.4 Install or modernize tail-end regulators 1.5 Install new groundwater recharge systems 1.6 Prepare and implement disaster flood management plans 2. Policies, systems, and institutions for IWRM strengthened (mm/yyyy) <ul style="list-style-type: none"> 2.1 Prepare and implement an IWRM Sub-basin Plan 2.2 Establish an IWRM institution or network 2.3 Establish a decision support system for IWRM in the sub-basin 3. Sustainable agricultural systems to support higher water-use efficiency, productivity and incomes of male and female farmers are implemented (mm/yyyy) <ul style="list-style-type: none"> 3.1 Rehabilitate ponds and tanks for flood retention and irrigation 3.2 Implement programs to support modifying cropping patterns and less water-consuming crop strains 4. Efficient multi-disciplinary Program management system established (mm/yyyy) <ul style="list-style-type: none"> 4.1 PMU formed and staffed 4.2 PMU procedures established 4.3 Consulting packages contracted 4.4 Project performance and monitoring system established, including ex-post evaluation surveys against sex-disaggregated baseline 	
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CGWB = Central Ground Water Board, km = kilometer, M&E = monitoring and evaluation, m³ = cubic meter, PMU = program management unit, TNGA = Tamil Nadu Groundwater Authority, WRO = Water Resources Organization, WUA = water users associations

PROJECT PREPARATORY TECHNICAL ASSISTANCE

A. Justification

1. The technical assistance (TA) for Support for the National Action Plan for Climate Change (TA7417)¹ produced a sub-basin profile and framework for climate change adaptation plan for the Cauvery delta. The State is willing to implement outputs of this TA including the roadmap and the investment strategy. The project preparatory technical assistance (PPTA) is necessary to support modeling and other analysis recommended under TA7417, and preparation of the investment Program and Project 1 in accordance with Government of India and the Asian Development Bank's (ADB) standards and expectations. A strategic roadmap for integrated water resources management (IWRM) in the sub-basin needs to be prepared with broad stakeholder participation. As to the specific investment, a multitranche financing facility (MFF) Project 1 package needs to be prepared with feasibility and safeguards studies with due implementation readiness.

B. Major Outputs and Activities

2. The TA will prepare an MFF for the Climate Adaptation through Sub-Basin Development Investment Program (the Program) that can lead to IWRM in the sub-basin while meeting all processing requirements for an MFF. The TA will prepare the following outputs:

- (i) **MFF Roadmap for IWRM.** The TA will prepare a roadmap for conjunctive water resources management, with reforms to provide an enabling institutional, legislative, and policy environment, and improved operational framework and capacities. The roadmap should cover structural and non-structural investments.
- (ii) **Hydrologic, Hydrodynamic and Water Resources Modeling.** The TA will conduct modeling of surface water resources, and design the plan for comprehensive modeling of surface water, groundwater, and coastal processes under Project 1.
- (iii) **Feasibility Studies of Project 1 Schemes.** The TA will conduct feasibility studies of the selected subprojects for Project 1 covering enhanced drainage systems and new and rehabilitated tail end regulators in the Vennar system.
- (iv) **Facility Administration Manual (FAM).** On the basis of the above, FAM will be prepared following the standard ADB format, along with relevant manuals and capacity development plan.
- (v) **Detailed Project Report (DPR) and Initial Procurement Packages.** Government of Tamil Nadu (GOTN) design engineers will prepare DPRs and associated procurement packages. The TA consultants will advise on these processes following up on the MFF loan fact-finding.

3. The major outputs and activities are summarized in Table A4.1.

Table A4.1: Summary of Major Outputs and Activities

Major outputs	ECD	Major Activities	ECD
MFF Roadmap for IWRM	Jul 2013	(i) Institutional and policy assessment (ii) Investment programming (strategy and plan) (iii) Operation and maintenance sustainability study (iv) Draft final reporting	Apr 2013 May 2013 May 2013 Jul 2013
Hydrologic, Hydrodynamic and Water Resources	Jun 2013	(i) Field surveys (ii) Model development and calibration (iii) Testing and development of interventions	Feb 2013 Apr 2013 Jun 2013

¹ ADB. 2009. *Technical Assistance to India for Support for the National Action Plan for Climate Change*. Manila.

Major outputs	ECD	Major Activities	ECD
Modeling			
Feasibility Studies of Project 1 Schemes.	Aug 2013	(i) Field engineering and baseline surveys (ii) Basic engineering and program designs (iii) Safeguards assessments (iv) Cost estimates, and feasibility assessments (v) Draft final reporting	Apr 2013 Jun 2013 Jul 2013 Aug 2013 Aug 2013
Facility Administration Manual (FAM)	Sep 2013	(i) Facility administration manual preparation (ii) Financial management and other manuals	Sep 2013 Sep 2013
DPRs and initial procurement packages	Nov 2013	(i) Advice on processing detailed project reports (ii) Advice on initial tender documents	Nov 2013 Nov 2013

DPR = detailed project report, ECD = expected completion date, IWRM = integrated water resources management, MFF = multitranchise financing facility

Source: ADB.

C. Cost Estimate and Proposed Financing Arrangement

4. The cost of the TA is estimated at \$1.14 million, of which \$1 million will be financed on a grant basis by ADB's Technical Assistance Special Fund (TASF-Others), and \$140,000 will be financed on a grant basis by the Multi-Donor Trust Fund under the Water Financing Partnership Facility (WFPF)² and administered by ADB. The Government has been advised that approval of the TA does not commit ADB to financing any ensuing Program. The detailed cost estimate is presented in Table A4.2.

Table A4.2: TA Cost Estimate and Financing Plan
(\$'000)

Item	Total Cost
ADB^a and MDTF-WFPF^b	
1. Consultants	
a. Remuneration and per diem	
i. International consultants (21.5 person-months)	566.7
ii. National consultants (48 person-months)	212.0
b. International and local travel	72.0
c. Reports and communications	5.0
2. Workshops, training, seminars, and conferences ^c	10.0
3. Vehicle ^d	6.0
4. Surveys	165.0
5. Miscellaneous administration and support costs	3.0
6. Contingencies	100.3
Total	1,140.0

ADB = Asian Development Bank, MDTF = Multi-Donor Trust Fund, WFPF = Water Financing Partnership Facility
Note: The total cost of the technical assistance (TA) amounts to an equivalent of \$1,368,000, of which contributions from ADB and MDTF-WFPF are presented in the table above. The government will provide counterpart support in the form of counterpart staff, office accommodation, and data, the value of which is estimated to account for 20% of the total TA cost.

^a Financed by ADB's Technical Assistance Special Fund-other sources (\$1 million) and the Water Fund Partnership Facility's Multi-Donor Trust Fund (\$140,000).

^b Contributors: the governments of Australia, Austria, Norway and Spain. The cofinancier fund is administered by ADB on a front-loaded basis.

² Contributors: the governments of Australia, Austria, Norway and Spain.

^c Workshops, training, seminars, and conferences

Purpose: Consultations with Stakeholders 30

^d Vehicle

One leased project vehicle for field visits

Expected length of use
6 months

Source: Asian Development Bank estimates.

D. Consulting Services

5. The TA will be implemented over a period of 19 months tentatively starting in October 2012 with the fielding of the topographical survey firm. TA activities are expected to be completed by June 2014. ADB will engage a topographical survey firm (national) using the least cost selection method. ADB will engage the main TA consulting team (consisting of 21.5 person-months of international experts and 48 person-months of national experts) using the quality- and cost-based selection (QCBS) method at a ratio of 90:10 based on full technical proposal. Given the complexity of the river system in the delta, more specialized modeling and infrastructure design expertise, and an innovative, climate-sensitive approach, are required. The main consulting team is expected to be mobilized in February 2013. All consultants will be engaged in accordance with ADB's *Guidelines on the Use of Consultants* (2010, as amended from time to time), and all procurement will be in accordance with ADB's *Procurement Guidelines* (2010, as amended from time to time). The terms of reference (TOR) of the consulting services are summarized below.

Table A4.3: Summary of Consulting Services Requirement

International		National	
Position person-months	Position person-months	Position person-months	Position person-months
Team Leader / IWRM Specialist	7.0	Deputy Team Leader / Institutional Specialist	8.0
Economist	2.5	Hydrologist	2.0
Hydrologist	2.0	Procurement Specialist	1.0
Hydro-geologist	1.5	Hydraulic Modelers (2)	8.0
Flood/Drainage/Hydraulic Structures Specialist	5.0	DSS Specialist	2.0
Coastal Engineer	0.5	Civil Engineer	4.0
Hydraulic Modeler	2.0	Groundwater Modeler	3.0
Agriculture Specialist	1.0	Flood/Drainage/Hydraulic/Coastal Structures Specialist	6.0
		GIS Specialist	2.0
		Agriculture Specialist	2.0
		Aquaculture Specialist	1.0
		Financial Analyst	2.0
		Social/Resettlement/Gender Specialist	5.0
		Environment Specialist	2.0
Total	21.5	Total	48.0

DSS = decision support systems, GIS = geographic information system, IWRM = integrated water resources management

Source: Asian Development Bank.

6. A team of individual climate change specialists (two international and one national) has been mobilized for the period August to December 2012 to conduct analysis on current and future climate conditions and sea level to support the hydrologic analysis and design of infrastructure improvements. The international consultants have been engaged by UNESCO-IHE as part of ADB's partnership with UNESCO-IHE under the WFPF, and the national consultant has been engaged by ADB as an individual staff consultant. See the TOR for the climate change team in Supplementary Appendix 4.

7. Topographical surveys will be conducted during the period October 2012 to February 2013. A national firm will be engaged by ADB to produce channel cross sections, elevations of

control structures, and a digital terrain map for the Vennar System. The TOR for the survey works are in Supplementary Appendix 5.

8. The scope of work for the main TA consultants follows, and the individual TOR for the experts is in Supplementary Appendix 6. The TA will focus its efforts on the Vennar System³ which is the worst affected and represents the problems and needs of the other three systems. The deliverables of the TA Consultants will cover the following areas:

- i. **Integrated programs and infrastructure for management of groundwater, surface water and salinity.** Activities of the TA consultants will include:
 - a. Recommend for new design guidelines for the drainage system in consultation with Public Works Department (PWD), and based on the results of the climate change modeling, and the needs of the Cauvery Delta.
 - b. In participation with PWD, recommend and prepare feasibility studies for structural drainage improvement interventions in the Vennar System to achieve the standards recommended in the new guidelines. Interventions may include but not be limited to modifying channel sections⁴ and alignments, increasing the capacity of existing or creating new flood retention areas, installing new control structures, re-designation of flood impacted land and formalized overland flow paths, and improving operation and maintenance procedures including improved sustainable management and removal of aquatic weeds.
 - c. Prepare feasibility studies for new and rehabilitated tail-end regulators⁵ to: (i) prevent seawater ingress in the drainage system; and (ii) trap and store un-used freshwater for: (a) storage for lift irrigation, and (b) groundwater recharge.
 - d. Develop a calibrated hydrologic and hydraulic model of the Vennar drainage system that will: (i) represent the present and future hydrologic and sea level conditions of the basin including the coincidence of extreme rainfall and high sea levels; (ii) take into account the flood diversion capacities of the Upper Anicut and Grand Anicut under present and expected future conditions; (iii) accurately represent the existing drainage system, control structures, flood plains and coastal outlets; (iv) be capable of assessing and developing proposed interventions; and (v) prepare sufficiently detailed flood maps (extent, risk and hazard) for current and future scenarios.
 - e. Assessing the geology, groundwater level and quality, and abstraction data within the project area to: (i) identify processes causing saline intrusion within the project area; (ii) develop a representative quantitative two-dimension groundwater model to analyze current and future scenarios (both climate change and interventions identified by this project); (iii) use the model to estimate and recommend indicative sustainable abstraction rates; and (iv) prepare the TOR for a more comprehensive 3-D groundwater model for the project area to be carried out under subsequent tranches of the Program.
 - f. Review current activities in the project area and recommend additional opportunities, locations and methods to supplement groundwater recharge based on: (i) the geology of the project area; (ii) the performance of the existing initiatives; (iii) the results of the groundwater model; and (iv) the existing and recommended drainage improvement interventions (for example flood retention areas may also be used for groundwater recharge reservoirs). Prepare feasibility studies and develop a

³ For the PPTA, the Vennar System also includes upstream areas that drain through the system. Subsequent tranches will focus on the remaining three systems.

⁴ Note that the irrigation systems use combined irrigation and drainage channels that are unlined and operate in regime.

⁵ The design horizon of feasibility studies for all tail-end regulators and other structures shall be based on the future design scenario accounting for expected climate changes.

- monitoring and evaluation system to assess the effectiveness of existing and groundwater recharge measures.
- g. Assess existing and future coastal processes and their impact on operation of the drainage system's natural beach outlets and prepare feasibility studies on appropriate methods for maintaining open outlets.
 - h. In consultation with the State Disaster Management Authority and other relevant government agencies, PWD and local communities, prepare a disaster flood management plan for when out-of-channel capacity of the drainage systems capacity is exceeded and productive land and communities are impacted by flood water, including: (a) flood warning system; (b) procedures during and after flood events; (c) and provision of flood-resilient infrastructure including water supply and sanitation facilities, dwellings and access.
- ii. **Policies, legislation, and institutions for IWRM established or strengthened.** Activities of the TA consultants will include:
- a. In a participatory manner, with full involvement of the GOTN, PWD, local communities and all other relevant stakeholders, prepare an IWRM Sub-basin Plan that will consider: (i) the roles and functions of the government offices, universities, non-government organizations (NGOs), civil-society organizations, and community groups; (ii) their respective duties, responsibilities and capacities in respect to water resource management; (iii) the effectiveness of inter-organization coordination, communication and cooperation; and (iv) gaps where structural and capacity improvements are required to support managing the Sub-basin following IWRM principles. The IWRM Sub-basin Plan will facilitate the sustainable management of surface and groundwater by recommending: (i) an appropriately empowered institution or network for collaboration, decision-making, monitoring, and enforcement; (ii) effective broad-based demand and supply-side management initiatives to address effective management of surface and groundwater taking into account the competing demands for their exploitation as resources; and (iii) appropriate rules, regulations and procedures to manage the resources under normal and extreme weather conditions. The Plan will consider the surface and groundwater resources management in relationship with climate change, future land-use management, interaction with coastal processes, the health and livelihoods of local communities, and the sustainable management and protection of the natural environment.
 - b. Review the existing Decision Support Systems (DSSs) used by the GOTN⁶ and where necessary expand their areal extent and if necessary broaden their function to support the IWRM Sub-basin Plan and effective management of surface and groundwater in the Cauvery Delta, including: (i) assessing available climate, hydro-meteorological, groundwater and sea-level data in the basin area; (ii) assessing the quality and usefulness of existing data for use in the DSS; (iii) assessing previous and ongoing data collection, management, modeling and DSS initiatives within Tamil Nadu to ensure effective integration of the recommendations proposed under the Program; (iv) with stakeholder participation identifying the likely decision making requirements appropriate to the needs of the basin; (v) where necessary recommending improvements to the existing climate and groundwater monitoring, data processing, archiving, and DSSs by either strengthening, improving or expanding current practices; (vi) undertaking a stakeholder assessment for

⁶ The State Ground and Surface Water Resources Data Centre is currently developing a DSS for other areas of Tamil Nadu using Mike Basin. The development of this DSS initiative is under the Work Bank-funded Hydrology Phase 2 Project within the Ministry of Water Resources.

capabilities and requirements to maintain, operate and manage the DSS; and (vii) prepare the TOR for development of a DSS that will be carried out during Project 1.

iii. **Sustainable agricultural systems to support higher water-use efficiency, productivity and incomes are implemented.** Activities of the TA consultants will include:

- a. With full participation of agriculture, fisheries and public works departments, local research institutions and farmers, assessing and recommending opportunities for: (i) improving water-use efficiency through conjunctive use of groundwater and surface water; (ii) provision of new, and optimization of existing ponds and tanks for irrigation supply (gravity or pump fed) that may also be used in conjunction with flood retention and groundwater recharge systems; (iii) modifying cropping patterns to optimize scheduling of water supply, and reducing non-beneficial evaporation and discharge to saline bodies; (iv) switching cultivation to less water-consuming crops or crop-strains with shorter growing season or suited for cooler and drier seasons including use of the System of Rice Intensification, direct seeded rice, saline-resistant rice-stains, and other agricultural technologies; and (v) assessing land-use change in over-exploited or saline-affected areas. Preparation of feasibility studies for the preferred interventions, including recommending appropriate monitoring and evaluation plans.
- b. Preparation of feasibility studies for new and rehabilitated tail-end regulators to trap and store un-used freshwater for lift irrigation and groundwater recharge, and recommending appropriate monitoring system to assess the effectiveness of groundwater recharge.
- c. Review of existing lift schemes and preparation of feasibility studies for upgrading existing PWD-owned and managed infrastructure. The feasibility studies should also consider replacing existing infrastructure with appropriate facilities and outreach programs for farmers to install individual equipment so they may pump on demand.
- d. Development of an appropriate sub-basin water balance model⁷ in combination with economic sector analyses to quantitatively assess the feasibility and benefits of the above mentioned interventions.

iv. **Program Proposal Documentation**

9. The TA consultants will produce the following documentation compiled as the consultants' report, in addition to progress reports: (i) Program appraisal report with design and monitoring framework (and baseline indicators); (ii) FAM with detailed implementation arrangements, costing, fund flow, procurement plan, consultant TOR, capacity development plan, and implementation procedures; (iii) social analysis, Project 1 gender action plan, involuntary resettlement framework and resettlement plan for Project 1, and consultation, participation and communications plan; (iv) financial, anticorruption, and procurement risk assessment and risk management plan; (v) EA financial management and procurement capacity assessment and detailed description for capacity development TA; (vi) assessment of the water resources sector; (vii) financial and economic analysis; (viii) environmental assessment review framework and sample initial environmental examination reports; (ix) feasibility studies for all Project 1 subprojects; and (x) sub-basin IWRM plan.

10. In addition to the technical inputs specified below, the experts will support the team leader in (i) evaluating and prioritizing subprojects under their area of expertise; (ii) supervising

⁷ Within the constraints of the Cauvery Tribunal Award, 2007

the required technical surveys for feasibility study design preparation; (iii) preparing the preliminary designs, quantities estimates, and cost estimates for the ensuing works; (iv) finalizing the sub-projects technical appraisal studies; (v) preparing comprehensive TORs for the implementation consultants for the ensuing works; and (vi) preparing relevant sections of Program design reports.

v. Support to Preparation of DPRs and Initial Procurement Packages.

11. WRO design engineers will prepare the DPRs and initial bidding documents for Project 1 subprojects. Certain consultants will provide advice and quality assurance.

E. Implementation Arrangements

12. The WRO will be the executing agency for the TA. The WRO will provide (i) counterpart staff to review climate scenarios work, supervise the topographical survey team, help with hydrologic modeling, and manage TA activities; (ii) office space and utilities for the consultants; and (iii) resources to prepare DPRs and tender documents including detailed design.

13. The proposed TA processing and implementation schedule is listed in Table A4.4.

Table A4.4: Technical Assistance Processing and Implementation Schedule

Major Milestones	Expected Completion Date
Reconnaissance / PPTA Fact-Finding Mission	1 Dec 2011
Government confirmation of Mission aide memoire	Aug 2012
ADB concept paper clearance (including PPTA)	Sep 2012
PPTA Implementation	
Climate modeling consulting team mobilization	Aug 2012
Surveying contractors mobilization	Oct 2012
Main consulting team mobilization	Feb 2013
Inception review	Mar 2013
Mid-term review	Jun 2013
Submission of draft consultants' report	Aug 2013
Tripartite review on MFF design	Sep 2013
Detailed designs and readiness criteria for Project 1 completed	Nov 2013
Submission of final report on MFF and Project 1 design	Nov 2013
PPTA Physical Completion	Jun 2014

Source: Asian Development Bank.

14. Disbursement under the TA will be done in accordance with ADB's *Technical Assistance Disbursement Handbook* (May 2010, as amended from time to time).

INITIAL POVERTY AND SOCIAL ANALYSIS

Country:	India	Project Title:	Climate Adaptation Through Sub-Basin Development Investment Program
Lending/Financing Modality:	Multitranches Financing Facility	Department/ Division:	South Asia Department (SARD), Environment, Natural Resources and Agriculture Division (SAER)

I. POVERTY ISSUES

A. Links to the National Poverty Reduction Strategy and Country Partnership Strategy

The 11th Five-Year Plan (2007-2012) of the Government devotes an entire chapter to the environment and climate change considerations. Adaptation is proposed through improvement of productivity potential and water use efficiency of agricultural crops. Adaptation strategies are also recommended for watershed management, coastal zone planning and regulation, forestry management, agricultural technologies and practices, and health. The Plan also describes a range of interventions relating to coastal protection and management, considering the impacts of sea level rise on coastal agriculture and the management of sea water ingress into coastal areas. The Program will also support the objectives of the Five-Year Plan and the government's strategy to provide essential services to the poor and reinvigorate the rural economy. ADB's Country Partnership Strategy (CPS) for India for 2009-2012 strives for stronger integration of environmental dimensions into ADB's India assistance program. ADB will assist the government to improve the management of water resources in the Cauvery Delta through improved flood control and drainage using an integrated water resources management approach. The focus is on enhanced capacity of state authorities to design, implement, monitor, and finance appropriate measures for watershed management and coastal protection. Agriculture and natural resource management are two of the five priority sectors during the CPS period, while environmental sustainability, governance and capacity development, gender equity, and knowledge solutions are key thematic concerns of relevance to the Program.

B. Targeting Classification

General Intervention Individual or Household (TI-H) Geographic (TI-G) Non-Income MDGs (TI-M1, M2, etc.)

The population of three main districts of the Cauvery delta of Tamil Nadu – Nagapattinam, Tiruvarur and Thanjavur – totals about 4.8 million. Of this, 73% is rural population whose main livelihoods are farming and fishing. This population is under direct threat from the adverse affects of climate change. The existing issues of water resources in Cauvery delta include very limited availability of water during southwest monsoon and very heavy and intense erratic rainfall in the northeast monsoon causing flooding and drainage congestion. There are issues of saline intrusion of water and drainage congestion in the lower delta area. Large scale inundation is caused due to back water flow combined with floods. Ground water in the delta has medium to high salinity and alkaline hazard. Much of the area in Nagapattinam district is below sea level making it difficult to drain. The significant coastal problems already experienced in the Cauvery delta are coastal erosion, and siltation and choking of inlets/estuary mouths.

C. Poverty Analysis

1. If the project is classified as TI-H, or if it is policy-based, what type of poverty impact analysis is needed? n/a

2. What resources are allocated in the PPTA/due diligence?

The technical assistance (TA) has allocated 3 national person-months of consultants' time to conduct analysis sufficient to design the social and poverty reduction strategy and to further define and address all safeguard requirements.

3. If GI, is there any opportunity for pro-poor design (e.g., social inclusion subcomponents, cross subsidy, pro-poor governance, and pro-poor growth)?

The TA consultants will prepare strategies for social inclusion and pro-poor governance linked to the integrated water resources management (IWRM) structure, income earning opportunities through construction, and environmental and land use management aspects of the project.

II. SOCIAL DEVELOPMENT ISSUES

A. Initial Social Analysis

Based on existing information:

1. Who are the potential primary beneficiaries of the project? How do the poor and the socially excluded benefit from the project?
Water suppliers and users; coastal and agricultural populations. Poor will benefit from reduced loss (of land, labor opportunities) due to flooding, greater water security and resilience to climate change.
2. What are the potential needs of beneficiaries in relation to the proposed project?
Solutions to the following problems in coastal areas: conflict over insufficient water supply, salinity of water supply, mouth siltation affecting fisheries (both fish catch, crab breeding and visiting of other fishing boats for sale of fish); coastal flooding and inundation. Other persistent problems identified by the participatory rural appraisal (PRA) include indebtedness, salt water intrusion, flooding, erosion, poor water management, pollution of canal water, incomplete drainage.
3. What are the potential constraints in accessing the proposed benefits and services, and how will the project address them?
Efforts will be made to address potential constraints if identified during the TA study.

B. Consultation and Participation

1. Indicate the potential initial stakeholders.
Water suppliers and users. Farmers, fishers, rural communities affected by flooding, water shortages, groundwater salinity, etc.
2. What type of consultation and participation (C&P) is required during the PPTA or project processing (e.g., workshops, community mobilization, involvement of nongovernment organizations and community-based organizations, etc.)?
Stakeholder workshops, community mobilization, involvement of nongovernment organizations and community-based organizations such as women's self help groups. PRA exercise already undertaken during previous TA, generating considerable primary information.
3. What level of participation is envisaged for project design?
 Information sharing Consultation Collaborative decision making Empowerment
4. Will a C&P plan be prepared during the project design for project implementation? Yes No Please explain.

C. Gender and Development

Proposed Gender Mainstreaming Category: EGM

1. What are the key gender issues in the sector/subsector that are likely to be relevant to this project/program?
Key gender issues are time spent by women collecting and transporting water, under-representation of women in decision making on systems that impact their lives and livelihoods, and impacts of climate change on women's income earning activities. On the coast one of the main income earning activities for women is selling and trading in fish and seafood. However, declining catches and less visiting boats due to silting of the river mouth has led to less income for local women. The effects of frequent flooding, loss of land and assets, deaths and injuries are also felt disproportionately by women, who assume the largest burden of care and are less able to migrate as a temporary solution to local economic setbacks. Agricultural labor is predominantly female, and inundation of crops impacts upon the amount of paid work available for poor women.
2. Does the proposed project/program have the potential to promote gender equality and/or women's empowerment by improving women's access to and use of opportunities, services, resources, assets, and participation in decision making?
 Yes No Please explain.
A project gender analysis will be undertaken and a gender action plan will be prepared during TA/due diligence with reference to the ADB gender checklist for water projects.
3. Could the proposed project have an adverse impact on women and/or girls or to widen gender inequality?
 Yes No Please explain

III. SOCIAL SAFEGUARD ISSUES AND OTHER SOCIAL RISKS			
Issue	Nature of Social Issue	Significant/Limited/No Impact/Not Known	Plan or Other Action Required
Involuntary Resettlement	The TA will prepare a Resettlement Framework for the Program and a Resettlement Plan for Project 1.	Limited to encroachers on flood embankments in some areas. Further study required during TA to determine exact areas and extent to which flood relief areas (retention and tanks) will have involuntary resettlement (IR) impacts.	<input checked="" type="checkbox"/> Resettlement Plan <input checked="" type="checkbox"/> Resettlement Framework <input type="checkbox"/> None <input type="checkbox"/> Uncertain
Indigenous Peoples	Tamil Nadu is 90% Tamil. Other ethnic groups are majorities from surrounding states. No populations of Scheduled Tribes in the delta area who would trigger ADB's Safeguard Policy Statement (SPS, 2009).	No impact	<input type="checkbox"/> Indigenous Peoples Plan <input type="checkbox"/> Indigenous Peoples Planning Framework <input type="checkbox"/> Environmental and Social Management System Arrangement <input checked="" type="checkbox"/> None <input type="checkbox"/> Uncertain
Labor <input checked="" type="checkbox"/> Employment Opportunities <input type="checkbox"/> Labor Retrenchment <input type="checkbox"/> Core Labor Standards		Petty contractors for embankment strengthening will require unskilled local labor for approximately 90% of the time.	<input type="checkbox"/> Plan <input checked="" type="checkbox"/> Other Action <input type="checkbox"/> No Action <input type="checkbox"/> Uncertain Loan documents will include the usual statements regarding Core Labor standards and equal pay for women.
Affordability		No impact	<input type="checkbox"/> Action <input checked="" type="checkbox"/> No Action <input type="checkbox"/> Uncertain
Other Risks and/or Vulnerabilities <input type="checkbox"/> HIV/AIDS <input type="checkbox"/> Human Trafficking <input type="checkbox"/> Others (conflict, political instability, etc.), please specify		No impact	<input type="checkbox"/> Plan <input type="checkbox"/> Other Action <input checked="" type="checkbox"/> No Action <input type="checkbox"/> Uncertain
IV. PPTA/DUE DILIGENCE RESOURCE REQUIREMENT			
1. Do the TOR for the PPTA (or other due diligence) include poverty, social and gender analysis and the relevant specialist/s? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			
2. Are resources (consultants, survey budget, and workshop) allocated for conducting poverty, social and/or gender analysis, and C&P during the PPTA/due diligence? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No			

CRITERIA FOR MULTI-TRANCHE FINANCING FACILITY (MFF)

MFF Requirement	How Addressed in the Program
Sector strategy or road map	National Action Plan for Climate Change (NAPCC) which includes 8 national Mission including a specific one for water. The main objective of the National Water Mission (NWM) is “conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources development and management.” NWM document lays out the road map for achieving this, consistent with the national water policy. Climate Adaptation through Sub-Basin Development Investment Program (the Program) provides forum to pilot national reforms and approaches. A specific MFF road map will be prepared under the project preparatory technical assistance (PPTA, the TA) supporting the NWM strategy.
Clear strategic context justifying ADB's intervention	<p>Agriculture and natural resources in Country Partnership Strategy since 2003, with strong emphasis on advising and piloting new approaches in water sector planning and reforms, especially in light of climate change.</p> <p>ADB completed a study in July 2011 to support the NAPCC/NWM. It identified core actions at the central and state levels to move the NWM recommendations towards a viable set of initiatives and investments. Its main outputs are strategic frameworks to identify and address the main areas of adaptation to climate change at two levels including (i) strategic framework for all India water systems that sets broad strategies for water resources related climate adaptation and the establishment of integrated water resource management (IWRM), and (ii) examples of location-specific strategic frameworks for three sub-basins with different sensitivity to the potential impacts of climate change</p>
Policy framework	Strong national water and agricultural policies are in place, and state has water policy, regulatory framework for groundwater, and policies in agriculture and participatory irrigation (see Supplementary Appendix 2). The Program may support policy changes based on lessons learned through sub-basin development, but within the existing policy platform.
Detailed investment program or plan, strongly owned by the client	State government has medium-term investment program for Cauvery sub-basin modernization (prepared in 2007-08), but a specific investment plan (outlining physical and non-physical investments) will be prepared during PPTA for the sub-basin using full IWRM approach. The

	investment plan in the Cauvery requires a phased approach, with the sub-basin studied systematically in 3-4 tranches and committing new tranches based on performance and lessons of previous/ongoing tranches.
Financing plan for the Program	This will be prepared under the TA
Facility level undertakings	Appropriate facility-level undertakings will be reflected in the Framework Financing Agreement, to ensure the client remains committed to the road map and policy framework.
Scope of entire MFF determined	A long list of physical and non-physical investments has been prepared for the four canal systems of the sub-basin. Project-1 will cover the Vennar canal system only, and the preliminary scope of the entire Program has been described in Supplementary Appendix 3.
Design of Project-1 representative of subsequent tranches	Tranches will be in accordance with 4 main canal systems so as to cover surface water, groundwater, and coastal processes holistically in each tranche for 1-2 of the 4 systems in each tranche. Project-1 will cover the Vennar canal system and its subprojects and safeguard issues will be representatives of subprojects in the other canal systems financed through subsequent tranches.
Size of MFF justified according to client needs/readiness, efficiency factors, absorptive capacity, and ADB's sector strategy.	Assessed during loan reconnaissance. Total Program amount anticipated to be \$300m in light of this criteria, with \$100m for Project-1.

POLICY AND INSTITUTIONAL FRAMEWORK FOR INTEGRATED WATER RESOURCES MANAGEMENT

1. The following summarizes the policy framework for integrated water resources management (IWRM) in the state of Tamil Nadu. The framework and its implementation will be reviewed during the project preparatory technical assistance (PPTA) while preparing the Program roadmap for IWRM. Recommendations for an improved operational framework for IWRM in the Cauvery sub-basin (including necessary institutions or coordination mechanisms) and measures to strengthen the capacity of institutions and agencies in IWRM, will be included in the IWRM roadmap planning process.

A. Government of India Water Policy (2002)

2. The National Water Policy was adopted in September 1987 and was reviewed and updated in April 2002. The National Water Policy provides for some of the amendments needed in the Interstate Water Disputes Act. Some of the features of the new National Water Policy (NWP, 2002) are:

- The National Water Policy provides for the formulation of the river basin organizations, it states also that the “scope and powers of the river basin organizations shall be decided by the basin states themselves” (Article 4.2).
- It provides for the creation of a standardized national information system promoting free exchange of data among various agencies (Articles 2.1 and 2.2). Here it might be mentioned that as per the Sarkaria commission recommendations, a data bank and information system at the national level has to be set up at the earliest and the states shall be required to compulsorily make the necessary data available. However the ground realities show that data accessibility is the major constraint for individual researchers as well as organizations, which leads them to take case studies of international water bodies at the cost of providing solutions using state of the art technologies for the Indian systems.
- It provides for “adequate safe drinking water facilities” without mentioning the quantity of water which should be provided at the urban and rural levels for various densities of population (Article 8). Although there is no mention of the quality of drinking water, Article 14 recommends regular water quality monitoring of surface and groundwater against the national water quality standards.
- The NWP also recognizes that water resource development should be planned for in hydrological units, or watersheds.
- The National Commission for Integrated Water Resources Development Plan had recommended repealing the River Boards Act and enacting a new Act called the Integrated and Participatory Management Act. It is proposed that sustainability in the quantity and quality of water resources can be achieved by taking into account multisectoral factors such as groundwater, surface water and other environmental considerations. Although the Act has not been passed as recommended, it has been reflected in the National Environment Policy (NEP, 2006). The NEP also addresses many other issues such as climate change and its impact on various sectors and the importance of exploring coping strategies.

3. Indian planning now has an emphasis on decentralized local planning. After the 1993 reform below the State level there are now District Panchayats, Block Panchayats and Village Panchayats. The most significant development is that the Panchayats have been assigned a

wide range of functions with respect to the preparation of plans and implementation of schemes for economic development and social justice. Some of these functions include agriculture, land improvement and soil conservation, minor irrigation and water management, social forestry and farm forestry. The role of the Panchayats in watershed development has been enhanced with the recommendations of the Haryali Guidelines of the watershed development (Guidelines for Hariyali, 2003) and they have been recognized as the primary implementing agency of watershed planning and action.

B. Water Policy of Tamil Nadu (1994)

4. Tamil Nadu's Water Policy is largely derived from the NWP. The Institute for Water Studies in Tamil Nadu is entrusted to implement the policy. Key policy provisions are to (i) establish a Management Information System (MIS) for water resources; (ii) ensure preservation and stabilization of existing water resources, including plans for augmentation of utilizable water resources; (iii) promote research and training facilities for water resources management; (iv) establish allocation priorities for water use by different Sectors with provision of drinking water being of highest priority; (v) maximize multi-purpose benefit from surface and groundwater, land and other resources, provide adequate water for different users; (vi) preserve and enhance the economics of fisheries; (vii) maintain water quality to established standards; (viii) promote equality and social justice among users of water for irrigation and domestic water supplies; and (ix) promote users participation in all aspects of water planning and management and provide mechanisms for the resolution of conflicts between users within and between interstate river basins.

C. Regulatory Framework for Groundwater

5. The Government of Tamil Nadu (GOTN) passed the Tamil Nadu Groundwater (Development & Management) Act in 2003. The Act calls for setting up a Tamil Nadu Groundwater Authority (TNGA) to regulate and control ground water development. Wells may be used for domestic purposes, scientific purposes, and small and marginal farmers. The TNGA monitors groundwater, stipulates the standards for groundwater quality depending on the kind of water use, and alters, amends, or cancels extraction permits. In the Cauvery delta, the Central Ground Water Authority has prohibited groundwater abstraction in Gangabialli, Thalaivasal and Veerapani blocks of Salem district, Thuraijpur block of Trichinapally district, Chengar block of Vallore and Pernampet block of Vellore districts. The Act ensures enforcement of TNGA decisions by prohibiting the Tamil Nadu State Electricity Board to supply electricity for wells for which permits have not been granted.

6. The Pondicherry groundwater (Control & Regulation) Act 2002 is invoked to regulate and control development of groundwater in neighboring Union Territory of Pondicherry.

D. Agricultural Policy

7. GOTN Agricultural Policy (2011) aims to double food production in the immediate future. The policy calls for (i) developing a scientific approach to support the development of the rural economy and preservation of ecological balance based on the requirements of agro climatic zones; (ii) increasing productivity, production and profitability; and (iii) implementing farmers welfare schemes such as integrated watershed development, land management, development of water resources, organic farming especially use of green manure, bio-fertilizers, bioconversion of agricultural wastes, bio pesticides and parasites, integrated pest management, remunerative price to agricultural produce, processing, value addition to agricultural produce,

promotion of crops with export potential, with a view to ensure economic improvement, besides rural prosperity.

E. Policies in Participatory Irrigation

8. The scientific and systematic development and maintenance of irrigation infrastructure is considered to be best implemented through farmers' organizations. Such farmers' organizations have to be given an effective role in the management and maintenance of the irrigation system for effective and reliable supply and distribution of water. The Tamil Nadu Farmers Management of Irrigation Systems Act (2000) was enacted to provide for farmers participation in the management of irrigation systems. The Act provides an enabling environment to the formation and functioning of water users associations (WUAs). However, like in many Indian states, WUAs have been formed but they have not taken their full responsibility as envisaged in Act. The main constraints are system deficiency, a lack of financial viability, lack of technical knowledge and complex maintenance requirements, low Irrigation rates, uncertainty of water availability, and lack of coordination between drinking water user committees and other water-related institutions

F. Institutional Framework for IWRM

9. The GOTN has made various steps towards IWRM and convergence of various departments. In 2000 a, Multi Department Project Unit was established for coordinated sub-basin planning with planning inputs coming from various departments including WRD, agricultural, fisheries to try and institutional response to various problems associated with the development and management of water resources was through a single window approach. A Water Resources Organization (WRO) has been formed under Public Works Department which initiates of the separation of cadres between water resources management and buildings. Other initiatives include strengthening of the Institute for Water Studies and the State Ground and Surface Water Resources Data Center and preparation of detailed spatial knowledge base for water management; setting up of a Reforms Task Force, creation of a multi-sectoral Water Resources Control and Review Council (WRCRC) chaired by the Chief Minister and includes ministers representing all government departments concerned with the development and use of water resources.

10. There are various options for the establishment of IWRM institutions. The approach recommended under TA7417 is to build IWRM under the existing institutional structure. This includes the establishment of a state steering committee, an IWRM unit as a part of the WRO and empowerment of the district planning committees and the sector departments at district levels. The only new organization would be the proposed water regulatory authority. This proposed approach will be assessed further during the PPTA.

11. GOTN established a WRCRC chaired by the Chief Minister and includes ministers representing all government departments concerned with the development and use of water resources. The WRCRC was essentially created to handle multi-sectoral water planning and allocation and acts as the state's principle water policy implementation body.

12. There is significant support within India for the establishment of State Water Regulatory Management Authorities (SWaRMAs) as an institutional mechanism to regulate the allocation, management and utilization limited water resources through a participatory approach. The 13th Finance Commission report (2009) made it mandatory for all states to constitute SWaMRAs by March 2012 to address injudicious inter-sectoral and intra-sectoral distribution of water amongst

various categories of water users. Low water use efficiency, fragmented approach to water resources planning and development, and low water user charges and meager recovery are cited as some of the major problems associated with the management of water resources. The SWaRMA must be truly consultative and participatory in its composition and functioning, and have representation of civil society. The SWaRMA should have powers and independence. The establishment of the SWaRMA is complex and requires consultations and discussions to ensure the necessary understanding and agreements. State support for the regulator is essential.

13. In October 2007 GOTN PWD issued an order to establish a SWaRMA, first as an agency rather than an authority. The SWaRMA will be an amalgamation of the existing Institute for Water Studies and State Ground and Surface Water Resources Data Centre. A policy framework to support the SWaRMA with legislative backing is also envisaged. The key functions expected of Tamil Nadu's SWaRMA are to (i) advise GOTN in water policies to support IWRM, (ii) advise GOTN in formulating a new water tariff system, (iii) advise GOTN on inter-state water issues, (iv) facilitate the development and use of a comprehensive water resources knowledge base and analytical tools, (v) establish an IWRM planning framework, (vi) advise GOTN in regulating water allocations for bulk users, (vii) establish and facilitate the work of basin/sub-basin agencies, and (viii) suggest ways to ensure effective water availability in tail end areas.

14. The portfolio of measures identified for water resource management require a strong coordinated approach with full support of Government at State, District and Panchayat level and stakeholders. To meet all these requirements requires an approach to build on the existing institutions, providing coordination and devolution of powers. Some transformation in roles/rules and relationship among the institutions is essential to facilitate: (i) holistic water planning; (ii) review of financial instruments like targeted subsidies to support adaptation, crop insurance; (iii) participation of stakeholders in planning and management; (iv) strategizing environmental management and control measures; (v) facilitate full basin planning and management; (vi) separation of roles between service provider-managers and regulators; (vii) conjunctive planning and regulation of surface and ground water; (viii) monitoring of quality of water; (ix) effective planning for disaster (flood) management; (x) revenue recovery mechanisms to be effective; and (xi) post project performance evaluation (outcome & impacts) to be prepared.

PRELIMINARY SCOPE OF INVESTMENTS

A. Approach

1. The Climate Adaptation through Sub-Basin Development Program (the Program) will support enhanced resilience to climate change by communities in the Cauvery delta. The expected Program outcome will be improved integrated water resources, flood and coastal management in the delta area. The key outputs are (i) integrated programs and infrastructure for management of groundwater, surface water and salinity (through flood dykes, drainage, expansion of flood alleviation areas as well as tanks, farm ponds, and natural water bodies to absorb floods); (ii) establishment and capacity strengthening of institutions and systems for sub-basin integrated water resources management (IWRM) (including planning, monitoring, and decision support systems addressing the impact of climate change); and (iii) sustainable agricultural systems to support higher water-use efficiency, productivity and incomes.

2. The Cauvery Delta, with an area of 560,000 ha, is irrigated and drained by four main canal systems: (i) Lower Coleroon Anicut (53,000 ha); (ii) Cauvery (200,000 ha); (iii) Vennar (190,000 ha); and (iv) Grand Anicut (121,000 ha). Program will take a phased approach whereby surface water, groundwater, and salinity management will be studied holistically and structural and non-structural investments will be implemented in each of the canal systems by taking one system at a time. As the drainage problems of the Vennar system are most critical, the TA will cover analysis and planning in the Vennar system, and structural and non-structural improvements will be implemented in the Vennar system under Project-1. Project-1 will also include a design facility to conduct analysis and planning for one or two of the other systems, with the investments of other systems implemented under subsequent tranches.

B. Tentative Outputs and Activities

3. For each tranche, the Program may include the following outputs and activities. Project-1 will focus on the Vennar System which is the worse effected and represents the problems and needs of the other three systems.

1. Integrated Programs and Infrastructure for Management of Groundwater, Surface Water and Salinity

- Improved Drainage: New design guidelines for the drainage system will be implemented based on the results of climate change modeling and a calibrated hydrologic and hydraulic model. The Program will support structural interventions such as modifying channel sections¹ and alignments; increasing the capacity of existing or creating new flood retention areas; installing new control structures; re-designation of flood impacted land and formalized overland flow paths; and, improving operation and maintenance procedures including improved sustainable management and removal of aquatic weeds. The Program will also support appropriate interventions and maintenance programs for sustainable river outlet openings.
- Salinity Control and Groundwater Recharge: Based on an assessment of geology, groundwater level and quality, and abstraction data within the delta, and recommendations for abstraction rates prepared during the PPTA for the Vennar

¹ Note that the systems in the sub-basin use combined irrigation and drainage channels that are unlined and operate in regime.

system, the Program will support comprehensive 3-D groundwater modeling for the delta. Structural interventions will include installation and modernization of tail-end regulators² to: (i) prevent seawater ingress in the drainage system; and, (ii) trap and store non-consumptive freshwater for groundwater recharge. The Program will also install new groundwater recharge systems in suitable locations after piloting appropriate methodologies in the delta. A monitoring and evaluation system for assessing the effectiveness of groundwater recharge and salinity control will be established.

- **Disaster Management**: Communities in the delta will prepare and implement disaster flood management plans for when out-of-channel the capacity of the drainage systems capacity is exceeded and productive land and communities are impacted by flood water, including: (a) flood warning systems; (b) procedures during and after flood events; (c) and provision of flood-resilient infrastructure including water supply and sanitation facilities, dwellings and access.

2. Policies, legislation, and institutions for IWRM established or strengthened

- **IWRM Planning**: The Program prepare and implement an IWRM Sub-basin Plan that will consider: (i) the roles and functions of the government offices, universities, non-government organizations, civil-society organizations, and community groups; (ii) their respective duties, responsibilities and capacities in respect to water resource management; (iii) the effectiveness of inter-organization coordination, communication and cooperation; and (iv) gaps where structural and capacity improvements are required to support managing the sub-basin following IWRM principles. The Plan will consider the surface and groundwater resource management in relationship with climate change, future land-use management, interaction with coastal processes, the health and livelihoods of local communities, and the sustainable management and protection of the natural environment.

In support of Government of India's agenda in supporting IWRM and with the involvement of the central government, the Program may also support the integration of the Cauvery Sub-Basin Plan into a Cauvery River Basin Plan. Cauvery basin planning will address technical, environmental, and development issues and opportunities.

- **Strengthening Institutions for IWRM**: The Program will support the sustainable management of surface and groundwater by: (i) establishing an appropriately empowered institution or network for collaboration, decision-making, monitoring, and enforcement; (ii) implementing effective broad-based demand and supply-side management initiatives to address effective management of surface and groundwater taking into account the competing demands for their exploitation as resources; and (iii) developing, approving, and enforcing appropriate rules, regulations and procedures to manage the resources under normal and extreme weather conditions.
- **Decision Support Systems (DSS) for IWRM**: The Program will review existing DSSs being developed and used by the Government of Tamil Nadu (GOTN) such as those being developed under the Hydrology Project Phase II (assisted by the World Bank). The Program will recommend how they can be expanded to include the Cauvery Basin and support the Program. Necessary groundwater, climate and related databases,

² The design horizon for all tail-end regulators and other structures will be based on the future design scenario accounting for expected climate changes.

water resources modeling, and GIS data for basin and sub-basin planning may be provided. The Program will also consider specific DSS systems that continually integrate climate change projections into modeling and supporting planning decisions.

3. Sustainable Agricultural Systems to Support Higher Water-Use Efficiency, Productivity and Incomes

- Conjunctive Water Use: The Program will support structural and non-structural interventions to improve water-use efficiency through conjunctive use of groundwater and surface water, implementing land use changes in over-exploited or saline-affected areas, as appropriate. Interventions include: (i) provision of new, and optimization of existing, ponds and tanks for irrigation supply (gravity or pump fed) that may also be used in conjunction with flood retention and groundwater recharge systems; (ii) programs to support modifying cropping patterns to optimize scheduling of water supply, and reducing non-beneficial evaporation and discharge to saline bodies; and (iii) programs to encourage switching cultivation to less water-consuming crops or crop-strains: with shorter growing season or suited for cooler and drier seasons including use of System of Rice Intensification (SRI) direct seeded rice, saline-resistant rice-strains, and other agricultural technologies.

C. Program Management and Design Support

4. The Government will implement the Program with the support of a multi-disciplinary Program coordination and management unit and subproject level offices of the concerned executing and implementing agencies, comprising GOTN and outsourced experts, consultants, and NGOs. The Program will also finance experts to prepare feasibility studies, project designs, and proposal documentation for Project-2 and subsequent tranches.

**INDIA: CLIMATE ADAPTATION THROUGH SUB-BASIN DEVELOPMENT
TERMS OF REFERENCE OF CONSULTING SERVICES
CLIMATE CHANGE SPECIALISTS**

I. Background

1. The Climate Adaptation through Sub-Basin Development Program (the Program) aims to enhance resilience to climate change by communities in the Cauvery delta of Tamil Nadu, India. The Project outcome will be improved integrated water resources, flood and coastal management in the delta area. The Project outputs will be: (i) integrated programs and infrastructure for management of groundwater, surface water and salinity (through flood dykes, drainage, expansion of flood alleviation areas as well as tanks, farm ponds, and natural water bodies to absorb floods); (ii) establishment and capacity strengthening of institutions and systems for sub-basin IWRM (including planning, monitoring, and decision support systems addressing the impact of climate change); and, (iii) implementation of sustainable agricultural systems to support higher water-use efficiency, productivity and incomes of male and female farmers.

2. Robust information on current and future climate conditions and sea level, based on the latest science, is required to support the hydrologic analysis and design of drainage improvement, flood control and irrigation structures as included in the project preparatory technical assistance (PPTA, the TA) for the Program. In addition, to integrate climate change and sea level rise risk management into the design of sub-basin development and investment projects, in an effective and cost-efficient fashion, the level of uncertainties associated with climate change and sea level rise needs to be adequately characterized and clearly communicated to the other members of the TA team, particularly hydrologists, coastal/marine environment specialists, and engineers on the team.

3. Under the ADB-supported Technical Assistance project “Support for the National Action Plan for Climate Change -Support to the National Water Mission” (TA7417-IND), efforts were made to develop sea level and regional climate projections to support climate risk assessments and management in the Cauvery sub-Basin. In relation to what is required to support the PPTA activities described above, there are notable gaps in the provision of climate and sea level information, including:

- Observed monthly data were derived from international sources (FAO CLIMWAT database)¹ and only available for a limited number of stations. This is insufficient for the purpose of detailed sub-basin level hydrologic modeling and adaptation planning, which requires daily data at more locations so that local scale meteorological (particularly rainfall) features can be sufficiently captured.
- For projections of climate conditions in the future, the TA7417-IND project used outputs from the regional climate model (RCM) Providing Regional Climates for Impacts Studies (PRECIS)² which was understood to perform poorly in representing the rainfall regime in the Cauvery sub-Basin. Therefore, projections of future climate scenarios (particularly rainfall) need to be developed using outputs from other sources of data, including simulations from a range of global climate models (GCMs) and other RCMs³.
- The global average of a 30 cm of sea level rise for 2050, as projected by the

1 <http://www.fao.org/nr/water/infores_databases_climwat.html>.

2 PRECIS is developed by the Hadley Centre of UK Met Office.

3 The Indian Institute of Tropic Meteorology (IITM) in Pune provided outputs of PRECIS simulations to the TA-7417 project and had plans to run RegCM in the Region.

Intergovernmental Panel on Climate Change (IPCC) was used in the TA project. This estimate needs to be reviewed in the context of the regional and local components of sea level rise, as well as new projections for global sea level rise.

4. In light of these gaps, the new generation of GCM simulations, designed to be completed in time for the IPCC Fifth Assessment Report (AR5), should offer opportunities to improve the scenario work carried out during the TA project.

II. Climate Change Coastal Zone Consultant (international, 1 person-month)

A. Scope of work

5. Services from an international climate change coastal zone consultant are sought to develop a set of and sea level scenarios as critical inputs to climate risk assessment and adaptation planning. These scenarios need to be based on the most up to date climate science, credible scenario analysis methodology, and to be accompanied by thorough analysis of limitations and uncertainties associated with the scenarios. The duration of the assignment is one month and the consultant will be home based with two missions to India⁴.

Expected outputs

6. To support the overall objective of the PPTA, the international consultant⁵ is expected to provide the underlying sea level data to support the relevant hydrologic analysis and design of drainage improvement and flood control structures. Key data outputs are summarized in Table SA4.1.

Table SA4.1: Sea level data to be provided through the consulting services

Sea level data			
	Variables	Temporal resolution	Spatial resolution
Baseline⁶	Local relative sea level	Annual	Specific locations
Scenarios (2050)			

Activities and deliverables

7. Major activities and associated deliverables under this assignment are outlined in Table SA4.2.

Table SA4.2: Activities and deliverables

	Activities	Deliverables
Initial scoping	Determine sea level data needs through consulting	A detailed inventory of data needs,

4 The first mission should be fielded at the beginning of the assignment and will be up to one week. The purpose of the mission is to acquire and process, with the assistance of the national consultant, tide gauge records from the Delta region. The second mission will be three days and intends to facilitate meetings and working sessions with the rest of the PPTA team to discuss the application of sea level scenarios to coastal flooding analysis, uncertainties and implications for adaptation planning under the Program.

5 A national consultant will be recruited to provide support on data acquisition and processing. In addition, another international consultant specialised in climate science will be recruited to work on climate scenarios. Interactions and discussions between the international consultants will be facilitated to ensure consistency in the use of global climate model outputs (more details on this in the later part of the ToRs) and the characterisation of uncertainties.

6 To analyse the long-term trend in local relative sea level along the coast of the Sub-Basin, efforts should be made to ensure the full use of available tide gauge records.

	relevant project documents and PPTA team members, particularly the hydrologist and marine/coast specialist	including specific locations for which data are required, indices of extreme events to be analysed, and data formats
Sea level data and scenarios		
Current trend in local relative sea level	<ul style="list-style-type: none"> • Collate relevant tide gauge records; • Analyse current trend in local relative sea level for locations with tide gauge records, and compare it with globally observed trend 	<ul style="list-style-type: none"> • Current trend in local relative sea level, and its comparison with global average trend
Scenarios	<ul style="list-style-type: none"> • Derive sea level change data (at least the component associated with thermal expansion) from GCM simulations for both the baseline period and 2050; • Analyse the global, regional and local components of local relative sea level change (see technical approach below); • Construct local relative sea level change scenarios for 2050; • Estimate sea level change in 2050 associated with 1 in 2, 5, 10, 20, 50, 100, 200 year events for all stations with tide gauge records of reasonable length 	<ul style="list-style-type: none"> • Local relative sea level change scenarios in 2050 for all stations in the sub-basin with tide gauge records of reasonable length; • Estimates of sea level change in 2050 associated with 1 in 2, 5, 10, 20, 50, 100, 200 year events for all stations with tide gauge records of reasonable length
Documentation	Document the technical details of the tasks listed above relating to sea level data	A technical note on the scope, methodology, sea level data outputs uncertainties associated with outputs and their implications for the design of drainage improvement and flood control structures to be considered under the PPTA, including confidence level statements on estimates of changes in sea level rise relating to the range of extreme events.
Communications and advice		
Communications of data uncertainty and confidence level	Brief PPTA team on the uncertainties associated with sea level projections and their implications for adaptation planning in the sub-basin	Briefing notes on uncertainties associated with sea level projections, particularly changes to relevant indices of extreme events, and their implications for adaptation planning
Advice on the integration of climate related risks into the design of drainage improvement and flood control structures	Provide targeted advice on adjustments required for designs of drainage improvements and flood control to be considered for implementation during Project-1 of the CASDP	Practical advice to engineers and economists designing and prioritizing the various structures to be included in the Project-1 investment program

B. Technical approach for scenario development

8. To deliver the expected outputs, the consultant may consider the following technical approach:

9. Based on the methodology outlined in TGICA (2010) (see full reference in the “reference materials” section below) and relevant datasets (e.g. sea level rise simulated by GCMs⁷),

- Analyse the trend of relative sea level representing the coastal area of the Cauvery Delta (*as expressed in mm change per year*);
- Analyse the significance of regional variation in ocean warming-related sea level rise along the coastal area of the Cauvery Delta;
- Analyse the local component of observed sea level change along the coasts of the Cauvery Delta;
- Select global sea level change scenarios from climate model simulations;
- Combine the local component of sea level change with the global and regional components to derive local relative sea level change for the project area

C. Qualifications and Skills Requirement

10. The consulting services outlined above require the following expertise and skills:

- An advanced degree in climate/marine environment science, geography or other relevant subject, with demonstrable knowledge and experience in sea level data and scenario analysis, and characterisation and communicating uncertainties associated with scenarios within the context of climate risk assessments and adaptation planning;
- Extensive experiences in working within a disciplinary team on projects relating to climate impacts assessments and adaptation planning;
- Excellent writing skills and ability to communicate complex technical issues in accessible and concise terms

D. Reference material

11. The consultant should refer to and/or make use of, but not limited to, the following:

For tide gauge records

- Permanent Services for Mean Sea Level (PSMSL) <<http://www.psmsl.org>>
- Inventory of relevant tide gauge records developed during the PPTA reconnaissance mission⁸

For guidance on developing local sea level scenarios

- TGICA guidance document (Nicholls et al., 2011)⁹

II. Climate Scenarios Specialist (international, 3 person-months)

7 Example datasets include those as assessed in the IPCC Third Assessment Report (TAR) (e.g. see Figure 11.13 in <http://www.grida.no/climate/ipcc_tar/wg1/pdf/TAR-11.pdf>).

8 To be provided by ADB project officer once the consultant is mobilized

9 Nicholls, R.J., Hanson, S.E., Lowe, J.A., Warrick, R.A., Lu, X., Long, A.J. and Carter, T.R. (2011) Constructing Sea-Level Scenarios for Impact and Adaptation Assessment of Coastal Area: A Guidance Document. Supporting Material, Intergovernmental Panel on Climate Change Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA), 47 pp. Available at <http://www.ipcc-data.org/docs/Sea_Level_Scenario_Guidance_Oct2011.pdf>.

12. Services from an international consultant are sought to develop a set of climate scenarios as critical inputs to climate risk assessment and adaptation planning. These scenarios need to be based on the most up to date climate science, credible scenario analysis methodology, and to be accompanied by thorough analysis of limitations and uncertainties associated with the scenarios. The duration of the assignment is three months. The consultant will be home based with two mission to India¹⁰.

A. Scope of work

Expected outputs

13. To support the overall objective of the PPTA, the consultant¹¹ is expected to provide the underlying climate data to support the relevant hydrologic analysis and design of drainage improvement, flood control and irrigation structures. Key data outputs are summarized in Table SA4.3.

Table SA4.3: climate data and scenarios to be provided through this consultancy

Climate data			
	Variables	Temporal resolution	Spatial resolution
Baseline (1961-1990)¹²	minimum temperature, maximum temperature,	Daily	Specific locations Gridded data ¹³
Scenarios (2050)	precipitation, wind speed, solar radiation, humidity, water vapor pressure, sea level air pressure		

Activities and deliverables

14. Major activities and associated deliverables under this assignment are outlined in Table SA4.4.

Table SA4.4: Activities and deliverables

	Activities	Deliverables
Initial scoping	Determine climate and sea level data needs through consulting relevant project documents and PPTA team members, particularly the hydrologist and marine/coast specialist	A detailed inventory of data needs, including specific locations for which data are required, spatial resolution of gridded climate data, indices of extreme climate events to be analysed, and data

10 The first mission will be up to three weeks long and its purpose is to acquire and process, with the assistance of the national consultant, intends to facilitate the international consultant to work with a national project partner on observed climate data and tide gauge records. The second mission will be one week long and intends to facilitate meetings and working sessions with the rest of the PPTA team hydrologist and marine/coastal specialist recruited under the CASDP PPTA to discuss the application of climate scenarios to hydrologic analysis, uncertainties and implications for adaptation planning under the Program.

11 A national consultant will be recruited to provide support on data acquisition and processing. In addition, another international consultant specialised in coastal zone/marine science will be recruited to work on sea level scenarios. Interactions and discussions between the international consultants will be facilitated to ensure consistency in the use of global climate model outputs (more details on this in the later part of the ToRs) and the characterisation of uncertainties.

12 Depending on the availability of observed data, 1971-2000 or 1981-2010 may be alternative baseline periods.

13 Spatial resolution of gridded climate data will be determined by the resolution of relevant hydrologic and coastal process models.

		formats
Climate data and scenarios		
Baseline data	<ul style="list-style-type: none"> • Derive key seasonal statistics of observed data for climate variables as specified in Table 1; • Analyse the following critical quantities for rainfall and wind speed using data from all stations: 1 in 2, 5, 10, 20, 50, 100, 200 year events; • Analyse rainfall amount at 80%, 95%, 50%, medium confidence level for the three main seasons in the sub-basin: southwest monsoon, northeast monsoon and dry seasons; • Analyse rainfall depths for durations of hourly (ideally if hourly data is available), daily, 2-days, 5-days and 10-days; • While needed, generate gridded data as per the pre-determined resolution 	<p>Key statistics of climate observations and estimates of critical quantities associated with extreme weather events for the baseline period:</p> <ul style="list-style-type: none"> • Key statistics of observed climate variables; • Estimates of rainfall amount and wind speed associated with 1 in 2, 5, 10, 20, 50, 100 and 200 years events, respectively; • Estimates of rainfall amount at 80%, 95%, 50% and medium confidence level, respectively, for the three seasons; • Estimates of rainfall depths for durations of hourly (if data available), daily, 2-days, 5-days and 10-days, respectively; • If needed, spatially interpolated gridded observational data
Scenarios (for 2050)	<ul style="list-style-type: none"> • Extract datasets covering the Cauvery sub-basin from GCM (see reference material below) and relevant RCM simulations; • Evaluate GCM and RCM performance using model simulations for the baseline period and respective observational data, and select GCM and RCM simulations that would provide the basis for climate scenario analysis under this project; • Synthesise daily model projection data for climate variables as specified in Table 1 from selected GCM and RCM simulations; • Perform statistical downscaling to obtain location-specific scenarios using relevant GCM and RCM outputs and observational data; • Derive key seasonal statistics for relevant climate variables; • Estimate critical quantities associated with extreme climate events for 2050: <ul style="list-style-type: none"> ◦ Rainfall and wind speed associated with 1 in 2, 5, 10, 20, 50, 100, 200 year events; ◦ Rainfall amount at 80%, 95%, 50%, medium confidence level for the three main seasons in the sub-basin: southwest monsoon, northeast monsoon and dry seasons; ◦ Rainfall depths for durations of hourly (ideally if hourly data is available), daily, 2-days, 5-days and 10-days 	<ul style="list-style-type: none"> • Evaluation of GCM and RCM performances over the sub-Basin area; • Key features (as expressed in relevant statistics) of climate change in 2050 over the sub-basin as projected by selected GCMs and RCM simulations; • Estimates of changes in critical quantities associated with extreme weather events in 2050 using daily scenarios derived from GCM and RCM simulations, as well as statistical downscaling: <ul style="list-style-type: none"> ◦ Rainfall amount and wind speed associated with 1 in 2, 5, 10, 20, 50, 100 and 200 years events, respectively; ◦ Rainfall amount at 80%, 95%, 50% and medium confidence level, respectively, for the three seasons; and ◦ Rainfall depths for durations of hourly (if data available), daily, 2-days, 5-days and 10-days, respectively

Documentation	Document the technical details of the tasks listed above relating to baseline climatology and climate scenarios analyses	A technical note on the scope, methodology, climate data outputs, uncertainties associated with outputs and their implications for the design of drainage improvement, flood control and irrigation structured to be considered under the PPTA, including confidence level statements on estimates of changes in critical rainfall and wind speed quantities relating to extreme events.
Communications and advice		
Communications of data uncertainty and confidence level	Brief PPTA team on the uncertainties associated with climate projections and their implications for adaptation planning in the sub-basin	Briefing notes on uncertainties associated with climate projections, particularly changes to relevant indices of extreme events, and their implications for adaptation planning
Advice on the integration of climate related risks into the design of drainage improvement, flood control and irrigation structures	Provide targeted advice on adjustments required for designs of drainage improvements, flood control and irrigation structures to be considered for implementation during Project-1 of the CASDP	Practical advice to engineers and economists designing and prioritizing the various structures to be included in the Project-1 investment program

B. Technical approach for scenario development

15. To deliver the expected outputs, the consultant may consider the following technical approach:

16. A combination of methods should be employed to derive climate scenarios to support hydrologic modelling and adaptation planning included in the PPTA phase of the CASDP. This include:

Deriving scenarios from outputs of Global Climate Models (or General Circulation Models) (GCMs) simulations

17. Based on GCM outputs included in the CMIP5 archive,
- Evaluate the performance of different GCMs by analyzing the skills of GCMs in simulating the key feature of current climate, particularly the key characteristics of monsoon climate;
 - Select a set of GCMs which are considered to exhibit reasonable skills;
 - From the outputs of the selected GCM simulations for the period up to 2050, derive the daily scenarios of changes in key climate variables as listed in Table 1 above;
 - Combine these daily climate change scenarios with observed baseline daily records for the corresponding climate variables to obtain climate scenarios, as inputs to hydrologic and coastal process (wind speed, air pressure) models

Deriving scenarios from outputs of Regional Climate Models (RCMs) simulations

18. Efforts should be made to source outputs of RCM simulations performed over geographic domain including the Cauvery sub-Basin. Potential data sources include outputs from possible simulations performed with RegCM at IITM and other regional climate modelling initiatives (e.g. results from future simulations under the Coordinated Climate Downscaling Experiments, CORDEX, South Asia component).

19. Once the sources of model outputs have been identified, the analytical procedure for deriving climate scenarios is similar to that applied to GCM simulation-based scenario analyses as described above.

Statistical downscaling

20. Statistical downscaling is to be applied with selected GCM- and RCM-based upper air indices, and observational data to develop location-specific climate scenarios and estimate the key indices of extreme rainfall and wind speed events. Depending on the status of data availability and the requirement of hydrologic modelling work and adaptation planning to be carried out under the PPTA, appropriate downscaling technique(s)/method(s) can be used. For an overview of different downscaling methods, see Table 1 of Wilby R. *et al* (2004).¹⁴

C. Qualifications and Skills Requirement

21. The consulting services outlined above require the following expertise and skills:

- An advanced degree in climate science, geography or other relevant subject, with demonstrable knowledge and experience in climate data and scenario analysis, and characterisation and communicating uncertainties associated with scenarios within the context of climate risk assessments and adaptation planning;
- Extensive experiences in working within a disciplinary team on projects relating to climate impacts assessments and adaptation planning;
- Excellent writing skills and ability to communicate complex technical issues in accessible and concise terms

D. Reference material

22. The consultant should refer to and/or make use of, but not limited to, the following:

For observed climate data

- Climate data collated for the Cauvery sub-basin under TA 7417;¹⁵
- Inventory of climate data developed during the PPTA reconnaissance mission⁹
-

For climate model outputs

- Data archive under the fifth phase of the Climate Model Inter-comparison Project (CMIP5) (<<http://cmip-pcmdi.llnl.gov/cmip5>>);
- Global climate model data archive at the Intergovernmental Panel on Climate Change Data Distribution Centre (<<http://www.ipcc-data.org>>);
- Coordinated Regional Climate Downscaling Experiment (CORDEX) (see e.g. <<http://www.meteo.unican.es/en/projects/CORDEX>>);

For guidance on developing climate scenarios from climate models and downscaling

- TGICA guidance document (TGICA, 2007)¹⁶

14 Wilby R., Charles S., Zorita E., Timbal B., Whetton P. and Mearns L. (2004) Guidelines for Use of Climate Scenarios Developed from Statistical Downscaling Methods. Intergovernmental Panel on Climate Change Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA), 27 pp. Available at http://www.ipcc-data.org/guidelines/dgm_no2_v1_09_2004.pdf

15 Relevant documents to be obtained from ADB officer.

16 IPCC-TGICA (2007) *General Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment*. Version 2. Prepared by T.R. Carter on behalf of the Intergovernmental Panel on Climate Change, Task Group on Data and Scenario Support for Impact and Climate Assessment, 66 pp. Available at <http://www.ipcc-data.org/guidelines/TGICA_guidance_sdciaa_v2_final.pdf>.

IV. Climate Change Specialist (national, 3 person-months)

23. A national consultant will assist the international consultants to develop a set of climate and sea level scenarios as critical inputs to climate risk assessment and adaptation planning. These scenarios need to be based on the most up to date climate science, credible scenario analysis methodology, and to be accompanied by thorough analysis of limitations and uncertainties associated with the scenarios. The assignment will require inputs of about 60 working days, to be rendered intermittently (tentatively) from 1 Aug 2012 to 31 Dec 2012, in Tamil Nadu. The consultant will be home based with field trips to the Cauvery Delta area as requested by international consultants.

A. Scope of work

24. To support the overall objective of the PPTA, the national consultant is expected to provide local support, particularly with relation to data acquisition and processing, to the international consultants in developing climate and sea level data to support the relevant hydrologic analysis and design of drainage improvement, flood control and irrigation structures.

B. Detailed Tasks and/or Expected Output

1. Initial scoping - supporting both international consultants:

25. Determine climate and sea level data needs through consulting relevant project documents and TA team members, particularly the hydrologist and marine/coast specialist

2. Climate data - supporting the climate change international consultant:

a. Baseline data

- (i) Derive key seasonal statistics of observed data for climate variables as specified in Table 1;
- (ii) Analyse the following critical quantities for rainfall and wind speed using data from all stations: 1 in 2, 5, 10, 20, 50, 100, 200 year events;
- (iii) Analyse rainfall amount at 80%, 95%, 50%, medium confidence level for the three main seasons in the sub-basin: southwest monsoon, northeast monsoon and dry seasons;
- (iv) Analyse rainfall depths for durations of hourly (ideally if hourly data is available), daily, 2-days, 5-days and 10-days;
- (v) While needed, generate gridded data as per the pre-determined resolution

b. Scenarios (for 2050)

- (i) Extract datasets covering the Cauvery sub-basin from GCM (see reference material below) and relevant RCM simulations;
- (ii) Evaluate GCM and RCM performance using model simulations for the baseline period and respective observational data, and select GCM and RCM simulations that would provide the basis for climate scenario analysis under this project;
- (iii) Synthesise daily model projection data for climate variables as specified in Table 1 from selected GCM and RCM simulations;
- (iv) Perform statistical downscaling to obtain location-specific scenarios using relevant GCM and RCM outputs and observational data;

- (v) Derive key seasonal statistics for relevant climate variables;
- (vi) Estimate critical quantities associated with extreme climate events for 2050:
 - Rainfall and wind speed associated with 1 in 2, 5, 10, 20, 50, 100, 200 year events;
 - Rainfall amount at 80%, 95%, 50%, medium confidence level for the three main seasons in the sub-basin: southwest monsoon, northeast monsoon and dry seasons;
 - Rainfall depths for durations of hourly (ideally if hourly data is available), daily, 2-days, 5-days and 10-days

c. Documentation

- (i) Document the technical details of the tasks listed above relating to baseline climatology and climate scenarios analyses

3. Sea level data - supporting the coastal zone international consultant:

a. Current trend in local relative sea level -

- (i) None.

b. Scenarios -

- (i) Provide estimates of local land movement rates (from previous studies or expert judgment), in consultation with international coastal zone consultant;
- (ii) Provide exccdance statistics of storm surge from previous studies in the region if available;

c. Documentation

- (i) Document the technical details of the tasks listed above relating to sea level data

4. Communications and advice - supporting the international consultants;

- (i) Brief PPTA team on the uncertainties associated with climate and sea level projections and their implications for adaptation planning in the sub-basin
- (ii) Provide targeted advice on adjustments required for designs of drainage improvements, flood control and irrigation structures to be considered for implementation during Project-1 of the CASDP

C. Deliverables:

1. For initial scoping:

26. A detailed inventory of data needs, including specific locations for which data are required, spatial resolution of gridded climate data, indices of extreme climate events to be analysed, and data formats. This should be prepared in consultation with international climate and coastal zone consultants;

2. For climate data:**a. Baseline data -**

27. Key statistics of climate observations and estimates of critical quantities associated with extreme weather events for the baseline period:

- (i) Key statistics of observed climate variables;
- (ii) Estimates of rainfall amount and wind speed associated with 1 in 2, 5, 10, 20, 50, 100 and 200 years events, respectively;
- (iii) Estimates of rainfall amount at 80%, 95%, 50% and medium confidence level, respectively, for the three seasons;
- (iv) Estimates of rainfall depths for durations of hourly (if data available), daily, 2-days, 5-days and 10-days, respectively;
- (v) If needed, spatially interpolated gridded observational data

b. Scenarios (for 2050) -

- (i) Evaluation of GCM and RCM performances over the sub-Basin area;
- (ii) Key features (as expressed in relevant statistics) of climate change in 2050 over the sub-basin as projected by selected GCMs and RCM simulations;
- (iii) Estimates of changes in critical quantities associated with extreme weather events in 2050 using daily scenarios derived from GCM and RCM simulations, as well as statistical downscaling:
 - Rainfall amount and wind speed associated with 1 in 2, 5, 10, 20, 50, 100 and 200 years events, respectively;
 - Rainfall amount at 80%, 95%, 50% and medium confidence level, respectively, for the three seasons; and
 - Rainfall depths for durations of hourly (if data available), daily, 2-days, 5-days and 10-days, respectively

c. Documentation -

28. A technical note on the scope, methodology, climate data outputs, uncertainties associated with outputs and their implications for the design of drainage improvement, flood control and irrigation structured to be considered under the PPTA, including confidence level statements on estimates of changes in critical rainfall and wind speed quantities relating to extreme events.

3. For sea level data**a. Current trend in local relative sea level -**

- (i) None

b. Scenarios

- (i) Estimates of local land movement rates (from previous studies or expert judgment);
- (ii) Storm surge exceedance curves from previous studies

c. Documentation

29. A technical note on the scope, methodology, sea level data outputs uncertainties associated with outputs and their implications for the design of drainage improvement and flood control structures to be considered under the TA, including confidence level statements on estimates of changes in sea level rise relating to the range of extreme events. The document should be prepared in consultation with international coastal zone consultant;

4. For communications and advice:

- (i) Briefing notes on uncertainties associated with climate and sea level projections, particularly changes to relevant indices of extreme events, and their implications for adaptation planning
- (ii) Practical advice to engineers and economists designing and prioritizing the various structures to be included in the Project-1 investment program

Technical approach for scenario development

30. To deliver the expected outputs, the consultants may consider the following technical approach:

Climate scenarios

31. A combination of methods should be employed to derive climate scenarios to support hydrologic modelling and adaptation planning included in the TA phase of the CASDP. This include:

Deriving scenarios from outputs of Global Climate Models (or General Circulation Models) (GCMs) simulations

32. Based on GCM outputs included in the CMIP5 archive,
- Evaluate the performance of different GCMs by analyzing the skills of GCMs in simulating the key feature of current climate, particularly the key characteristics of monsoon climate;
 - Select a set of GCMs which are considered to exhibit reasonable skills;
 - From the outputs of the selected GCM simulations for the period up to 2050, derive the daily scenarios of changes in key climate variables as listed in Table 1 above;
 - Combine these daily climate change scenarios with observed baseline daily records for the corresponding climate variables to obtain climate scenarios, as inputs to hydrologic and coastal process (wind speed, air pressure) models

Deriving scenarios from outputs of Regional Climate Models (RCMs) simulations

33. Efforts should be made to source outputs of RCM simulations performed over geographic domain including the Cauvery sub-Basin. Potential data sources include outputs from possible simulations performed with RegCM at IITM and other regional climate modelling initiatives (e.g. results from future simulations under the Coordinated Climate Downscaling Experiments, CORDEX, South Asia component).

34. Once the sources of model outputs have been identified, the analytical procedure for deriving climate scenarios is similar to that applied to GCM simulation-based scenario analyses as described above.

Statistical downscaling

35. Statistical downscaling is to be applied with selected GCM- and RCM-based upper air indices, and observational data to develop location-specific climate scenarios and estimate the key indices of extreme rainfall and wind speed events. Depending on the status of data availability and the requirement of hydrologic modelling work and adaptation planning to be carried out under the TA, appropriate downscaling technique(s)/method(s) can be used. For an overview of different downscaling methods, see Table 1 of Wilby R. *et al* (2004).¹⁷

Sea level rise scenarios

36. Based on the methodology outlined in TGICA (2010) (see full reference in the “reference materials” section below) and relevant datasets (e.g. sea level rise simulated by GCMs¹⁸),

- ⤴ Analyse the trend of relative sea level representing the coastal area of the Cauvery Delta (*as expressed in mm change per year*);
- ⤴ Analyse the significance of regional variation in ocean warming-related sea level rise along the coastal area of the Cauvery Delta;
- ⤴ Analyse the local component of observed sea level change along the coasts of the Cauvery Delta;
- ⤴ Select global sea level change scenarios from climate model simulations;
- ⤴ Combine the local component of sea level change with the global and regional components to derive local relative sea level change for the project area

A. Qualifications and Skills Requirement

37. The consulting services outlined above require the following expertise and skills:

- ⤴ Advanced degree in environmental science, geography or other relevant subject;
- ⤴ Extensive knowledge and experiences in data processing;
- ⤴ Good knowledge on the status of climate and sea level data availability and procedures for data acquisition in India

B. Reference material

38. The consultant should refer to and/or make use of, but not limited to, the following:

For observed climate data

- Climate data collated for the Cauvery sub-basin under TA 7417;¹⁹
- Inventory of climate data developed during the TA reconnaissance mission¹⁰

For tide gauge records

- Permanent Services for Mean Sea Level (PSMSL) <<http://www.psmsl.org>>
- Inventory of relevant tide gauge records developed during the TA reconnaissance mission¹⁰

For climate model outputs

- Data archive under the fifth phase of the Climate Model Inter-comparison Project (CMIP5) <<http://cmip-pcmdi.llnl.gov/cmip5>>;
- Global climate model data archive at the Intergovernmental Panel on Climate Change Data Distribution Centre (<<http://www.ipcc-data.org>>);
- Coordinated Regional Climate Downscaling Experiment (CORDEX) (see e.g.

17 Wilby R., Charles S., Zorita E., Timbal B., Whetton P. and Mearns L. (2004) Guidelines for Use of Climate Scenarios Developed from Statistical Downscaling Methods. Intergovernmental Panel on Climate Change Task Group on Data and Scenario Support for Impact and Climate Analysis (TGICA), 27 pp. Available at http://www.ipcc-data.org/guidelines/dgm_no2_v1_09_2004.pdf

18 Example datasets include those as assessed in the IPCC Third Assessment Report (TAR) (e.g. see Figure 11.13 in <http://www.grida.no/climate/ipcc_tar/wg1/pdf/TAR-11.pdf>).

19 Relevant documents to be obtained from ADB officer once the consultant is mobilized.

<<http://www.meteo.unican.es/en/projects/CORDEX>>;

For guidance on developing climate scenarios from climate models and downscaling

- TGICA guidance document (TGICA, 2007)²⁰

For guidance on developing local sea level scenarios

TGICA guidance doc

20 IPCC-TGICA (2007) *General Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment*. Version 2. Prepared by T.R. Carter on behalf of the Intergovernmental Panel on Climate Change, Task Group on Data and Scenario Support for Impact and Climate Assessment, 66 pp. Available at <http://www.ipcc-data.org/guidelines/TGICA_guidance_sdciaa_v2_final.pdf>.

TOPOGRAPHICAL SURVEY WORKS

A. Introduction

1. The project preparatory technical assistance (the TA) for the Climate Adaptation through Sub-Basin Development Investment Program (the Program) will support project preparation through the following main outputs: (i) preparation of a roadmap for integrated water resources management in the sub-basin; (ii) hydrologic, hydrodynamic, and water resources modeling of the Vennar canal system; (iii) feasibility studies for schemes to be financed under the first tranche of the program; (iv) preparation of implementation manuals and capacity development plan; and (v) advice on the preparation of detailed project reports and initial procurement packages. The Water Resources Organisation (WRO) of the Public Works Department, Government of Tamil Nadu, is the executing agency for the TA.

2. The modeling work will be completed prior to preparation of the feasibility studies for sub-projects and will be designed to address the following: (i) approaches to arrest saline intrusion in groundwater, (ii) development of sustainable drainage systems, (iii) optimum sites for regulator structures for salinity control, (iv) options to prevent or reduce blocking of river outlets, (v) support for land use planning, (vi) options for flood control and management, and (vii) sites for freshwater abstraction points for water supply and irrigation to ensure that they are out of the saline zones.

B. Summary Scope of Survey Works

3. To support the modeling, the TA will require topographical surveys of the canal and drainage network of the coastal part of the Vennar system, and development of a digital elevation map (DEM). These two outputs need to be completed prior to the main consulting TA team being mobilized so that they can start the modeling work with the data in hand. Initiation of the survey is expected to start immediately upon TA effectiveness (estimated October 2012) and be completed over a period of 4 months (until January or February 2013). ADB will engage a national survey firm (the Survey Firm) for the survey works using the least cost selection method in accordance with ADB's *Guidelines on the Use of Consultants* (2010, as amended from time to time), and all procurement will be in accordance with ADB's *Procurement Guidelines* (2010, as amended from time to time).

C. Topographical Survey Requirements

1. Survey Works

4. **Description of works.** The Work comprises of: (i) topographical surveys of river longitudinal and cross section profiles that will be used for developing hydraulic models in a later study,¹ and, (ii) establishing survey control points (SCPs) within 1,800km² of the Cauvery Delta for calibrating satellite stereo imagery. The Work will be carried out in the Cauvery Delta with the project area and the channels to be surveyed shown in Annex A.

5. **Longitudinal and Cross-section Survey.** The total length of channels to be surveyed under this package is about 414km. A summary of the channels to be surveyed including the approximate extent of survey is shown in Annex A. The Work includes the surveying of all

¹ The models will be used to determine the existing capacity of the channels and where necessary the design of rehabilitated enlarged channels.

structures that are located within the channels in the project area. The approximate total number of structures to be surveyed is about 126 (also shown in Annex A referenced to each channel). Structures include any human made structure the spans the channel including but not limited to: flow and level regulator structures; road and rail bridges; weirs; drop structures; etc. For the river longitudinal and cross section surveys, within the reaches defined in Annex A and taking into account the following section, the Survey Firm shall consult WRO Vennar System staff to select final survey locations.

6. **Establishing survey control points.** For the establishment of the SCPs the Survey Firm shall receive instruction on all specific locations from WRO staff from either the State Ground and Surface Water Resources Data Centre (SGSWRDC) or Institute for Water Studies (IWS). All SCPs will be within the project area shown in Annex A.

7. **Locations of survey points.** Intervals shall be measured along the length of the channel in the direction of flow. Chainages shall be based on those of the Vennar System's. The cross sections shall be taken perpendicular to the general alignment of the channel. On average, cross sections should be surveyed at 250m intervals within the reaches defined in Annex A. However, shorter intervals between surveyed cross sections are required where: (i) the characteristics of the terrain change radically; (ii) where the channel flow is constricted; (iii) where the shape of the channel changes (width or depth); (iv) at sharp bends in the stream; (v) at dramatic changes in the profile of the stream flow; and, (vi) immediately upstream and downstream of structures.

8. The intent of the survey is to provide sufficient and accurate topographical detail of the channels, associated structures, and flood plain areas within the project area. For channel cross-sections this includes, but is not limited to, surveying and recording the elevations and coordinates: (i) every 5 meters (m) above the water level; (ii) every 2 m below the water level; (iii) at the centre of the channel including the water level; (iv) the left and right limits of the channel width, their invert levels and water levels (clearly shown on outputs);² (v) the top of bank on both left and right sides of the channel; (vi) the widths of the top of banks on both sides of the channel; (vii) either continuing the cross section surveys for 100 m beyond the embankments on both sides of the channel embankments or where there are no embankments extending the survey until the ground level is 2 m above the normal water level of the channel and the ground continues rising at a consistent gradient beyond the limit of the survey; and, (viii) any anomaly feature within the channel and floodplain including but not limited to: sand mounds, vegetation, human-made structures, etc besides points designated in the above items (i) to (vii).

9. For structures within the channel (for example: weirs, regulators and bridges) this includes, but is not limited to, surveying and recording the elevations and coordinates: (i) the channel cross-section as detailed in the above paragraph above at locations immediately upstream and downstream of the structure, and also at locations 20 m upstream and downstream of the structure; (ii) all structural dimensions of the structure including but not limited to: invert and sill levels; weir levels and dimensions; gate and vent dimensions including but not limited to levels, widths, heights and positions; bridge soffit and deck levels and dimensions; (iii) bridge structures shall be surveyed for 100 m beyond the embankments on both sides of the channel; and, (iv) observed marked flood levels painted on the structures by WRO staff and the associated date of the mark.

² Left and right are relative to the channel alignment in the direction of its flow.

10. Topographic surveys shall record key levels and dimensions in sufficient detail to prepare accurate drawings of the existing structures, plus the surrounding area. The existing structure survey shall include: (i) existing plan dimensions of structure; (ii) levels of key walls, bridge decks, upstream and downstream bed and apron levels, and sill level, and other structural elements; (iii) dimensions and elevations for at least two cross sections across the structure, at right angles to each other.

11. The Survey Firm will receive the specific locations for the establishment of all SCPs from WRO staff. WRO staff will issue to the Survey Firm a form for each SCP showing satellite image of the location and the Longitude and Latitude of the required SCP. The Survey Firm shall establish a SCP at this location, accurately measure the elevation, and fully complete all necessary sections of the form.

2. Survey Framework, Accuracy and Control

12. Survey co-ordinates and maps shall use standard India horizontal and vertical datums as origin with survey observations tied into Government of India survey control stations and benchmarks (BMs) as necessary. The scale of capture of survey data shall be suitable to support mapping at 1:2,500 scale or better where larger scale mapping is used for crossings and other specialist areas.

13. **Survey Control and Benchmarks.** Where necessary, the Survey Firm shall establish new permanent BMs. These shall be clearly visible from at least two others to facilitate reinstatement in the event of one being damaged or lost. The new BMs may be located on existing immovable structures or rocks, with a concrete nail driven into the object to indicate the exact point and the position clearly marked with permanent red paint. If no such hard point exists, a 600 millimeter (mm) long, 200 mm diameter concrete benchmark shall be provided that protrudes 150 mm above ground level. Each new BM shall be clearly numbered in red paint or in the case of a concrete block, etched into the top whilst the concrete is still wet. A register of the new and existing benchmarks shall be set-up and a separate site plan for each new BM shall be prepared giving the co-ordinates, a description of the point and a sketch map.

14. The permanent BMs shall be reduced to the India National Datum and the field survey shall connect to a minimum of two national BMs. The maximum closing error between two adjacent bench marks shall be ± 5 mm for elevation and ± 20 mm for the horizontal coordinates and the overall closing error through all the BM shall not exceed ± 10 mm for elevation and ± 50 mm in the horizontal.

15. Surveying of the channel alignment and cross sections shall be conducted to achieve: (i) horizontal accuracy of ± 0.05 m; (ii) vertical accuracy of ± 0.05 m; and, (iii) surveying of structures shall be conducted to achieve an accuracy of ± 0.01 m, relative to the BMs. To ensure these accuracies are maintained, the Survey Firm shall make regular (not longer than manufacturer's recommended frequency) verifications to demonstrate that the initial bench calibration by the manufacturer is still valid and within specified requirements.

16. **Geodetic Horizontal and Vertical Datums.** All survey work shall be based on World Geodetic System (WGS) 84 standard and the Universal Transverse Mercator (UTM) co-ordinates, or otherwise as directed by the ADB. Topographical heights shall be in meters and based on Ordinance Datum Mean Sea Level (MSL).

17. **Secondary Control.** Secondary network stations shall be established at every cross section location. Such stations shall be tied into the primary network and full station descriptions (including witness marks) provided to ADB. The secondary network controls will mark the location of every surveyed cross section on both the left and right banks of the channels and shall be constructed using markers that will remain in serviceable condition for up to 2 years.

18. **Level Control.** Local vertical control shall be undertaken using double measurement techniques (forward and reverse) using control data obtained from the national mapping authority. A minimum of 2 vertical control points shall be used at the terminations of the routes and two further points along the route section.

19. **Calibration and Check Survey.** The accuracy of primary and secondary control shall be determined by the Survey Firm to meet the requirements of the topographic survey. The Survey Firm shall: (i) keep GPS, electronic and optical surveying instruments in close adjustment according to manufacturer's specifications or in compliance to textbook standards; and, (ii) ensure that electronic distance measuring devices are compared to a base line, measured by static GPS or a standardized or calibrated tape, at least every six months. Field measurements of angles and distance shall be done in such fashion as to satisfy the closures and tolerances expressed above.

20. **Equipment.** The Survey Firm shall supply, maintain and operate all the equipment³ necessary to carry out the Work in accordance with this specification. An equipment itinerary sufficient for each survey team to work simultaneously shall be submitted to ADB when a firm expresses interest in the Work, and shall be confirmed by the Survey Firm prior to commencement of any fieldwork. The Survey Firm shall ensure that all equipment necessary to carry out the Work has been calibrated within 6-months prior to commencing fieldwork. Copies of relevant calibration certificates shall be made available to the ADB for review, as requested, prior to commencement of Work. Copies of the calibration certificates shall be included in the Field Survey report. The Survey Firm shall carry out daily and weekly field checks on equipment to ensure the continuing validity of calibrations. The results of these field checks and any subsequent adjustments shall be documented and all such documentation shall be part of the regular reporting.

21. The Survey Firm shall communicate as necessary with WRO and ADB staff. The Survey Firm shall have computer capabilities with high-speed modem and appropriate communication software for transfer of survey information via standard communication links. All technical information shall be sent to WRO and ADB in native format - e.g. drawings in AutoCAD, tabulations in a data base format or Excel or equivalent etc. Signature certified data can be sent in Adobe PDF format together with an unsigned native format copy. Formats of deliverables are further discussed below.

3. Presentation of Data

22. In addition to the survey points of the channels, flood plains and associated structures, ancillary objects should also be included including but not limited to: BMs, description of roads

³ Equipment includes differential GPS, total station theodolites, appropriate software and computers for post-processing of survey results, benchmark posts, survey pegs and nails, telescopic leveling staffs, appropriate equipment for installing benchmarks and clearing vegetation, appropriate water craft for carry out surveys in water bodies, and appropriate safety equipment for working in and near water bodies.

and railways (edges and centerlines); dwellings; significant trees; transmission lines for communications, water and electrical needs; any other minor water channels such as drainage ditches and sewers; and all other topographical features required to achieve the specified accuracy and to define the terrain in its entirety. The survey map shall represent the information gathered during the survey and shall be prepared using AutoCAD. Further presentation requirements are outlined in Annex B.

4. Procurement of Satellite Imagery

23. The Survey Firm will purchase satellite imagery from appropriate vendors that is suitable for developing the DEM and work with staff from the WRO to ensure timely DEM development. The areal extent of the imagery is the project area covers a similar area to the river channels shown in Annex A. An indicative budget of \$51,000 has been included in the cost estimate under “provisional sums.”

D. Government Role in Survey Supervision and DEM Preparation

24. **Survey Supervision.** WRO staff will accompany the Survey Firm in the field to confirm: (i) preferred locations along the channels for the survey of cross sections, and (ii) necessary structures that require surveying.

25. **DEM Preparation.** Staff from the WRO’s SGSWDC will be responsible for developing the DEM. Using their in-house software and equipment, they will: (i) review the satellite imagery; (ii) identify locations of required SCPs, prepare associated elevation request forms, and issue these forms to the Survey Firm for completion; and (iii) on receipt of completed forms, process the satellite imagery and SCPs to create a calibrated DEM.

E. Personnel

26. The Survey Firm shall appoint an experienced Team Leader/Senior Surveyor to: (i) manage and co-ordinate the field survey activities; (ii) ensure overall quality control; (iii) manage data processing and drawing production; (iv) be responsible for managing the preparation and timely delivery of all outputs; and, (v) liaise with ADB. The Survey Firm shall mobilize five experienced surveying teams to undertake the field work, data processing and preparation of deliverables. Each field team shall be led by a suitably qualified and experienced Surveyor who will be supported by a suitably qualified and experienced Assistant Surveyor and a suitable number of support staff. The follow table summarizes the key inputs and qualification requirements:

Table 1: Key Personnel Inputs and Qualifications

Position	Qualifications	Person-months
Senior Surveyor/Team Leader	Candidate should preferably have a master degree in surveying, engineering or an equivalent professional qualification and more than 10 years experience in undertaking topographical and bathymetric surveying, and at least 5 years of managing surveying projects.	4
Surveyor (5 people)	Candidates should be have a suitable degree in engineering or an equivalent	4 each (20 total)

	professional qualification, and at least 5 years experience in undertaking topographic surveys, preferably within river and canal environments.	
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F. Output Requirements

27. **Output Schedule.** In addition to the reporting schedule discussed below, the Survey Firm is also responsible for submission of completed sub-packages of works according to those shown in Annex B. The Pandavayar Sub-package is to be delivered to ADB and the WRO first within 1 month of mobilization. The early delivery of this sub-package will be used to assess the quality and performance of the initial Works and allow changes to procedures if necessary. The remaining sub-packages and any changes to the Pandavayar Sub-package are to be delivered to ADB with the Draft Final Report. All field work shall be completed within 3 months of mobilization.

28. **Reporting.** The Survey Firm shall submit the following reports to ADB (2 copies) and the WRO (4 copies):

Table 2. Reporting Requirements and Schedule

Document	No. of Copies	Submission Date
Inception Report	6	Within 1 week of mobilization
Weekly Progress Reports	digital	Weekly
Draft Final Report	6	Within 2 weeks of completing field work
Final Report	6	Within 2 weeks of receiving comments from ADB and the WRO

29. The Inception Report shall comprise, amongst other things: (i) the project-specific quality plan; (ii) a technical method statement; (iii) the proposed survey, drawing and document reference system; (iv) work plan and personnel schedules to complete the Work; (v) the primary survey control plan; (vi) a weekly progress report proforma; and, (vii) project team organogram and contact details of senior team members.

30. The Survey Firm shall prepare weekly progress reports in digital format for electronic correspondence for ADB to review, which shall document: (i) activities undertaken during the week; (ii) progress made during the week and the overall progress with reference to the work plan and personnel schedule; (iii) any problems encountered and envisaged, and steps taken to alleviate these problems to avoid delaying the contract schedule; and, (iv) intended activities for the next week. This report may be of a brief nature and should be submitted each Monday.

31. The Draft Final and Final Reports will address for each sub-package: (i) the scope of works (specified and achieved); (ii) deviations and concessions; (iii) description of the works undertaken including: a) survey overview; b) horizontal and vertical positioning systems; c) equipment layouts / configurations; d) description of survey instrumentation, including scales, sensitivity settings, calibrations and operating parameters; and, e) survey procedures, including a quality statement covering sufficiency and accuracy of data gathered, a comparison of data from survey line crossings, and a discussion of any problems affecting data acquisition or interpretation; (iv) an explanation of the reference system used and table of contents for all data

and material being delivered; (v) survey results including topographic, level and detail survey data; (vi) three-dimensional data, presented in comma delineated ASCII format; (vii) a log of events covering all relevant information in chronological order; (viii) personnel; (ix) equipment calibration certificates; and, (x) photos of calibration points and points of interest.

32. ADB may issue comments on all outputs and the Survey Firm shall incorporate these comments into the issue of their final deliverables. Copies of the above reports and documents shall be submitted to ADB by the submission deadline. In addition to the printed versions, the Survey Firm shall submit six electronic copies on clearly labeled CD or DVD or other approved media, conforming to the following requirements:

- (i) Where appropriate, the Survey Firm shall compress (ZIP) files, so that the entire report (or volume) is stored on a single CD or DVD.
- (ii) The report contents shall be clearly indexed and stored in Adobe PDF format. Where MS EXCEL has been used in preparation of lists, calculations, etc, the complete MS EXCEL files shall also be submitted to facilitate verification by ADB.
- (iii) The CD or DVD shall contain all data in the formats required specified for all survey data including but not limited to: stereoscopy imagery purchased, surveyed cross sections, surveyed structures, BM stations. These are to be held in separate directories which are suitably titled according to the agreed reference system.
- (iv) In general, only standard commercially available software shall be used in the work and the Survey Firm shall list the software they propose to use. Under certain circumstances, and with the approval of ADB, the Survey Firm may use non-standard software to perform part of the work, provided the firm makes provision for the handover of the software to ADB, so it is available for use at a later date to update or revise the data.

33. All reports and other study documents shall be in the English language. Printing and binding shall be of high quality, suitable for presentation to government and international funding agencies. All reports shall be in A4 paper format (with fold out A3 sheets where required), except for the drawings which should be A3. Metric units according to the International System of Units are to be used throughout.

34. **Meetings.** The Survey Firm's participation in certain non-productive activities may be required. These activities may include, but not be limited to, meetings to be held with ADB and the WRO.

G. Cost Estimate

35. The cost is estimated at \$140,000. See Table 3 for the breakdown.

Table 3. Cost Estimate

Items	Cost (\$)
Remuneration	73,000
Report production and transmission	2,000
Satellite imagery	51,000
Contingency	14,000
Total	140,000

ANNEX A: CHANNEL AND STRUCTURE SURVEY LOCATIONS

Survey Locations in Vennar System of Cauvery Sub-basin

Channel	From ¹		To ¹		Overall Distance ¹ (km)	No. Structures ¹
	Location	Chain (km)	Location	Chain (km)		
Pandavayar Sub-Package						
Pandavayar	Erayangudi TER	143	Vellaiyar	148	5	1
Vellaiyar	Vellaiyar Head	121	Bay of Bengal	153	32	13
Sub-Total					37	14
Harichandra Nadhi Sub-Package						
Harichandra Nadhi	Mulliyar Head	121	Bay of Bengal	165	44	15
Athiveeraramanar	Palliverthi Village	0	Harichandra Nadhi	6	6	2
Sub-Total					50	17
Mulliyar Sub-Package						
Mulliyar	Thiruthuraipoondi	146	Lagoon	166	20	3
Adppar	Pamani	147	Bay of Bengal	172	25	8
Valavanar	Thiruthuraipoondi	0	Lagoon	20	20	5
Chettipulam	Mulliyar	0	Adppar	12	12	0
Manakondanar	Mulliyar	0	Lagoon	18	18	0
Sub-Total					95	16
Koraiyar Sub-Package						
Koraiyar	Koraiyar	116	Lagoon	179	63	28
Kandaparichanar	Koraiyar	0	Lagoon	10	10	1
Marakkakoraiyar	Madapuram	0	Lagoon	22	22	13
Old Kilaithangiyar	Railway Line	0	Lagoon	10	10	2
New Kilaithangiyar	Old Kilaithangiyar	6	Lagoon	12	6	1
Vetter Drain	Old Kilaithangiyar	0	Lagoon	9	9	0
Sub-Total					120	45
Paminyar Sub-Package						
Paminyar	Mannargudi Drain	110	Lagoon	153	43	13
Kananar	Vaduvur Tank	0	Paminyar	35	15	11
Sub-Total					58	24
Vedaranyam Sub-Package						
Vedaranyam Canal	Velankanni	0	Topputturai	41	41	10
Chaliyan Voikal SC	Vedaranyam Canal	0	Bay of Bengal	13	13	0
Sub-Total					54	10
TOTAL					414	126

Notes: (1) These are approximate only and chainages/numbers may change in the field.

ANNEX B: PRESENTATION OF DATA

1. **General Data Format.** Unless stated otherwise, all text, dimensions, test data, results and all other information relating to the Work shall be expressed in English and referenced to SI units. The Survey Firm will provide a survey, drawing and document reference system for the approval of the ADB prior to commencement of Works. On approval, this system will be used for preparation and communication of all deliverables.
2. The Survey Firm shall provide outputs for the Pandavayar Sub-Package as soon as possible after commencement of Works. This data will be used for checking and Quality Control purposes. The ADB reserves the right to alter size type and representation of data provided by the Survey Firm. The format of deliverables are:
 - i. All linear features shall be presented as a 3D polyline and all non-linear features shall be presented as 3D points. All features defining closed boundaries of data shall be represented as 3D polygons.
 - ii. All data shall be supplied in both AutoCAD and ArcGIS formats;
 - iii. All drawing objects are to be drawn in model space at a scale of 1:1 (i.e. AutoCAD units = 1m, INSUNITS (AutoCAD setting) to be set to the value of 6, which defines the drawing as metres);
 - iv. All entities are to be in colour BY LAYER and line type BY LAYER;
 - v. All entity groups i.e. trees are to be on separate layers;
 - vi. All point data are to be defined as a block and have attributes assigned;
 - vii. All polyline data i.e. field boundaries are to be one continuous polyline with no slope line shown. i.e. tracks and roads are to be defined by a continuous polylines. All polylines are to have text on the line describing the entity in the field;
 - viii. The completed forms for each SCP.
3. Furthermore, all surveyed cross section data shall be delivered in ASCII digital tabular format suitable for importation to hydraulic modeling software. An example will be provided by ADB.
4. **Surveyed Mapping Data.** The surveyed mapping and cross section data shall illustrate the following:
 - i. Natural features, including but not limited to the channels, structures, river crossings etc including water level and bed level;
 - ii. Observed flood levels marked on structures;
 - iii. Existing man-made features, including but not limited to; houses, schools, plantations, vegetation, electric lines (including the cable height for overhead lines), water pipes, roads and future roads, bridges etc. An attribute shall be shown which provides a brief description;
 - iv. New and existing survey BMs;
 - v. Transverse profiles location;
 - vi. Co-ordinates of all bench marks shown next to the symbol. (The referenced elevations shall be rounded to and shown to the nearest 1cm).
 - vii. Spot elevations shown to the nearest 1cm.
 - viii. Contour lines shall be at 0.20m (minor), 1m (major) vertical intervals and shall be labeled with the correct elevation above a specified reference datum.

5. **Structure Drawings.** The Survey Firm shall prepare detailed surveys and drawings for all hydraulic structures spanning the channels including regulation structures, weirs and bridges (road, rain and foot), plus any additional locations as required by the Contracting Authority. The drawings shall include the plan of the structure and vertical elevation profile both longitudinal and perpendicular to the alignment of the channel. The drawings will show the dimensions of embankment levels, invert levels, sill levels, weir levels, gate sizes, orifice sizes, soffit levels of bridges, past observed flood markings, and any other feature identified by ADB or WRO. The plan drawings shall show the location, direction and reference ID of associated photographs. The area surrounding the structure shall be surveyed and shall extend 50m both sides of the channel axis and 50m upstream and downstream of the structure.

6. **Photographs.** The Survey Firm shall maintain a geo-referenced digital photographic record of all survey activities including but limited to BMs, cross-sections, the upstream and downstream profiles of every surveyed structure, other features that will appear on survey plans prepared by the Survey Firm, and any other features requested by ADB. The resolution of photos shall be appropriate to present sufficient detail. The photos shall be labeled using the agreed reference system.

INDIVIDUAL CONSULTANT TERMS OF REFERENCE MAIN TA CONSULTING TEAM

1. **IWRM Specialist / Team Leader** (international, 7 person-months [p-m]). The expert will have professional experience in preparing and/or implementing multidisciplinary water resources management projects. Experience in project preparation in external funding agencies will be given preference. The expert will undertake the following tasks after familiarization with the Project, and requirements of MFF project preparation including sector roadmap and investment plan:

- (i) Provide overall direction of the TA team, and manage the relations with the EA, and undertake TA workshops/seminars to discuss inception report and draft outputs.
- (ii) Prepare inception report within 15 days of fielding setting out structure or table of content of TA outputs referred above for finalization in consultation with the EA and ADB.
- (iii) Establish MFF project structure, finalizing schemes for Project-1 (for feasibility studies), and the systems covered in subsequent tranches with list of subprojects.
- (iv) With the Project Economist, establish baseline data and result targets (as per preliminary design and monitoring framework [DMF]) arranging necessary surveys²⁶ and data collection.
- (v) Manage the process of sector analysis and roadmap preparation.
- (vi) Manage the process of feasibility assessment of Project-1 interventions and their reporting, covering the following aspects: (a) basic infrastructure and program design and options including climate change resilient design; (b) implementation cost, arrangements, schedules; (c) economic and financial impacts, and environmental, and social safeguards including actions to enhance the participation of vulnerable groups; and, (d) risk assessments and mitigation measures.
- (vii) Lead the process of MFF program (and Project-1) packaging covering the following aspects, following the set formats for framework financing agreements and periodic financing request, and facility administration manual: (a) component design, cost estimates and financing, implementation arrangements, detailed implementation plan, procurement plan, and monitoring and evaluation with effective management information system (MIS); (b) Institutional arrangements for effective multidisciplinary project implementation; and, (c) capacity development plan.
- (viii) Advise on the post appraisal Project processing actions.

2. **Institutional Specialist / Deputy Team Leader** (national, 8 p-m). The expert will have professional experience in analyzing and diagnosing institutional strengthening preferably in water resources/irrigation/drainage sector. The expert will undertake the following tasks after Project familiarization:

- (i) Take coordinating role of Team Leader in the latter's absence.
- (ii) Prepare MFF investment plan with inventorying of proposed flood management, institutional and agricultural interventions.
- (iii) Undertake sector water resources institutional sector analysis following diagnostic analysis approach including establishing the institutional and program context for this project and its linkages with other National and State level initiatives.
- (iv) Recommend: (a) appropriate institutional structure of Project implementation for flood management, and, (b) project design and arrangements to strengthen WUAs including resource requirements and task list.

²⁶ Including land use mapping, PRA with local NGO, surveys for agro-economic, social indicators, social and environmental safeguards, and any other subjects to establish appropriate baseline data.

- (v) Review the institutional structure and arrangements governing the project area and recommend improvements based on: (a) current structure and capabilities (skills, responsibilities and resources); (b) IWRM principles; (c) needs to address and manage impacts of climate change; (d) special needs of the delta region, specifically the conjunctive relationships between meteorology, surface water, groundwater, coastal management, and land-use; (e) effective maintenance requirements; (f) budget needs and availability; and (g) the empowerment, strengthening and participation of WUA's to manage and effectively maintain their drainage systems.
- (vi) Recommend implementation schedule to support the institutional changes proposed under the above.
- (vii) Identify and recommend suitable capacity and awareness programs that will support and facilitate the proposed above changes. The fore-mentioned recommendations will be based on the context of the wider regional and national institutional arrangements including recommendations of other ongoing programs.

3. Flood Management / Drainage Design / Hydraulic Structures Specialists (international, 5 p-m; national 6 p-m) will have professional experience in the planning and design of large scale open water course controlled drainage systems and hydraulic structures. The national expert will have experience in sustainable coastal management. The experts will undertake the following tasks:

- i. In participation with PWD, prepare drainage design guidelines to assist with climate proofing the Cauvery Delta's drainage system including recommending appropriate design standards taking into account existing standards and design procedures.
- ii. Assess the existing drainage of the Vennar System and its upstream tributaries, its problems, past studies and recommendations and prepare feasibility studies of interventions to alleviate routine flooding. Interventions may include but not be limited to modifying channel sections and alignments, increasing the capacity of existing ponds and tanks, proposing formalized flood retention areas, rehabilitating existing and installing new control structures, re-designating flood impacted land, formalizing overland flow paths when the capacity of the drainage system is exceeded, and improving operating and maintenance procedures including proposing interventions for the sustainable management of sediments and aquatic plants.
- iii. Assess the flood diversion capacity of upstream flood control structures including the Upper and Grand Anicuts for both the existing and future scenarios.
- iv. Prepare feasibility studies for new and rehabilitated tail-end regulators to: (a) prevent seawater ingress in the drainage system and neighboring productive land; and, (b) store un-used freshwater for lift irrigation and groundwater recharge. The location of new tail-end regulators shall be identified with participation of PWD and local farming and aquaculture communities, and shall consider the impacts of the structure and retained freshwater on neighboring productive land.
- v. Prepare feasibility studies of other recommended drainage structures including but not limited to regulators, control and diversion structures, flood embankments, ponds and tanks, and emergency drainage channels.
- vi. Assess existing lift irrigation schemes in the Vennar System and prepare feasibility studies for maximizing pumping capacities during flood events in order to minimize downstream flood levels. Also, prepare feasibility studies for using or enhancing existing ponds and tanks (and those proposed under this project including formalized flood retention areas) as bulk water storage for irrigation during dry periods, including: (a) preliminary design of the storage systems and conveyance channels to the command areas including both gravity and pumped systems; (b) operation requirements; and, (c) opportunities for ownership and management by local farmer co-operatives.

- vii. In participation with PWD, existing disaster management authorities and communities, prepare a disaster management plan for out-of-channel flooding when the capacity of the drainage system is exceeded impacting on communities habitations and productive land. The Plan shall account for expected climate change and include: (a) a community based flood warning system; (b) procedures for ensuring the health and safety of communities during and after flood events; and, (c) recommendations for flood-resilient infrastructure including maintaining freshwater supply, sanitation facilities and emergency dwellings and access/egress routes
- viii. Supervise and provide quality assurance during the preparation of detailed design reports (DPRs) and associated procurement packages for Project-1 subprojects.

4. **Hydrologist** (international, 2 p-m; national, 2 p-m) will have professional experience in carrying hydrological analyses and modeling in tropical and cyclone affected areas. The experts will undertake the following tasks:

- i. Collect and review the outputs from the climate change specialists which will include present and future rainfall depths for various durations and design storm events.
- ii. Use the extreme data to develop storm profiles for the Vennar system based predominant historic observed storm events or suitable alternative methods.
- iii. Develop, calibrate and use a rainfall-runoff model to simulate inflows to: (a) the flood management hydraulic model in liaison with the flood management and hydraulic modeling specialists; and (b) the water balance model in liaison with the Agriculturalist.
- iv. Provide recommendations for suitable interventions that benefit flood management, improving water-use efficiency, and groundwater recharge.
- v. Assess the current hydro-meteorological network, associated institutions, and ongoing improvement programs within the Sub-basin and recommend: (a) measures to modernize current data collection, processing and storage practices; (b) improve the capacity and structure of existing institutions; and, (c) support the development of the DSS.

5. **Hydro-geologist and Groundwater Modeler** (international, 1.5 p-m; national, 3 p-m) will have professional experience in developing groundwater models in coastal areas to assess the causes and impacts of groundwater depletion and salinization. The experts will undertake the following tasks:

- i. Collect available data of the geology of the project area, aquifer formations, groundwater levels and flows, groundwater quality and abstractions in the project area, and analyse this data to understand the processes that are causing saline intrusion within the project area.
- ii. Develop a representative 2-D model within the project area to provide quantitative analysis of groundwater quantity and quality under various scenarios (both climate change and interventions identified by this project).
- iii. Use the model to recommend indicative sustainable abstraction rates on a regional basis under various scenarios of proposed interventions.
- iv. Review existing groundwater recharge initiatives in the project area, recommend improvements where necessary, and recommend sites in the Vennar System for up-scaling. Opportunities for groundwater recharge sites may include but not be limited to existing and proposed flood retention areas and upstream of tail-end regulators. Prepare a feasibility study for additional groundwater recharge interventions and recommend an appropriate monitoring and evaluating program.
- v. Recommend requirements for more comprehensive 3-D groundwater model for the project area including input data requirements, software, consultant scope of works, implementation schedule, costs and discuss how the model can be used for: (a) the

DSS; and, (b) effective IWRM including planning future structural, non-structural and land-use management interventions.

6. **Hydraulic Modeling Specialists** (international, 2 p-m; national, 2 specialists for 4 p-m each) will have professional experience in developing complex unsteady state 1D floodplain hydraulic models. The international specialist may also be the Hydrologist. The experts will undertake the following tasks:

- i. Collect and review available data (hydrological, topographical, structural and coastal), and determine the geographical extents and channels to be included within the hydraulic model based on the drainage layout of the Vennar System, its upstream tributaries, and known flood prone areas. The extent of the model must be sufficiently flexible to allow for changes to develop and assess proposed interventions during the course of the study. The boundary conditions will be provided by the hydrologists and climate change specialists however, liaising with the Hydraulic Structures Specialist the modelers must assess the current and future flood diversion capacities of the Upper and Grand Anicuts, and other upstream diversion structures, to account for any non-diverted flood flow within the hydraulic model.
- ii. Develop a 1D-2D hydraulic model²⁷ of the drainage system and associated floodplains. Then calibrate the model using available historical records and observations.
- iii. Use the model to develop interventions to a feasibility level. The “with” and “without intervention” cases shall be assessed with the present and future climate scenarios and the 1 in 2, 5 10, 50 and 100-year design storm events. The modelers must account for the coincidence of extreme rainfall and sea level events; and also address current practices communities and PWD use for opening the beach outlets during times of high flows and any impacts on the functionality of the drainage system. The model shall also be used to analyze the benefits and impacts of interventions, including a do-nothing case which will be considered the base-case for comparative and economic appraisals.
- iv. To ensure robustness of the proposed interventions, the modeling must include appropriate sensitivity analyses allowing for variability within the climate change scenarios, hydrological models, channel roughness, and downstream controls (i.e. unpredictable beach outlet profiles).
- v. Using the model results and GIS software, prepare flood extent, duration, and hazard maps for all design storm events and the current and future scenarios. The maps will provide sufficient detail for: (a) economic assessment of the interventions; (b) comparative analysis of the expected impact of climate change; (c) comparative analysis of interventions and the no-nothing scenario; and, (c) development of disaster risk management plans.
- vi. Use the model to develop operating rules for management of hydraulic structures and for planning maintenance throughout the system including recommending dredging and aquatic weed removal scheduling.

7. **GIS Specialist** (national, 2 p-m) will have professional experience in using international GIS software, developing GIS databases, and using GIS to prepare maps. The expert will:

- i. Gather all available and relevant spatial data related to the project area and river basin including topographical data, land-use data, soils and geological data, and any other relevant data to the project, and develop a GIS database for this information.

²⁷ Note that PWD are already using DHI software in the State of Tamil Nadu and this project strongly supports extending its use for the models prepared in the Cauvery sub-basin to foster capacity development and maintain consistency across the State.

- ii. Support the Hydraulic Modeling Specialists by preparing flood maps based on the outputs of the hydraulic modeling.
 - iii. Support the Economist using the flood maps to assess potential benefits.
8. **Coastal Engineer** (international, 0.5 p-m; national, as a component of the national Flood Management / Drainage Design / Hydraulic Structures Specialist) will have professional experience in assessing coastal processes and bar-mouth (beach outlet) opening structures and dredging programs. The expert will undertake the following tasks:
- i. Review available data from other coastal projects along the east coast of India²⁸ to understand the current and possible future shoreline processes resulting from expected climate change and provide advice on impacts to drainage within the project area.
 - ii. Assess the feasibility of constructing formal beach outlet structures, including future maintenance requirements. The feasibility of the structure must account for any benefits and impacts that the structure may have on other parts of the coastline and account for these in its assessment.
 - iii. Assess the feasibility of managing the beach outlets of the drainage system using routine dredging programs only.
 - iv. Provide advice to the Drainage and Hydraulic Modeling Specialists on likely downstream boundary conditions under various outlet scenarios, including closed, partially-opened, and fully-opened outlets.
 - v. Provide advice to the Hydraulic Structures Specialist on appropriate positioning and design of tail-end regulators.
9. **Decision Support System Specialist** (national, 2 p-m) will have professional experience in hydro-meteorological data collection, processing and storage systems, hydrological and hydraulic modeling, and developing decision support systems. The expert will assist with:
- i. Assessing available climate, hydro-meteorological, groundwater and sea-level data in the basin area and assessing its quality and usefulness for use in the DSS;
 - ii. Assessing previous and ongoing data collection, management and modeling initiatives within the State of Tamil Nadu to ensure effective integration of the recommendations proposed under this Program.
 - iii. With stakeholder participation identify the likely decision making requirements appropriate to the needs of the basin;
 - iv. Undertaking a stakeholder assessment for capabilities and requirements to maintain, operate and manage the DSS and recommend capacity development programs if necessary.
 - v. Preparing the TOR for development of a Decision Support System (DSS) that will be carried out during Project-1.
10. **Civil Engineer** (national, 4 p-m) will have professional experience in designing and preparing cost estimates for hydraulic structures and drainage systems. The expert will assist with preparing preliminary designs and costs of recommended interventions, and provide quality assurance during the preparation of detailed design reports (DPRs) and associated procurement packages for Project-1 subprojects.
11. **Agriculture Specialists** (international, 1 p-m; national, 2 p-m). The experts will have professional experience in planning and implementing irrigated agriculture development programs, including field based technology demonstration and dissemination, value chain

²⁸ Review findings from the World Bank-supported bar mouth opening project, among others.

development including market linkage development and action-oriented researches for new technologies. Experience in options to promote higher crop per drop is highly preferred. The experts will undertake the following tasks.

- i. Develop an appropriate water balance model to quantitatively assess the feasibility and benefits of proposed water-use efficiency interventions.
- ii. Support the Project Economist with establishing benchmarks on cropping intensity and productivity and also with identifying current seasonal agriculture practices in the project area.
- iii. Recommend water efficiency initiatives through conjunctive use of surface and groundwater for water supply and irrigation needs and propose trials areas and monitoring and evaluation systems.
- iv. Recommend modifications to existing cropping schedules to minimize overall scheme water demands, maximize water-use efficiencies and reduce non-beneficial evaporation and discharge to saline bodies.
- v. Explore and assess exhaustively options for more “crop per drop” crop diversification initiatives including switching cultivation to less water-consuming crops or crop-strains with shorter growing seasons, or suited for cooler and drier seasons, including SRI direct seeded rice, saline-resistant rice-strains, and other agriculture technologies such as micro irrigation, including the perspectives of enhancing climate change resilience.
- vi. Assess present system of market and extension information systems, and propose any measures to be considered in project areas in promoting crop diversification to maximize water demand efficiencies.
- vii. Link with local universities and research agents and identify areas of action research.
- viii. Assess the overall impacts on current land-uses and livelihoods within the project area and provide recommendations on how possible adaptation interventions could improve the incomes of local communities particularly with respect to future changes in available water resources, crops, fisheries and aquaculture.

12. **Project Economist** (international, 2.5 p-m). The expert will have professional experience in undertaking economic sector assessment of flood management, agriculture development, as well as economic and financial analyses of irrigated agriculture development projects, including baseline surveys. Experience in externally assisted programs will be taken as advantage. The expert will undertake the following tasks.

- (i) Establish benchmarks (differentiating flood and salinity affected areas with non-affected areas) with arrangement of agro-economic surveys, flood management specialist, hydraulic modelers and agricultural specialists. Benchmarks are also to include current level of WUA participation in operation and maintenance of the project area; and current cropping intensities and productivity at the system and farm level.
- (ii) Undertake a detailed economic and financial analysis of the subprojects in accordance with ADB’s *Guidelines for the Economic Analysis of Projects* (1997);
- (iii) Identify the economic and financial risks associated with the Project-1 subproject(s) and conduct a sensitivity and risk analysis;
- (iv) Prepare economic and financial analyses of proposed interventions in coordination with the team members for Project-1 feasibility studies.
- (v) Calculate the incremental cost of recommended interventions in light of climate change.
- (vi) Prepare and provide the detailed costing of the Program (MFF and Project-1), collecting component-wise detailed costs from other experts, and contribute to project packaging.

13. **Financial Analyst** (national, 2 p-m). The expert will have professional experience in undertaking economic sector assessment of flood management, agriculture development, as well as economic and financial analyses of irrigated agriculture development projects, including baseline surveys. Experience in externally assisted programs will be taken as advantage. The expert will undertake the following tasks.

- (i) Support the Economist in preparing financial analyses of proposed interventions in coordination with the team members for Project-1 feasibility studies.
- (ii) Undertake financial management assessment (FMA) of the EA and any implementing agencies and recommend necessary capacity building programs. Prepare a financial management manual for Project-1. Consideration should be given to (a) the design of the funds flow and disbursement mechanisms for the ensuing project, based on FMA of executing/implementing agencies, and (b) identification of any further capacity building (financial management and ADB's disbursement procedures) that will be necessary for the project, based on the results of the FMA.
- (iii) Assist the Economist in preparing detailed costing of the Program (MFF and Project-1).

14. **Environment Specialist** (national, 2 p-m). The expert will have a post graduate degree in environmental science/engineering degree in environmental science/engineering or any related degree. S/he will have at least 8 years of experience in conducting environmental assessments. The expert will:

- i. Prepare all necessary assessments and framework to meet ADB's Safeguard policy requirements and Government of India's statutory requirements and regulations on Environmental assessments. To meet ADB's safeguard requirements (as per the Safeguard Policy Statement 2009-SPS) an Environmental Assessment and Review Framework (EARF) is required to provide guidance on screening and categorization, assessment, planning, institutional arrangements, and processes to be followed for subprojects and/or components that are prepared under the multitranche financing facility. For Project-1, an initial environmental examination (IEE) will be prepared according to guidelines presented in the SPS. One comprehensive IEE (which includes the environmental management plan) will be prepared for all interventions proposed in the Vennar System. The consultant will assess: (a) positive and negative environmental impacts of proposed interventions related to location, design, construction, and operation and maintenance; (b) propose mitigation measures; and develop an environmental management plan; (c) conduct consultations as per ADB and Government requirements; and, (d) together with the social development specialist determine the most appropriate grievance redress mechanism to address social and environmental grievances.
- ii. Work with the government counterparts to ensure that project affected persons and stakeholders are consulted during the preparation of the IEE, and that key information on project, impacts and proposed mitigation and management measure are provided to affected persons in a manner that is easily understood (in the local language) and in place which is readily accessible.
- iii. Work with the other specialists in the team, in the finalization of the river basin management plan, through assessment of the likely environmental impacts of the proposed river basin plan and suggesting measures to integrate environmental concerns into the plan.

- iv. In addition to the above, provide inputs in to the project RRP, and Project Administration Manual (PAM), and provide support to obtain the government's endorsement on the EARF.

15. **Aquaculture Specialist** (national, 1 p-m). The expert will have professional experience environmental science/engineering degree in environmental science/engineering or any related degree. S/he will have at least 8 years of experience in conducting environmental assessments. The expert will:

- i. Review existing guidelines and practices of aquaculture development in the project area and identify current issues related to aquaculture, in particular shrimp farming. Recommend improvements where necessary to support possible up-scaling of operations where saline-affect land is identified as no longer suitable for agricultural practices.
- ii. Establish benchmarks on current extent, intensity and productivity of aquaculture activities in the project area.
- iii. Prepare guidelines on required conditions (such as soil, water quality, in particular where abandoned saline agricultural lands are to be used) for the sustainable establishment of aquaculture farms that do not impact on adjacent agricultural activities;
- iv. Together with the Environment Specialist determine the environmental risks of increasing aquaculture farming on the environment and other agricultural practices and provide guidelines on site selection, determine areas most suitable for aquaculture farming to be considered in the river basin plan;
- v. With the Agricultural Specialist and Economist, assess the economic viability of expanding aquaculture development in the area and together with the social development specialist assess the social impact of the proposed expansion.
- vi. Recommend measures for: (a) improvement of production and marketing of aquaculture products both locally and further afield; and (b) improvement to supply chains of aquaculture equipment and consumables; and, (c) external assistance and financial incentives for supporting sustainable development and growth of the industry.

16. **Social, Gender and Resettlement Specialist** (national, 5 p-m). The expert will have a post graduate qualification in a relevant social science. S/he will have at least 15 years of work experience in the design and implementation of resettlement action plans and in gender sensitive, participatory rural appraisal for community development. S/he will act as principal adviser to the Government and the TA Team on resettlement, socio-economic analysis and development of a gender mainstreamed, pro-poor approach to the Program. S/he will also ensure that the organizations, policies and investments being developed in the proposed loan are socially sound, responding to both gender equitable and sustainable considerations and in accordance with ADB's policies on Involuntary Resettlement (Safeguards Policy Statement 2009) and Gender.

17. The consultant will prepare documentation required to meet ADB SPS and national regulations for Involuntary Resettlement. For a project implemented under MFF modality, a Resettlement Framework (RF) is required to provide guidance on screening and categorization, assessment, planning, institutional arrangements, and processes to be followed for subprojects and/or components that are prepared after the ADB approval. For Project-1, a draft Resettlement Plan will be prepared on the basis of stakeholder consultation, social profile, institutional assessment and an analysis of likely project impacts. Specifically, the consultant's tasks will include but are not limited to:

- i. Undertake stakeholder consultation in identified project areas, including separate focus group interviews with groups of men and groups of women, occupational groups and civil society organizations
- ii. Identify key stakeholders (poor and vulnerable groups in particular), their project-related interests, identify their likely barriers to participate in and benefit from project resources, and suggest possible strategies for addressing the concerns of these stakeholders. As the proposed impact of the investment program is to improve the resilience of communities in the Cauvery Delta to climate change, (sex-disaggregated) baseline data must be collected during TA on the effect of current environmental factors, e.g., flooding, growing salinity, drought, etc., on the communities' daily lives, specifically their means of livelihood, income, access to water and other services, security and protection from natural disasters, among others. These data will in turn, help carry out a social/gender analysis and provide a baseline against which envisaged improvements in the communities' lives can be measured.
- iii. Prepare an initial stakeholder analysis and a draft participation plan.²⁹
- iv. Conduct a gender analysis to translate prominent gender issues in Tamil Nadu, project specific gender concerns and exploration of gendered social vulnerabilities into actions which, in recognition of women's different social status, needs and abilities, gender roles and social vulnerabilities, will:
 - o Promote women's participation in project planning and implementation.
 - o Maximize women's access to project benefits.
 - o Provide opportunities to increase women's skills, incomes and participation in decision-making (practical and strategic benefits to women, progress towards gender equality). This will include analysis of women's loss of income from trading fish and seafood due to declining catches (amongst other trends) and how such livelihood transition of women can be supported by the project.
 - o Minimize social vulnerability.
- v. Prepare a Gender Action Plan for Project-1 in the prescribed format, including implementation arrangements, budget and any capacity building requirements for implementation. Provide a guide for how the GAP is to be updated for subsequent tranches.
- vi. Improve on the gendered indicators in the DMF to make them more tangible and measurable, such as the specific nature of gender-responsiveness in disaster management plans or minimum % target of women in the executive committees of WUAs.
- vii. Prepare the project RF, including lessons learned from previous and ongoing relevant projects in Tamil Nadu, proposed entitlements, implementation arrangements and budget for discussion and awareness raising/ capacity building during the MTR workshop.
- viii. Ensure livelihood restitution measures for relocated households and otherwise impacted people are closely integrated with the livelihood development strategy of the project, including adoption of measures proposed in the Gender Action Plan.
- ix. Activity and capacity analysis of local NGOs in the Project-1 subproject area, suitability to work in project implementation particularly with regard to monitoring or implementation of pro-poor gender sensitive initiatives, or scaling up activities contributing to project outcomes, for example use of water hyacinth, which is a major cause of drainage channel clogging, for productive or income generating purposes.
- x. Prepare all safeguards documentation as well as inputs for project RRP, FAM and Summary Poverty Reduction and Social Strategy (SPRSS).

²⁹ Please refer to the Handbook on Social Analysis.

- xi. Initiate public disclosure of project safeguard documentation to affected persons, in cooperation with the Environment Specialist.
- xii. Provide necessary support in initiating the government endorsement of resettlement related documents.

18. **Procurement Specialist** (national, 1 p-m). The expert will have in-depth familiarity in the procurement systems of multilateral development banks, and have practical experience in preparing and processing relevant documents. Experience in training of staff of the executing agencies of the MDB-assisted projects will be taken as an advantage. The expert will undertake the following tasks.

- i. Undertake procurement assessment of the EA, including the existing procurement systems of the State. Assess if there are any capacity, procedural and organizational constraints that may affect effective Project implementation, and recommend an action plan with the EA to address these constraints.
- ii. Assess the procurement risk and put in place appropriate review and supervision processes and thresholds to mitigate those risks.
- iii. Prepare procurement plan for Project-1, and assist and advise on the preparation process of the procurement documents and materials in line with the requirement of the State and for ADB financing.
- iv. Undertake seminars on the relevant guidelines on procurement and engagement of consultants and NGOs.