

PC-II FORM FOR

FEASIBILITY STUDY FOR EXPLORING WATER POTENTIAL OF SOAN RIVER

S.No. _____

(To be filled in by Planning Commission)

1. **Name by which the name will be identified:** FEASIBILITY STUDY FOR EXPLORING WATER POTENTIAL OF SOAN RIVER

2. **Administrative authorities responsible for :-**

a) **Sponsoring:** Irrigation Department, Government of the Punjab.

b) **Execution:** Small Dams Circle-II Jhelum, Irrigation Department, Government of the Punjab

3. **Detail of Survey / Feasibility study**

General Description of the Scheme

The land of Potohar Plateau is broken and un-even. The average run-off generated is about 1.88 MAF out of which only 0.26 MAF (14%) could be tapped so far by small dams reservoirs whereas efforts are in progress to trap further about 0.302 MAF (16%). In the area, two third of annual precipitation occurs during the monsoon season i.e July to September, whereas the remaining nine months are nearly dry. Due to steep ground slopes, the rain water from numerous streams running at high velocities result in erosion of agriculture land. Further, the high velocity does not permit the water to soak down and recharge aquifer. Moreover, a little delay in rainfall at time of sowing and growing result in reduction of crop yield to less than half. The drought cycle add further uncertainty towards agriculture in the area.

Presently 57 No. small dams have been constructed whereas 13 No. dams are under construction / near completion. These reservoirs provide irrigation supplies beside drinking water supplies to the adjoining abadies (cities / villages). The designed command area has not yet been fully developed due to lack of resources with farmers in respect of costly inputs like land leveling, construction of water courses and awareness about high value crops and its marketing.

Ground water in potohar plateau, generally available along the natural streams, in other areas ground water is not available even up to 300 feet depth, therefore, only source of drinking water is mini to medium size reservoirs. The water needs of rapidly growing population of cities, towns & villages met through existing reservoirs, mini ponds, ground water pumpage, which are also under stress in respect of future requirements.

The Soan River is a stream in the Potohar or North Punjab region of Pakistan, and drains much of the water of Potohar. It starts near the small village of Bun in the foothills of Patriata and Murree. It provides water to Simly Dam, which is the water reservoir for Islamabad. Near Pharwala Fort it cuts through a high mountain range at a location called Soan cut. As streams do not typically form across mountains of this height, it is likely that the Soan was there before the formation of this range. Ling stream, following a relatively long course through Lehtrar and Kahuta joins the Soan near Sihala on southern side of Village Gagri.

The Islamabad Highway crosses this stream near Sihala at the Kak Pul bridge. The Ling Stream joins the Soan river just before the Kak Pul. Two other streams, the Korang River and the Lai stream, join the Soan just before and just after the Soan Bridge, respectively. After following a path along a big curve, the stream reaches the Kalabagh proposed dam Site close to Pirpiyahi where it falls into the Indus river. There is a railway station by the name of Sohan and a railway bridge very close to it.

The Soan river is more than 250 kilometres (160 mi) long. Due to its mountainous course and shallow bed, it is rarely used for irrigation purposes. Chinese rahu, mahseer, snakehead, balm, and catfish species are the main inhabitants of the river, including many species of turtles and tortoises.

Basins in Potohar Region

The Potohar region is divided into 06 No. basins.

- Soan Basin
- Haro Basin
- Kanshi Basin
- Reshi Basin
- Khahan Basin
- Bunha Basin

- Soan basin is the largest basin in the potohar plateau and it drains much of the water of

Potohar. It starts near a small village Bun in the foothills of Patriata and Murree. Soan River is the tributary of Indus River.

- The Soan basin consists of the area of District Rawalpindi (Tehsil Muree and Rawalpindi) and District Attock (Tehsil Fateh Jang and Pindi Gheb).
- The stream reaches Kalabagh proposed Dam Site close to Pirpiyahi where it falls into the Indus River

Water Resources

The only and ultimate source of all forms of water resources is the rainfall in Soan Basin. Two third of the total annual rain precipitates during the three months of summer i.e. July, August and September. A huge quantity of rain water thus goes waste. Therefore, to conserve the rain water, the only solution is to build up dams and diversion structure for irrigation water supplies.

Location

The Soan Basin lies between Latitudes 32 °-40' and 33 °-55 ' and it originates in the south-western range of Murree hills and after flowing through hills and gorges with a steep gradient of about 206 feet per mile, enters the plains near Chirah. Up to Chirah it drains an area of about 137 square miles which varies in elevation from 2,200 feet to 7,500 feet. In the plains, Soan River flows in a south-western direction to join Indus River at about 10 miles upstreams of Kalabagh. In a distance of about 145 miles in plains, it is fed by its major tributaries and flows smoothly with a gentle gradient of about 6 feet per mile. From Nila to mouth of Sill, the Soan flows in a narrow bedrock valley.

Catchment Area

The Soan river basin lies in three districts namely Rawalpindi, Attock and Chakwal. The total length of Soan River is 170 miles and it drains a total catchment area of 4,335 square miles.

About 30% of catchment area lies on the East is hilly and the remaining 70% comprises of rolling plains. The rainfall in the hilly reaches is heavy and that in the plains is low. The total yield of the Basin has been assessed as 1.525 MAF. Due to its topography there is great scope for developing the irrigation potential in the Basin.

Climate

Soan basin features semi-arid to sub-humid zone of climatic region with hot summers and cold winters except Murree which falls in humid zone of climatic region. Daily mean maximum temperature varies from 33° to 44° during the summer and 2° to 22° during the winter. During the summer the hot air blows during the day timings. Soan River is mainly a monsoon fed stream with minor contribution from snowmelt and groundwater.

The average annual rainfall amounts ranging from 600 mm to 1800 mm, the maxim being in the north. The average rainfall over the catchment of Soan River is around 750 mm. About 40% of total annual precipitation occurs in spring and winter seasons and the rest in the monsoon season.

The river has nine main tributaries in a total drainage area of 4,335 Sq. miles. The lengths of these tributaries vary from 20 to 50 miles and drainage areas from 50 to 450 sq.miles.

Physiography

The Soan river basin lies in three districts namely Rawalpindi, Attock and Chakwal. The total length of Soan River is 170 miles and it drains a total catchment area of 4,335 square miles. Its varied landscape is constantly affected by erosion. Its elevation varies from 1,000 to 2,000 ft (300 to 600 m) in a system of residual hills and hillocks formed from glacial debris as remnants of the Ice Age. The Kāla Chitta Range thrusts eastward across the plateau toward Rawalpindi; the valleys of the Haro and Soān rivers cross the plateau from the eastern foothills to the Indus. Most of the hills and rivers are bordered by dissected ravine belts. The streams, due to constant rejuvenation, are deep set and of little use for irrigation. Agriculture is dependent largely on rainfall, which averages 487 to 1766 mm annually; rainfall is greatest in the northwest and declines to arid conditions in the southwest.

Geology

The project area falls into the southern part of the potohar plateau. The rock exposed in the area belong to Dhok Pathan formation (Siwalik of middle Miocene age) the

Dhok Pathan formation is typically represented by cyclic alternation of sandstone, siltstone and shale

Project Components

In Potohar plateau, total 57 No. dams have been completed with gross storage capacity of 252,619 Aft and CCA 72,209 acres.

The Soan River is main stream of Potohar plateau and passing through 03 districts i.e Rawalpindi, Chakwal & Attock and it drains most of the area of Potohar plateau. During monsoon season, most of the runoff drains out in Indus water without any effective utilization. There is need of rain water harvesting in Soan River basin through construction of small dams, weir or diversion structure to utilize rain water for agricultural, drinking or ground water recharge purposes.

Additional 10 No. potential dam sites / weir / diversion sites will be identified during a preliminary desk study, out of these potential dam sites / weir / diversion sites or any other site indicated from some further source will be taken up and only 06 No. most feasible sites or more as per requirements will be selected for further feasibility study & detailed design. For the feasibility study & detailed design following components of each selected site will be taken-up:

- i. Main dam / weir / diversion structure
- ii. Saddle embankment / flood bunds (if any)
- iii. Spillway / Head & Cross regulators
- iv. Outlet structure
- v. Irrigation network
- vi. Water supply system (if any)
- vii. Detailed working of land to be acquired & documentation as per Land Acquisition Act 1894.
- viii. Resettlement Action Plan (RAP)
- ix. Environmental Studies
- x. Cost, benefits & Economic feasibility

Feasibility Study

Under this component the comprehensive feasibility study / detailed design will be carried out for 06 No. most feasible sites or more sites based on the Hydrological, Geological environmental, technical and financial / economic recommendation. Environmental Impact Assessment Report of the Project and resettlement plan will also be carried out. After the identification / comparison of most viable site, PC-I will be prepared. Based on the feasibility report recommendations, detailed design of each component will be carried out by the Consultants. The completed detailed design will be placed

for review at different forum as identified by the government leading to final outcome acceptable to competent authority.

Objective of Study

The objective of proposed study will be

- Catchment area and hydrology of Soan basin
- Identification of potential of rain water harvesting in Soan basin
- preliminary & reconnaissance surveys.
- Identification of potential sites for water conservation.
- GIS based screening of available potential rain water harvesting sites on criteria to be developed by the consultants with mutual consents of Irrigation Department
- Carrying out feasibility study level design and preparation of reports of 06 No. selected dam / weir/ diversion structures sites
- Preparation of PC-I.
- Detailed design of 6 No. dam / weir/ diversion structures sites.
- Preparation of BOQ, tender documents, criteria of prequalification of contractors.

Justification of the Scheme

Nation Water Policy was announced during April 2018 which explicit that Pakistan is water stress country. Therein emphasis was laid on water conservation. Extreme importance was assigned to construction of dams. Consequently, new dams sites are to be explored and feasibility reports will be prepared for construction of new dams. This study is to be carried out in accordance with objectives highlighted in national water policy.

The section 7 of Nation Water Policy is **“CONSERVATION OF WATER”**, which states:

- The criticality of fresh-water for sustenance of human life, coupled with scarcity warrants recognition of water conservation to be accorded the highest national priority.
- In the choice of conservation technology due care shall be exercised to select the most appropriate technology which:

- Has the proven record of performance;
- Is the economically viable option;
- Has the potential to generate multi-benefits;
- Is environment friendly.

➤ It is recognized that the large annual and seasonal variability of fresh-water availability makes it necessary to:

- Build large dams for system augmentation with consensus of all federating units;
- Build small and medium dams for local and regional use;
- Build check dams and delay action for recharge of aquifers and to reduce the flow velocities and erosion;
- Recharge the underground aquifers during floods and surplus water flow periods for later use.
- Provide sub surface dams, where very feasible.

➤ The Water Conservation Plans shall include:

- Re-use and recycling of municipal and industrial waste water effluent after appropriate treatment at source; adoption of rain water harvesting technology.
- Adoption of water conservation techniques / technologies at the farm level.

Analysis of work involve

The study will be carried out *for 06 No.* most feasible sites or more as per requirements in different parts / sections / packages. The detailed feasibility study includes the field data collection and office work.

The description is as follows: -

Surveys, Investigations and Studies

Hydrology of the Area.

The Soan river basin lies in three districts namely Rawalpindi, Attock and Chakwal. The total length of Soan River is 170 miles and it drains a total catchment area of 4,335 square miles.

About 30% of catchment area lies on the East is hilly and the remaining 70% comprises of rolling plains. The rainfall in the hilly reaches is heavy and that in the plains is low. The total yield of the Basin has been assessed as 1.525 MAF. Due to its topography, there is great scope for developing the irrigation potential in the Basin.

Water harnessing activities need be carried out in conjunction with construction of conveyance network; development of command areas and water courses for

cultivation of high value horticultural crops as well as capacity building of farmers for practicing more remunerating irrigated agriculture under changing climatic conditions. The combined effects of these interventions would contribute significantly in enhancing crop yields, increasing farm incomes, improving livelihood of people, enabling farmers to adjust the agriculture practices with varying environments, and alleviating poverty in the region. Such effort promises to increase cropping intensity by 2-3 folds.

There is need of new site selection, topographic survey, Hydrological study, geological investigation, EIA report, preparation of resettlement plan, land acquisition plan and detailed design of new selected sites.

Now under this PC-II the following new surveys, investigation & studies will be carried out to prepare the feasibility study reports, PC-I and tender documents, detailed design etc.

Geological Investigation

Geotechnical investigations /report will include the following parameters for each site.

1) *Surface Geological Mapping*

Surface geological mapping of area including reservoir area, dam /weir/diversion structure, head & cross regulators, irrigation system network, and spillway site etc

2) *Sub Surface Investigation*

a) Core Drilling at Structure Area

Approximately 1200 ft core drilling on each potential site, and other structures etc. will be carried out along with permeability tests at suitable interval.

b) Test Pits

15 test pits on each potential site, reservoir and channel sites

c) Sampling

Extraction of undisturbed samples from cohesive layers, samples including preservation, transportation to approved labs.

d) Field Testing

Standard penetration test (SPT), preservation of SPT core sample and transportation to approved labs.

e) Laboratory Testing

Selected construction material sample collection and testing in approved laboratory.

f) Topographic Survey

Average 1200 acres topographic survey of reservoir area, 5000 acres of command area on scale 1:2000, Observations of X & L sections of potential sites & channel alignment through latest available surveying methodologies and techniques.

Other Studies

a) Hydrological Study

For hydrological study consultants are required to carry out comprehensive study for the estimation of following design parameters.

- Delineation of catchment areas of Soan basin and potential sites for dam /weir/diversion structure by GIS software i/c potential of rain water harvesting.
- Design Rainfall
- Frequency analysis
- Standard Project Flood / rainfall
- Monthly runoff availability for irrigation
- Design inflow hydrograph
- Routed flood hydrographs at points of interest
- Sediment yield
- Types of spillways
- Crop water requirement
- Reservoir planning extent of command area.
- Long term reservoir operation studies to estimate the yield of the dam and water supplies to the communities.

b) Design of Dam, Weir, Head regulators, Cross regulators, Spillway and Appurtenant structures

The consultants will, based on the hydrological, geological, soil and topographical surveys / studies/field

data collection, carry out detailed hydraulic and structural design of the dam /weir/diversion structure outlet works and other appurtenant structures. Seismic consideration will specifically be taken into account. A comprehensive slope stability analysis will also be carried out in respect of each dam embankment. Based on the studies carried out, as mentioned in the preceding sections, a comprehensive hydraulic and structural design of the spillway will be performed including the stilling basin and determination of conservation level for each potential site.

c) Design of Irrigation Network and Command Area Development

The consultants will, based on the hydrological, geological, soil and topographical surveys / studies/field data collection, carry out detailed Irrigation network design including syphons, gravity pipes, open channels where feasible, cross drainage works, pressurized irrigation system, head regulators, Cross regulators, inlets, out lets structures, bridges, culverts etc. The consultants shall also finalize the type of material for syphons and gravity pipes. Moreover, concrete mix design shall also be carried by consultants to ensure concrete strength for its life.

The consultants shall also provide design and estimate for command area development including land leveling, laser leveling, network of water courses, types of crops to be cultivated in that particular potential sites.

d) Environmental Impact Assessment Report

Detailed socio economic and environmental studies will be carried out to assess the environmental impact of each project. The assessment will include but not limited to: -

- Lower riparian studies to ascertain the impact of the project on the water rights
- Assessment of land acquisition and resettlement requirement and preparation of resettlement plan.
- Socio economic impact of the project

Detailed initial environmental examination will be carried out to: -

- Describe the proposal and examination alternatives,
- Identify and address the concerns of the communities,
- Identify and assess the potential environmental effects,
- Mitigate adverse effects and enhance potential benefits
- Detailed resettlement plan

Detailed Environmental Impact Assessment (EIA) will be carried out based on the Environmental Protection Agency (EPA) requirements.

e) Preparation of Engineering Drawings, Bill of quantities and cost Engineering drawings estimate

Based on the design, bill of quantities for different project components will be prepared and cost estimate prepared on the basis of prevailing market rates for viable / selected site.

f) Detailed Financial and Economic Analysis

The consultants will carry out detailed identification and assessment of each project benefits and costs. Based on it, economic and financial analysis of the project will be carried out to assess the viability / sustainability of the project.

g) Feasibility Study Report and PC – I

Based on the preceding activities detailed feasibility study report and PC–I will be prepared for each dam /weir/diversion structure site.

The detailed design will comprise but not limited to.

- Conducting topographic survey, collection of hydrologic, soil data;
- hydrological studies;
- Sub surface investigations and borrow material investigations.
- Laboratory testing of soil and water;
- Preparation of detailed design, cost estimates and tender documents, i) dam /weir/diversion structure, spillway and intake structures, ii) treatment works if required and, iii) water conveyance system.
- Irrigation network, type of material for syphon pipes and concrete mix design
- bill of quantities and cost estimates based on the detailed design;
- Updating of financial and economic analysis;
- land acquisition and resettlement plans;
- PC-I proforma and submission
- Preparation and submission of 15 copies of detailed design report;
- Preparation of tender documents including detailed

specifications, tender drawings and bill of quantities.

SCOPE OF SERVICES / TERMS OF REFERENCE (T.O.R)

Attached in Section-4

4. Implementation Period

After the commencement of the study, it will take **24** months to complete the study.

5. Year wise Estimated Cost

Activities	Cost (Rs. Millions)			
	2022-23	2023-24	2024-25	Total
Survey, Investigation & data collection etc.	5	75.922	10	90.922
Consultancy Cost etc.	20	169.998	30	219.998
Total	25	245.92	40	310.92

6. Man Power Requirements

i) Consultant through competitive bidding process will be hired for the preparation of design, tender documents and detailed feasibility report and detailed design of the Project.

ii) For the field data collection like geological investigation, laboratory sample test will be collected by the existing staff of Small Dams Circle-II, Jhelum.

7. Financial Plan

2022-23	2023-24	2024-25	Total
25.000	245.92	40	310.92

8. Expected Outcome of the Study

The study will entail the delivery of following outcomes for all saluted sites.

- Inception Report
- Monthly Progress report
- Pre-qualification criteria for Geotechnical and Topographic survey firms
- Delineation of catchment areas of Soan basin, potential for rain water harvesting, potential sites for dam /weir/diversion structure & hydrological report Soan basin.
- Geological Report
- Environmental Report
- Reservoir planning report
- Resettlement Plan
- Hydraulic & structural design report
- Crop water requirement.
- Irrigation system network design report

- Pressurized irrigation network system report
- Report on use of type of material in syphon reaches
- Agronomy / benefits report
- Cost & benefits analysis
- Complete feasibility report
- PC-1
- Project Planning Report
- Detailed Design Report with design calculations with drawings
- Detail Engineering Drawings for construction
- Engineering Estimates
- Tender Documents
- Pre-qualification criteria of contractors

Officers responsible for preparation of PC – II

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