International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 06 | June 2021 www.irjet.net p-ISSN: 2395-0072

Panj Amu River Basin Sector Project – a step towards self-reliance for Afghanistan

Rajib Chakraborty

Technical Director- Water Resources Dept., Eptisa India Private Limited

---

Abstract: *Afghanistan is considered to be the "Heart of Asia", acting as a land bridge linking South Asia, Central Asia, Eurasia and the Middle East. Due to the advantage of its strategic location, historically Afghanistan has been used as a transit and transport hub between Central Asia and South Asia. Since the Soviet invasion of 1979, Afghanistan has struggled with the challenges of conflict, drought and floods. After the fall of the Taliban, the Government of Afghanistan has boosted the water and agriculture sector of the country using financial aid from various international donor agencies, with the aim of making it self-reliant in food production. The Panj Amu River Basin Sector Project (PARBSP), centred around the Amu Darya Basin, is one such initiative. The Amu Darya river is the lifeline and source of prosperity for over 25 million people living in the lower part of the Amu Darya Basin in Afghanistan, Tajikistan, Uzbekistan and Turkmenistan. Under the PARBSP, the 22-canal system will be regenerated covering an area of 74000 ha. The Asian Development Bank and European Union are co-financers of the project, which will be executed jointly by the Ministry of Water and Energy (MEW) and the Ministry of Agriculture, Irrigation and Livestock of Afghanistan (MAIL). Almost 55,000 farming households, comprising of more than 400,000 people, will benefit from increased cropping intensities, higher crop yields, and crop diversification.*

Key Words: Water Resources, Irrigation Rehabilitation, Water Management in Rural area, Water Users' Associations

1. INTRODUCTION

Afghanistan is considered to be the "Heart of Asia", acting as a land bridge linking South Asia, Central Asia, Eurasia and the Middle East. It is surrounded by six countries, having borders with Uzbekistan, Turkmenistan, and Tajikistan in the north, Iran in the west, Pakistan in the south- east, and China in the remote east. Further, although the country has no direct land contact with India, the countries are close enough to be considered neighbours. In light of the strategic context outlined above, Afghanistan is ideally placed to link the markets of South Asia, the Middle East, Central Asia and China as a transit and transport hub. Due to the advantage of its strategic location, Afghanistan has historically been used as a transit and transport hub between Central Asia and South Asia.

Since the Soviet invasion of 1979, Afghanistan has struggled with the challenges of conflict, drought and floods. The economy of this semi-arid landlocked country is rural based, and more than three quarters of the people live in rural areas. Poverty is widespread throughout the country, which has a high population growth rate. An estimated 21 per cent of the rural population lives in extreme poverty and 38 per cent of rural households face food shortages. Agricultural production is the main source of rural livelihoods; however, years of conflict have hampered development of the agriculture sector, which also suffers from natural disasters and insufficient investment. Landholdings are small, so agriculture is rarely the family's main source of food or income. About two thirds of rural households own some livestock, and farmers also sell their labour. Security and development challenges remain daunting, the security situation being a constraint on confidence, investment and growth.

After the fall of the Taliban, it was expected that the new government would refocus on making up for lost opportunity, but unfortunately there has been no satisfactory progress. The government needs to pave the way so that all opportunities can be explored. To enable this, the government will have to rely on the private sector as an engine to lead the country towards a self-sustaining economy. This is possible only if the government can create an enabling environment for private sector development. In addition to Afghanistan's strategic location, it has very rich natural and mineral resources.

To attract private investment, and to generate the climate to enable long term sustainability, it is very important to improve the country's irrigation system, rail and road transportation system and its ability to generate power.
79 percent of the workforce in Afghanistan is dependent on agriculture. Agriculture in Afghanistan is also dependent on irrigation with irrigated agriculture bring the mainstay of food security and income for the majority of the rural population. It accounts for more than half of the country's GDP, 70 percent of total crop production and provides a reliable and sustainable production base for many rural communities. The rural sector in particular has been severely affected by war and civil unrest during the past 40 years. Since the fall of the Taliban in 2001, international reconstruction and rehabilitation assistance has focused primarily on the agricultural sector, aiming to improve rural productivity and livelihood sustainability. While there is considerable

ongoing effort to rebuild and strengthen irrigated agriculture, most of this work, by necessity, has been emergency assistance, largely designed to meet the immediate needs of the population. The Panj Amu River Basin Sector Project is one such initiative.

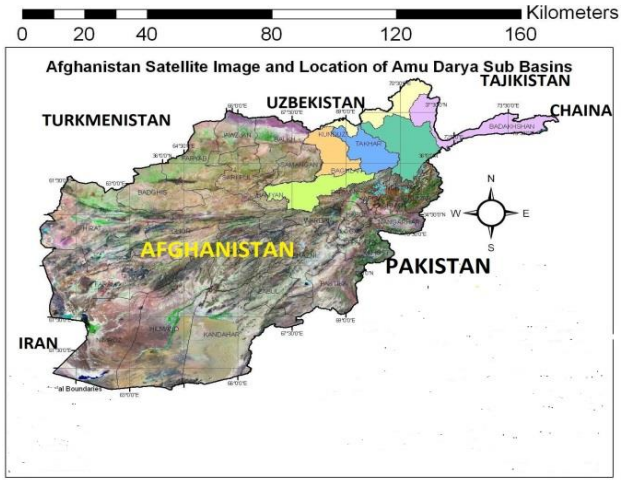

Figure 1: Index Map of Panj Amu Project Area

2. GOVERNMENT SECTOR POLICIES

The Afghan Government implemented several strategies and laws in order to develop the water sector in Afghanistan. The strategic framework, approved in 2006, guides operation of the water sector in Afghanistan. The policy indicates that (i) communities are responsible for the planning and management of basin water resources, supported by the Ministry of Energy and Water (MEW); (ii) Water Users Associations (WUAs) have a key role in regenerating small and medium irrigation schemes; and (iii) user-pay principle enables cost recovery. To support this policy, in 2009 a revised water law was enacted, which stipulated that (i) the river basin management approach for water resources planning would be followed, led by MEW through the establishment of sub-basin agencies (SBAs) and river basin agencies (RBAs); (ii) service providers (including WUAs) could charge for water delivery; and (iii) ownership, operation and maintenance (O&M) of schemes would be handed over to WUAs and irrigation associations. The National Water and Natural Resources Development Program (NWNRDP), approved in 2010, acts as the government's sector development plan. The National Irrigation Program, 2016–2025 builds on the NWNRDP and, with a budget of $1. 5 billion, aims to achieve self-sufficiency in wheat agriculture through (i) improved irrigation services; (ii) enhanced extension services; and (iii) improved on-farm water management, operation, and maintenance.

The Asian Development Bank (ADB), the European Union (EU), the United States Agency for International Development (USAID), the World Bank (WB), the Canadian International Development Agency (CIDA) and the Swiss Agency for Development and Cooperation (SDC) were the major development partners.

3. AMU DARYA SYSTEM:

The upper Amu Darya Basin is one of the world's most important headwater areas, the largest part of it covered by the Pamirs. The Amu Darya, which runs for 2,540 kilometers (1,578 miles) and whose drainage basin covers a total area of 534,739 square kilometers (206,464 sp. miles), is the lifeline and source of prosperity for over 25 million people living in the lower part of the Amu Darya Basin in Afghanistan, Tajikistan, Uzbekistan and Turkmenistan. Depending on its level, the water is used for the irrigation of crops covering over six million hectares of land.

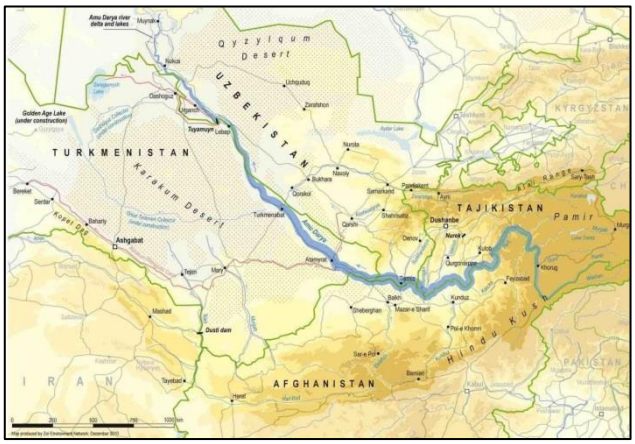

Figure 2: Panj Amu River

The Amu Darya drainage basin includes most of Tajikistan, the southwest corner of Kyrgyzstan, the northeast corner of Afghanistan, a narrow portion of eastern Turkmenistan and the western half of Uzbekistan.

The Pamir River originates from Lake Zorkul in the Pamir Mountain and flows west to Qila-e Panja, where, 50 Km downstream, it joins the Wakhan River (which originates from a glacier) to form the Panj River. After the confluence, the Panj River flows along a considerable part of the border between Afghanistan and Tajikistan up to the confluence with the Vakhsh River which drains from Tajik territory. Lake Chamaktin, which discharges to the east into the Aksu River, which in turn becomes the Murghab and then Bartang rivers, and which eventually joins the Panj Oxus branch 350 kilometres downstream at Roshan Vomar in Tajikistan. From the North eastern part of Afghanistan Kokcha river drains in the Panj River from the left. After the confluence with Vakhsh

Table1: Details of Panj Amu River Sub-basin

No	River Sub-Basin	Area [km^2]	Mean annual precipitation per annum [mm]	Specific runoff RSP [l/skm^2]	Estimated mean annual water volume [Mm^3]
1	Upper Panj	17,195	437	(19.7)	(36,000) >6,000[31]
2	Lower Panj	11,611	638		
3	Kokcha	22,196	748	9.1	6,400
4	Taloqan	10,888	797	7.0	2,400
5	Upper Kunduz	16,524	530	6.9	3,600
6	Lower Kunduz	12,526	394	1.5	600
7	Shortepa	5,005	179	0	0

River the river is called Amu Darya and finally drains out in Aral Sea in Uzbekistan after travelling 1415 Km (879 Mi).

Not far beyond the confluence of the Panj and the Vakhsh rivers, the Amu Darya is joined by three additional tributaries: from the south by the Qondūz River in Afghanistan and from the north by the Kofarnihon (Kafirnigan) and Surkhan rivers in Tajikistan. After leaving the highland zone, the river bends to the northwest to cross the arid Turan Plain, where it forms the boundary between the Karakum Desert to the southwest and the Kyzylkum Desert to the northeast. The Amu Darya loses much of its water in this region due to irrigation, evaporation, and seepage.

The Amu Darya provides a mean discharge of around 97.4 cubic kilometres of water per year. About 61% of the drainage lies within Tajikistan, Uzbekistan and Turkmenistan, while 39% is in Afghanistan. The abundant water flowing in the Amu Darya comes almost entirely from glaciers in the Pamir Mountains and Tian Shan, [14] which, standing above the surrounding arid plain, collect atmospheric moisture which otherwise would probably escape elsewhere. Without its mountain water sources, the Amu Darya would not exist, because it rarely rains in the lowland areas through which most of the river flows

4.1 Panj Amu River Basin in Afghanistan:

In 2009, Afghanistan was divided into five major river basins. The Panj Amu River Basin (PARB) is the third largest river basin in Afghanistan having a total area of 95000 ha. The PARB comprises seven sub basins

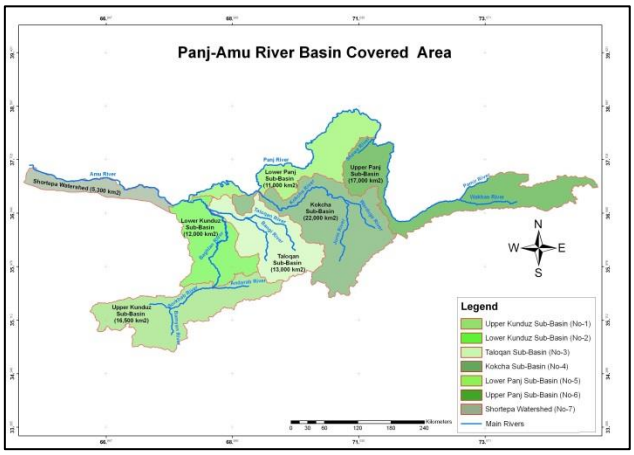

Figure 3: Panj Amu River Sub Basin

These seven sub-basins include the Upper Panj and Lower Panj which join the Panj Amu River from north eastern part of Afghanistan, the Kokcha River draining 6,400 Mm^3/a from the Kokcha River Sub-basin (which has an area of 22,000 km^2) and the Kunduz River draining 6,600 Mm^3/a. The Kunduz river basin itself comprises of three river sub-basins: the Upper Kunduz River Sub-basin (draining 3,600 Mm^3/a from 16,500 km^2), the Taloqan River Sub-basin (draining 2,400 Mm^3/a from 13,000 km^2), and the Lower Kunduz River Sub-basin (draining 600 Mm^3/a from 12,000 km^2). These two tributary basins generate a total mean annual volume of 13,000 Mm^3/ per year from a total drainage area of 63,500 km^2, resulting in a mean specific runoff of 6.5 liter per square kilometer, the highest specific runoff in the country. The PARB covers 15% of the country and produces more than 19,000 Mm^3 or at least 48.7% of the country's mean annually generated surface water resources.

4. DEVELOPMENT OF THE PARBS PROJECT

In 2004 the EU allocated funding for the PARBS project throughout Badakhshan province, with the British firm Landell Mills assigned to provide technical services between 2009 and 2017. Support was also provided from the Ministry of Energy and Water (MEW). Landell Mills helped establish the first River Basin Agency (RBA) and the Sub-Basin Agencies (SBAs) in Afghanistan (as well as supporting various procedures which were implemented in order to enable the work to move forward, such as "The Water Law of Afghanistan"). Both these agencies are under the control of the MEW but, operating at a local level, are better able to respond to the community's needs. Landell Mills also increased the ability of the RBA/SBA members to undertake river basin planning, to ensure that **water is managed more equitably** between upstream and downstream users. In 2017 the Asian Development Bank (ADB) selected the basin as the target area for a new water resources project, to be implemented by the government with ADB and EU financing. Landell Mills worked with the ADB and EU to design, establish and prepare the framework for the project, which is set to continue until 2022.

There are expected to be three main outcomes resulting from the project: Outcome 1: Improved water allocation and availability, outcome 2: Enhanced on-farm water management and Outcome 3: Proper management and protection of watersheds.

In 2018, the American firm Sheladia Associates was assigned to provide technical assistance for implementation of the PARBS project alongside the MEW, and the Spanish firm Eptisa Services was engaged in order to prepare both a feasibility study into the improvement and rehabilitation of all the sub projects and tender documents.

The Feasibility Study and Detailed Design (FSDD) and Implementation Support Consultancy (ISC) consultant will work with the Central Project Management Office (CPMO) under the MEW. After detailed designs are produced, tender documents will be prepared for various packages. Supervision of the construction will be the responsibility of the MEW. Once rehabilitation of the canal systems is complete it will be handed over to the Ministry of Agriculture, Irrigation and Livestock (MAIL). The MAIL will be responsible for the rehabilitation of the secondary and tertiary canals through the Sub-basin Agencies (SBA) and the Water User Associations (WUAs).

The Emergency Irrigation Rehabilitation Project (EIRP) also started in June 2004, and was implemented by the Ministry of Energy and Water (MEW) with support from the Food Agriculture Organization (FAO) with funding from the World Bank. The EIRP is still active in the PARBSP area, particularly in the north of Afghanistan around the Kokcha river area in Kunduz and Takhar Provinces. Currently the FAO and EIRP are completing a feasibility study for a Lower Kokcha Irrigation and Hydropower Project. Once completed, this project will result in water supplies for about a further 132,000 ha. of agricultural land. The Irrigation Restoration and Development Project of 2011–2017 and the On-Farm Water Management Project of 2011–2016 in Kunduz and Takhar province, were both funded by the World Bank.

4.1 Present Project:

Under the present project, 22 sub-projects, over a command area of about 74,500 ha., have been identified as requiring rehabilitation as a priority before September 2022. Of these 22 sub-projects, 4 sub-projects are located in Badakhshan Province in the Kokcha Sub Basin, 6 sub-projects are located in Thakar Province in the Lower Panj Sub Basin, 5 sub-projects are located in Thakar Province in the Talokan Sub-basin, 2 sub-projects are located in Kunduz Province in the Talokan Sub-basin and 5 sub-projects are located in Kunduz Province in the Lower Kunduz Sub-basin. The total command area of these 22 sub-projects is 74,500 ha. The length of the main canals varies between 10 km and 40 km and the CCA varies from 500 ha. to 15,000 ha.

The canal system was constructed about 80 to 100 years ago, but a lack of maintenance and flash flooding resulted in the deteriorated the canal and its structures. In most cases the water doesn't reach the tail end. The team of consultants performed a walkthrough survey of all the canals to assess their current condition, to identify the reasons for the deterioration, to meet the local representatives of the SBAs and WUAs, and to understand the requirements of the structures and how best to prioritize the restorations.

Most Canal systems have the following components

Diversion structure: Water flow is diverted from the river or stream by a sarband (diversion weir), which is typically constructed from a combination of local materials such as timber, gravel and sandbags. The length and dimensions of a sarband are generally a function of river morphology, system flow requirements, available materials, and labour requirements for construction and maintenance.

The operation and maintenance of the sarband is critical to overall system performance and reliability, but it is, for most systems, the most difficult structure to maintain due to its vulnerability to flood damage. This damage can lead to drop-off in water intake flows and a premature decline in water availability. Repairs are difficult to undertake in high flow conditions and are often delayed until the flow of water decreases.

More than one intake is often constructed depending on river hydrology and flow characteristics. The intakes may include a "spring" intake to divert high spring flows and a "summer" intake to supplement flows following the spring

peak. The summer intake intercepts and diverts the base flow from the shallow gravels to prolong water supply into the late summer months, albeit at lower supply levels.

Main canal: The main (or primary) canal conveys water from the intake structure to and through the command area. Depending on the location and river gradient, the main canal may extend for several kilometers in order to command the irrigable area. With a few exceptions, main canals are hand-dug and made of unlined earth. The initial sections from the intake, frequently run alongside the river or stream due to access and slope constraints. These sections are vulnerable to flooding.

Water flow into the main canal is traditionally unregulated. Depending on the source of the water, canals generally have high capacities, for accommodating large peak flows and provide a storage buffer to allow for variations between day and night irrigation demand. The canal serves as the water conveyor that supplies offtakes and secondary canals.

Secondary and tertiary canals: From the main canal to the farm turnout, water flows through an extensive network of secondary and tertiary unlined earth canals. Typically, the secondary canal is the responsibility of a village or group of villages and the offtake rate is based on established water entitlement. It is not uncommon to see a number of secondary canals closely aligned in parallel, supplying separate villages.

Control structures: Most larger systems have a range of control structures for the regulation and distribution of water from the main canal to the secondary canals and offtakes. Cross regulators, which are weirs of various types, are constructions that regulate canal water levels, usually in conjunction with bifurcators and offtakes. Bifurcators or sehdaraks, divide the water flow into secondary canals and offtakes, according to a proportional distribution that serves water entitlement and system operation. Offtakes are outlet structures from primary and secondary canals. Spillways discharge excess water from the canal and protect the system and community from flooding.

Conveyance structures: Most systems commonly have inverted siphons of various capacities which act as conveyance structures for crossing major washes, canals and drains. There are culverts for canal cross drainage.

Protection Structures: Protection structures, like earthen embankments, retaining walls and gabion walls, are constructed in order to protect canals and intakes. Sometimes these are constructed using readily available materials such as war junk.

Field Surveys and Designs

The Reconnaissance Survey and the consultation meetings with locals in head, middle and tail reach areas identified that, in most cases, the Headworks are damaged and silted up.

Figure 4: ***Damaged head works***

The damage is due to the gates no longer functioning properly, and the main canal is silted up in many places as it is unlined and irregular in shape.

Figure 5: Present condition of main canals

In addition, most of the existing traditional off-takes are located at a high level, but there are no structures in the canal to raise the water in the main canal to the level required to adequately feed the branching canal during periods of low water flow. The secondary and tertiary canal network does not have water regulators or head work structures, the secondary canal being controlled using sandbags. During the flood season, these bags are washed away and an uncontrolled amount of discharge flows into the secondary and tertiary canals, causing inundation and siltation in the surrounding fields. There are also no proper access points to the canals for domestic purposes and for livestock.

Figure 6: Present domestic and livestock access point

Finally, there are no escape structures at the end of canals so any surplus water is wasted. The registered WUAs manage the canal in collaboration with the SBA. The Mirabs are responsible for the operation and maintenance of the main canal and the Kokbashis are responsible for the operation and maintenance of secondary and tertiary canals. However, currently the operation and maintenance being undertaken is still very basic and suffers from a lack of proper tools such as staff gauges to ensure transparent and equitable water allocation and distribution between the secondary or branching canals. Consequently, there is no correlation between the quantities of water being diverted from the main canal to each secondary canal, and the corresponding command area.

Following the Reconnaissance survey, a list of priority works was prepared taking into account the allocated budget. Teams of consultants performed a hydrological survey, an agricultural survey, an environmental survey and a social survey in the field, in preparation for the feasibility studies for each of the sub-projects. Various structures have been designed, based on the crop water requirement and availability of water. The cost, which includes the replanting of trees along the canals, has been estimated and the financial viability of the project has been checked by a financial stability review (FSR).

In most cases the proposed solutions to the issues highlighted by the Reconnaissance Survey are;

- The rebuilding or rehabilitation of Diversion and Headworks with an arrangement of gates
- Dredging and desilting the canal to restore its usual course
- Lining the main canal
- Installing flood protection
- Improving regulating structures
- Providing drop structures to negotiate bed slopes
- Providing domestic and livestock access points in line with the requirements of locals
- Organizing plantation along the canals
- Introducing proper maintenance arrangements and building capacity for the SBAs and WUAs.

Figure 7: Headworks under construction:

Figure 8: Rehabilitated headworks

5. CHALLENGES

Some parts of the command area in both Badakhshan and Kunduz provinces are under the control of the Taliban and consequently there are a number of security issues around the development work. Most foreign workers prefer to avoid going for site visits in these areas, so the areas are surveyed by local afghan experts. In addition, the frequent conflicts between the Government and the Taliban disrupt the work. Survey work has been stopped several times and has only been able to be completed after negotiation with local Taliban leaders in the disputed areas**.** In some areas, construction by the contractors has been challenging as a result of various demands being made by the local population, which were not scientifically viable in the community projects

6. SAFEGUARDS

An environmental assessment and review framework together with initial environmental examinations (IEE) have been carried out as per the Asian Development Bank's (ADB's) Safeguard Policy. Consultants have performed Environmental and Social surveys in the field and have conducted Public Consultation meetings separately for male and female representatives in different areas along the canals.

Figure 9: Consultation meeting with female

Sample questionnaires were prepared for the Social and Environmental surveys, and were completed using the responses from the meetings. The Environmental and Social Impact has been assessed for all sub-projects and an environmental monitoring plan has been prepared. As per ADB norms, all sub-projects are classed as Category B. The main adverse effect to the environment was deemed to be the felling of trees as part of the project. However, the effect of this will be lessened by the replanting of trees along the canals.

Following the assessment, the Land Acquisition and Rehabilitation Plan (LARP) has been prepared to address any issues arising in relation to individuals whose land is being acquired or whose trees are affected. As this is a rehabilitation project the acquisition of land is minimal. The project is categorized as some gender benefit. Gender activities will be mainstreamed in the project.

7. BENEFIT OF THE PROJECT

The project will benefit low-income and marginal smallholders (with household landholding of 1.0–2.0 ha.)

Figure 10: Benefited command area

The target provinces have some of the highest food insecurity levels in the country: 73.0% for Badakhshan, 34.8% for Takhar, and 27.5% for Kunduz. Project interventions will increase production of wheat by 23,000 tons per year and the production of rice by 25,000 tons per year, significantly improving the food security of project beneficiaries. Incremental household income and the jobs created during the implementation of the project will significantly contribute to local poverty reduction

Almost 55,000 farming households, comprising more than 400,000 people, will benefit from increased cropping intensities, higher crop yields and crop diversification. Incremental crop labour will create an equivalent of 9,000 full-time rural jobs per annum valued at $8.7 million and project construction works are expected to generate an equivalent of 1,700 full-time rural jobs for 6 years with an estimated value of $1.6 million. More economic opportunities will be created for downstream (input suppliers) and upstream (processors of, and market intermediaries for, agricultural products) industries in the agricultural supply chain.

The project is categorized as some gender benefit. Gender activities will be mainstreamed in the project. It will improve the livelihood of locals by providing them with proper domestic and livestock access points to the canals and culverts under the canals.

Sustainability of the Project

The project is designed to ensure long-term sustainability, its success being achieved through efficient operation and maintenance of the canals. To ensure the infrastructure lasts its economic life, a number of design measures have been included in the project.

1.Gated headworks will protect other infrastructures by reducing any flood damage caused by future change and variability in the climate.

2. For headworks and main canals, O&M will be delegated to the WUAs and, where such works are outside the scope of the WUAs, SBAs will be made responsible for O&M.

3. O&M for secondary and tertiary canal infrastructure will be delegated to irrigation associations.

4.Watersheds adjacent to the schemes will be rehabilitated and protected, thereby reducing run-off and decreasing the siltation of irrigation canals and lowering the risk of damage to the infrastructure by flash flooding.

5. Improved water distribution within and between schemes will be guaranteed by improving the functioning of the WUAs and the irrigation associations for equitable water distribution within the schemes (particularly by ensuring that the middle and tail reaches receive fair shares of water).

The Panj Amu River Basin Association (RBA) and Sub Basin Associations under the management of the RBA, has been already established. 112 WUAs have been established to take on the work and the staff have been given proper training, The RBAs and SBAs, working with the WUAs, will ensure that water is distributed fairly between schemes. Consequently, downstream schemes will also experience benefits even though they have received no direct project investment. Finally, training farmers on improved on-farm water management and agronomic techniques (such as land leveling, bed and

furrow irrigation, and intercropping) will also help leverage infrastructure investment by ensuring that irrigation water is used efficiently.

The government will ensure that, for structures outside the capacity of community-based O&M, adequate funds are allocated from its budget to finance the O&M activities of the SBAs. Completion of the Project will bring the county one step further towards self-reliance in food security . self-reliance in food security .

REFERENCES:

i) ADB Portal

ii) Information from Internet

iii) How the Water Flows: A Typology of Irrigation Systems in Afghanistan, June 2008

iv) Afghanistan Agriculture Sector Review, Land and Water Resources Assessment, 2014

BIOGRAPHIES

Rajib Chakraborty is presently working as Technical Director- Water Resources of Eptisa India Pvt Ltd which is subsidiary farm of Eptisa Servicios de Ingenieria SL, Spain