

**Terms of Reference (ToR)**  
**Feasibility Study of 50 Nos Small Dams and**  
**Lining of 50 Nos Ponds / Tاراies in Sindh Province**

<b>Activity Reference No</b>	:	<b>PK-SID-247635-CS-QCBS</b>
<b>Project ID</b>	:	<b>Pakistan P155350</b>
<b>Project Name</b>	:	<b>Sindh Resilience Project (Irrigation Component)</b>
<b>Credit No</b>	:	<b>IDA-6794-PK</b>
<b>Implementation Agency</b>	:	<b>Sindh Irrigation Department Government of Sindh</b>

**1. Introduction**

The main responsibility of Sindh Irrigation Department is operation and maintenance of the irrigation, drainage, and flood protection system, regulation of flows of river Indus and canal system, construction of small storage and recharge dams in water scarce areas of Sindh to recharge freshwater aquifers, which are utilized for domestic and agricultural purposes to uplift livelihood of inhabitants. Other responsibilities of the department are execution of development schemes, mega projects and managing administrative and financial matters.

Besides floods, Sindh province faces droughts in north-western and southern regions on recurring basis. The drought from 1998-2002 affected 1.4 million people, 5.6 million cattle head and 12.5 million acres cropped areas, triggering spread of malnutrition-based diseases in the population and food scarcity in the province due to poor overall crop production.

The province of Sindh is highly vulnerable to natural disasters i.e. floods, droughts, cyclones, heat waves, etc. because of its geo-graphical location and climatic cycles. In recent past province has faced heavy losses to public and private infrastructure, livestock, livelihood etc. worth billions of rupees. Sindh Irrigation Department aims to fulfill agricultural and domestic water needs by managing floods and droughts through improved infrastructure in the water scarce areas of Sindh Province.

**2. Main Objective**

Sindh Resilience Project-SRP (Irrigation Component) intends to hire services of a consultancy firm to carry out, "Feasibility Study of 50 Nos Small Dams and Lining of 50 Nos Ponds / Tاراies in Sindh Province"

The small dams shall be constructed to recharge groundwater aquifers or storage of fresh water for domestic, agriculture and livestock purposes to improve the livelihood of poor people, as well as minimize runoff and downstream nutrient loading into rivers and water bodies.

There exist many small to large size ponds (locally called "Tاراies") in Thar Desert where rainwater is stored and used by the local communities for domestic and livestock consumption. These ponds (Tاراies) are formed in natural depressions. The water stored in these ponds / Tاراies remains for few days to maximum one month before percolating in the groundwater. In some areas, groundwater levels are deep and the quality of groundwater is brackish, hence water percolating to groundwater is completely lost. In such cases, lining of ponds / Tاراies allow to store water for much longer period which gives direct benefits to local communities.

### 3. Background

The construction of small dams and other rainwater harvesting interventions in arid zones of Sindh were taken up by various agencies since early 1980. The Sindh Arid Zone Development Authority (SAZDA) carried out feasibility study of small dams and gabion weirs in Nagarparkar and Kohistan region in 1991. About 6 or 7 dams were constructed in Nagarparkar area at that time. Most of those got damaged with passage of time.

In the late 1990s 5 small dams were constructed in Nagarparkar area by some NGOs. One of them, the Kalidas dam, got breached on its first filling and remaining four developed heavy leaks. A few dams were constructed on Malir and Thado Rivers by Sindh Irrigation Department and Karachi City Government in late nineties. There is a clear need of better engineering of the water infrastructure.

In year 2003, the Sindh Irrigation Department formed Small Dams Organization (SDO) under a Chief Engineer level Project Director with an aim to carryout design, construction and maintenance and operation of small dams in the province. Under SDO following studies were carried out for feasibility and detailed design of small dams in various parts of Sindh:

Name of Study	Year	No. of Dams Studied
Comprehensive Feasibility Study for Design and Construction of Small Dams & Detention Weirs for Leftover Potential Sites in Nagarparkar Area Including Construction of Irrigation Bund along Chhrasar Nai	2008	48
Feasibility Study for Construction of Small Dams on Nai Baran, Nai Sann, Nai BazKhando, Nai Bandhni and Other Nais in Kirthar Range (Sindh)	2008	54
Consultancy Services for Planning and Preparation of Detailed Designs of 40 Small Dams, Recharge Dams and Vetting of Designs of 63 Detention Weirs located in Kohistan and Nagarparkar areas of Arid Zone, Sindh.	2009	50
Feasibility Study for Design and Construction of Small Dams on Nais Originating from Quba Qadir Bux and Ubhan Shah Hills in Sukkur and Khairpur Districts	2009	20
Consultancy for Surveys, Investigations, Detailed Designs, Tender Documents and PC-I of Seven (07 Dams in Kohistan Region, Sindh	2010	06

A study for feasibility of 2 number small dams (Pokhan and Injeer in central Kohistan) was also carried out by Ministry of Water and Power Islamabad under Water Sector Capacity Building and Advisory Services Project (WCAP) in 2013.

As a part of World Bank-funded Sindh Resilience Project-SRP (Irrigation Component), in its phase-1 a total of 14 small dams have been constructed in various parts of Sindh. Whereas, 53 small dams are under construction in SRP Phase – II.

A number of streams and potential locations of dam sites have been identified by previous studies. Many ponds/Taraies have also been identified which require lining. The Consultants shall evaluate dam sites on these streams and analyze locations of ponds/Taraies after carryout initial desk studies, field reconnaissance survey, rapid social & environmental assessments and develop a ranking list for 50 dam sites and 50 ponds/tarries for detailed feasibility study, designs and other project documentation.

#### **4. Location of Study Area**

Feasibility study is proposed to be conducted over all the Sindh Province. The consultants may select after approval from the Client the dams from previous studies which are neither constructed nor being tendered. Similarly, ponds/Taraies may also be selected from the already identified sites. However, the updating and completion of investigations surveys, design and other aspects of feasibility study of those dams shall be responsibility of the Consultant.

#### **5. Scope of Work**

The consultants would be assigned but not restricted to the following responsibilities:

##### **I. Collection of Data**

Consultant shall collect the available primary and secondary source data related to the study.

##### **II. Review of Data**

Consultant shall review all the data collected through previous feasibility studies, such as rainfall and stream flow data, climatic and weather data, topographic data, demographic data or any other data deemed necessary for the detailed feasibility study.

##### **III. Additional Data Collection**

The Consultants shall collect all additional data including metrological data, groundwater data, agricultural data, etc. necessary for conducting feasibility study & design of the project components.

##### **IV. Collection of Baseline Data for Future Performance**

Collection of baseline data including agriculture, social, environmental and groundwater for future monitoring of the impact of dams.

##### **V. Investigations, Surveys and Analysis**

After completion of review, consultant shall devise strategy for collection of relevant data needed for conduction of feasibility, study for which consultant shall carry-out further investigations and additional surveys and information or data deemed necessary based on each potential site. These shall include the following:

- a. Topographic Surveys, Geo-technical Investigations, Base Line Environmental and Monitoring Survey, Hydrology Studies and other studies of each proposed site which are essentially required for detail designing of a safe, technically reliable, and economically viable structure.
- b. The available data shall be collected which may comprise of design features, topography, geology, land use and others. The Digital Elevation Model (DEM) and satellites imageries shall be acquired to get the topographic and land-use features of individual catchments on

adequate scale and resolution. In addition, soil maps of catchment area shall also be procured. Daily rainfall and flow data from relevant rainfall and stream flow gauging stations shall be collected from the relevant agency and incorporated in the GIS system for the assignment.

- c. Analysis of rainfall data frequency, Run-off data (A-FT), evaluation of maximum discharge of 25, 50, 100, 500 or 1000 years return periods, as well as run-off characteristics (e.g. mean value and standard deviation).
- d. Prepare a Baseline Report pertaining to Environmental and Social conditions in the before-Project status of the project-affected areas. The baseline should include quantifiable indicators that allow to monitor environmental and social effects during project's implementation and during project's operation.
- e. All required investigations including seismic assessment and geo-technical investigation etc. should be conducted in detail in order to ensure safe and hydraulically efficient works under all expected static, dynamic, hydrodynamic forces, and seepage gradients. The Consultants shall conduct the geotechnical investigations through a properly qualified sub- contractor / firm.

Bidders to propose list and quantities of site investigation works. Bidders to quote lump sums for those. The proposed programs are part of the technical evaluation. The proposed lump sums are NOT part of the financial evaluation. During the assignment, the selected consultant updates the list; the Client reviews and determines suitable program and associated costs.

- f. Consultant shall assess the incremental flooding in case of dam break and prepare associated inundation maps.
- g. Consultant shall also carry out dam break study, safety check flood (SCF) analysis ratio between Design Flood and the flood that can be passed with water level immediately below the dam crest elevation) and use that to assess overtopping resilience.
- h. Consultants shall also study the various options for lining of ponds/Taraies including concrete lining, geomembrane lining, clay lining, combination of concrete and geomembrane lining, geomembrane lining covered by stone pitching, etc. After detail study and comparison of technical and economic parameters, Consultants shall recommend best option for lining of ponds/Taraies.
- i. Consultants shall study volume of inflow and out flow from the ponds/Taraies. Based on the volume of inflow, Consultants shall calculate the feasible size of ponds/Taraies to be lined. The arrangements for inflow and out flow of rain water shall also be designed considering the volume of inflow/outflow and area topography.
- j. Consultants shall also study the impact of storage of water in the ponds/Taraies on the water quality, especially considering that water will be stored in the ponds/Taraies for a longer period and both humans and animals will drink water from the same pond. They shall recommend and design the measures to be taken to maintain the water quality as per the approved standards.
- k. Observe water availability of each proposed dam site and ponds/Taraies in the project area.
- l. Monitoring of groundwater levels in area prior (baseline survey) to construction of each dam and lining of ponds/Taraies, and provide forecast during operation.
- m. Based on the above. provide guidance to Sindh Irrigation Department on how to monitor and interoperate the recharge of aquifer and storage in the ponds/Taraies in project area and to maintain the record of water table profile and contours.
- n. Availability of lands and its associated cropping pattern for purpose of utilization of

- storage water of the dams.
- o. Command area of each proposed recharge facility and areas benefited.
  - p. Based on discharge observation and sediment yield at existing ponds, provide an initial assessment of sedimentation trends, recommend frequency of sedimentation surveys, and suggest sedimentation measures.
  - q. Impact on Socio-Economic life of communities located at dam sites, command areas and lower riparian.

## **VI. Feasibility and Detailed Design of Dams and Lining of Ponds/Taraies**

Based on all reviews, data collection reports, technical investigations and analysis the consultant shall identify the potential sites for construction of small dams and lining of ponds/Taraies. Identification of sites must address:

- a. Catchment area of respective proposed dam and pond/Taraie site.
- b. Reservoir boundaries and reservoir capacities of respective dam and Taraie site.
- c. Storage capacity of each pond/Taraie.
- d. Type of dam structure.
- e. Type of lining of pond/Taraie.
- f. Design of proposed structures including various components.
- g. Prepare detailed design of dams and ponds covering all the aspects required to prepare the engineer's estimates.
- h. Considering the elevation contours of stream and upstream area and annual water inflows, propose the best suited size of the reservoir/ dam crest level and inlet/outlet arrangements for ponds/Taraies.
- i. Recommended strategies for sediment management.
- j. Type and suitability of construction material required and its availability in the near-by areas.
- k. Recommended cropping patterns and irrigation practices.

## **VII. Environment and Social Safeguards Management**

Under this item of work, the consultant shall be required to prepare Environmental and Social Safeguards Assessment aligned with the Project's Environment and Social Management Framework (ESMF)

- i. Identify primary and secondary impact zones, collect and analyze relevant data for these zones including land use and cropping patterns etc.
- ii. Conduct environmental and socio-economic surveys, including laboratory analysis (where required)
- iii. Identify and assess impacts of the proposed intervention on the environmental and social receptors, and propose relevant mitigation measures according to the mitigation hierarchy.
- iv. Prepare ESMP/ IEE / ESIA / EMMP of each proposed site in accordance with the ESMF of the project, and in line with Government of Pakistan/ Government of Sindh regulations and laws, and World Bank guidelines, and will get approval for each document and package from Sindh Environment Protection Agency (SEPA), and Sindh Forest & Wildlife Department.

- v. Prepare Resettlement Action Plans (RAP)/Abbreviated Resettlement Action Plans (ARAP) where required in accordance with the Resettlement Planning Framework (RPF) of the project.

### **VIII. Designers Operational and Maintenance (O&M) Plan**

The Consultants are required to submit the O&M plan. The contents of O&M plan shall include:

- Details of the project Operation instructions pertaining to dry and flood periods, including flood forecasting.
- Maintenance program for the civil works, access roads, and wells; planned maintenance schedule.
- Surveillance program including visual surveillance, piezometer monitoring, and expert inspections.
- Long term asset management including sediment surveys and sedimentation management measures.
- Emergency preparedness in case of sudden release of water from the weir.

### **I. X. Financial and Economic Analysis**

As first step for financial and economic analysis, all benefits and costs of the project shall be assessed. Irrigation benefits shall be calculated as difference between 'with project' and 'without project' situations. Benefits shall be calculated in financial and economic terms. After the preparation of cost estimates, the concerned expert shall compose cost and benefit streams over the project life, and compute the economic internal rate of return and the net present worth of the project. Sensitivity of results shall be tested for changes in major parameters such as engineering cost estimates, expected years of service, projected yields, product prices and discount rates. The analysis shall establish whether the project is economically viable or not.

### **II. Final Feasibility Report**

Based on Identification of feasible dam sites and ponds/Taraies for lining, Consultant shall prepare a detailed report. The report shall include proposed mitigations for potential environmental and social impacts and its indicative budget. Report should be submitted to Project Director, SRP in five hard and two soft copies \; the latter shall include all data and studies.

### **III. PC-I**

The Consultant shall submit PC-I as per guidelines and specifications of Pakistan Planning Commission for the assignment.

### **IV. Bidding Documents & Engineer's Estimates**

The Consultant shall prepare and submit complete Bidding Documents of the assignment as per World Bank Procurement Regulations November 2020. The document shall include Instructions to Bidders customized and contextualized through Bid Data Sheet, Eligibility, Qualifications and Experience Criteria, General Conditions of Contract customized and contextualized through Special Conditions of Contract, Bid Forms, Bill of Quantities and Technical Specifications, and other sections as warranted under World Bank requirements. Engineer's Estimates will be prepared on prevailing market rates.

## **V. Bidding Process, Bid Evaluation and Recommendation of Award**

Consultant will provide their complete assistance in the bidding process including preparation of Minutes of pre-bid meetings, Replies to queries from bidders and preparation of Addendum if any. Assist Procurement Committee in preparation of Bid Evaluation Report with Recommendation of award of contract.

## **VI. Detailed Design and Construction Drawings**

Consultant will also provide detailed design and construction drawings of all the proposed dams and ponds/tarries.

## **VII. Operation & Maintenance Manual**

Consultant will prepare and submit Operation and Maintenance Manual for small dams as well for the Taraies.

### **STAFFING:**

The staff should meet the following criteria.

#### **A. Key Staff**

##### **i) Team Leader**

The expert will have a Master's degree ( 18 years of education) in water resources engineering /civil engineering with at least 20 years of experience in design, and construction management of dams and irrigations infrastructures; and team leadership of similar projects. The Team Leader must have demonstrated ability to lead teams composed of international and national consultants and create a strong working relationship with the PMT-Sindh Irrigation Department.

##### **ii) Hydraulic Design Engineer**

The expert will have a Master's degree (eighteen years of education) in Water Resources Engineering / Hydraulics Engineering with preferably 15 years of experience in design of hydraulic structures; including cost estimation, preparation of BOQs, including experience working on donor funded projects. S/he will have demonstrated ability to work in a multidisciplinary team.

##### **iii) Groundwater Specialist**

The experts will have a Bachelor's degree (sixteen years of education) in Civil Engineering/Geophysics with at least 10 years' experience .

##### **iv) Dam Design Engineer**

The expert will have a Master's degree (eighteen years of education) in Hydraulic Structural Engineering / Geotechnical Engineering with preferably 15 years of experience in design of dam and other irrigation structures; including dams cost estimation, preparation of BOQs, including experience working on donor funded projects. S/he will have demonstrated ability to work in a multidisciplinary team.

##### **v) Hydrologist**

The expert will have a Master's degree (eighteen years of education)in Hydrology / Water

Resources engineering with preferably 15 years of experience in hydrological studies, sedimentation processes, modeling and estimating flows. S/he will have demonstrated ability to work in a multidisciplinary team.

**vi) Senior Geologist**

The expert will have a Master's degree (eighteen years of education) in Geology with preferably 15 years of experience in geological investigations of dam projects and have demonstrated ability to work in a multidisciplinary team.

**vii) Procurement & Contract Management Expert**

The experts will have a master's degree (sixteen years of education) in Engineering/Management/Procurement or Social Sciences with 15 years' experience in procurement of works and goods, preparation of procurement documents, evaluation of bids, and contracts management. The expert should have demonstrated experience with managing of FIDIC and WB contracts for large works.

**viii) Environmental Specialist**

The expert will have a Master's degree (eighteen years of education) in environmental sciences with 15 years or more professional experience in conducting environmental screening and assessment and monitoring and implementation of environment management plan. He/she will have experience of working on similar major flood & irrigation sector projects and should be fully familiar with the relevant national and provincial legislation and international environmental safeguards policies, and demonstrated ability to work in a multidisciplinary team.

**ix) Social Safeguards / Resettlement Specialist**

The expert will have Master's degree (eighteen years of education) in social sciences with preferably 15 years of relevant work experience including experience of social surveys and monitoring and implementation of social safeguards and resettlement plans. Should be fully familiar with relevant national and provincial statutes and regulations, and the WB safeguard policies and standards.

**NON- KEY STAFF:**

1. Senior Engineer, BE Civil Degree with 5 years of experience in relevant field.
2. GIS Expert, Relevant Degree with 5 years of experience in relevant field.
3. Economic Expert, Relevant Degree with 5 years of experience in relevant field.
4. Agriculture Expert, Relevant Degree with 5 years of experience in relevant field.
5. Bio Engineer/ Ecologist, Relevant Degree with 5 years of experience in relevant field.
6. Junior Engineers, Relevant Degree with 2 years of experience in relevant field.
7. AutoCAD Draftsman, Diploma with 2 years of relevant experience.
8. Quantity Surveyor, Diploma with 2 years of relevant experience
9. Surveyor, Diploma with 2 years of relevant experience
10. IT Support, Diploma with 2 years of relevant experience



## Reporting Requirement and Time Schedule for Deliverables

The Consultants shall prepare the following reports for the project and submit all deliverables as electronic copies as well as printed copies within the specified period.

Sr. Nr.	Description	Copies	Milestone
1	Inception Report	05	At the end of 1 <sup>st</sup> Month
2	Site Selection Report (including initial social acceptance)	05	At the end of 3 <sup>rd</sup> month
3	Draft IEE/ESMP/ESIA Reports	05	At the end of 08 <sup>th</sup> month
4	PC – I	50	At the end of 10 <sup>th</sup> Month
5	Draft Feasibility Report	05	At the end of 12 <sup>th</sup> month
6	Draft Bidding Document	05	At the end of 12 <sup>th</sup> month
7	Final IEE/ESMP/ESIA	05	At the end of 13 <sup>th</sup> month
8	NOC on Environment Impact Assessment (EIA) and Initial Environment Impact Assessment of the project from Sindh Environment Protection Agency (SEPA) and Sindh Forest and Wildlife Department		At the end of the 15 <sup>th</sup> month
9	Final Feasibility Report	05	At the end of 16 <sup>th</sup> month
10	O&M Manual	05	At the end of 16 <sup>th</sup> month
11	Final Bidding Document, detailed design and construction drawings	25	At the end of 17 <sup>th</sup> month
12	Bid Evaluation/ Recommendation Report	-	At the end of 18 <sup>th</sup> Month

**Feasibility Study of 50 Nos Small Dams  
and Lining Of 50 Nos Ponds / Taraies in Sindh Province  
List of Key & Non-Key Staff**

	<b>Position</b>	<b>Time Input in Person-month</b>
<b>A</b>	<b><i>Key Staff</i></b>	
1	Team Leader	18
2	Hydraulics Design Specialist	10
3	Ground Water Specialist/ Hydrogeologist	8
4	Dam Design Expert	12
5	Hydrologist	12
6	Senior Geologist	12
7	Procurement Engineer	12
8	Environment Specialist	16
9	Social Safeguard Specialist	16
<b>Sub - Total A</b>		<b>116</b>
<b>B</b>	<b><i>Non- Key Staff</i></b>	
1	Senior Engineer	18
2	GIS Expert	12
3	Economic Expert	4
4	Agriculture Expert	8
5	Bio Engineer/ Ecologist	8
6	Junior Engineers	110
7	AutoCAD Draftsman	40
8	Quantity Surveyor	12
9	Surveyor	12
10	IT Support (2 Positions)	36
<b>Sub - Total B</b>		<b>260</b>
<b>Total Costs A + B</b>		<b>376</b>

**Feasibility Study of 50 Nos Small Dams  
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Direct (Non-Salary) Costs**

Sr. Nr.	Description	Unit	Quantity	Unit Price (Rs.)	Remarks
1	Per Diem Allowance	Day	150		
2	Communication Cost between Project Office and Field Office Staff and with the Client	Month	18		
3	Drafting and Reproduction of Reports	LS	-		
4	Office and Accommodation Rent (Design Office Karachi)	Month	18		
5	Furnishing of Design Office Karachi	LS	-		
6	Office and Accommodation Supplies and Utilities	Month	18		
7	Cost of Travel / Vehicles Rent, Maintenance, Driver & POL	Vehicle Month	100		
8	Cost of Rent of Computers & Other Equipment's	Month	18		
9	Cost of GIS Maps and Images	LS	-		
10	Collection of Data (Including Socio-Economic Data)	LS	-		
11	Domestic Air Tickets for Intermittent Input of Key Experts	LS	-		
12	Hotel Accommodation for Experts for Every Day of Absence from the Home Office for the Purpose of Service	Day	150		
13	Misc. / Unforeseen (Overtime etc.)	LS	-		
14	Direct Cost Staff				
	i)	Computer Operator	Month	36	
	ii)	Admin/Accounts Officer	Month	18	
	iii)	Assistant Sociologist Female	Month	16	
	iv)	Office Boys	Month	40	
	v)	Watchmen	Month	40	

**1. SELECTION PROCESS**

A consulting firm will be selected in accordance with Quality and Cost Based Selection method set out in the "World Bank Procurement Regulations for IPF Borrowers (July 2016) Revised November 2017 & August 2018 [www.worldbank.org/procure](http://www.worldbank.org/procure).

## Annexure

### Distribution of Junior Engineers

Sr. Nr.	Position	Task	Man-Months
1	Junior Engineer	Assist Team Leader	16
2	Junior Geologist (2 Positions) 05 months Each	Supervision of GI Works	10
3	Junior Surveyor (2 Positions) 05 months Each	Supervision of Survey Works	10
4	Junior Engineer Hydrologist	Assist Expert	8
5	Junior Engineer Ground Water (2 Position) 05 months Each	Collect Ground Water Data	10
6	Junior Engineer Drawing Design	Assist Expert	10
7	Junior Engineer Hydrologist	Assist Expert	10
8	Junior Engineer Procurement	Assist Expert	12
9	Junior Engineer Agriculture	Assist Expert	6
10	Junior Engineer Quantity Surveyor	Assist Expert	18
<b>Total</b>			<b>110</b>