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RIVER BASIN MANAGEMENT PLAN FOR LOWER HARIRUD RIVER BASIN

AFGHANISTAN SIDE

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A black and white photograph of a wide river. On the left, there is a rocky bank with some sparse vegetation. In the distance, a tall power line tower stands on the right side of the river, with power lines stretching across the sky. The water is calm, reflecting the sky and the tower. The overall scene is a natural landscape with some infrastructure.

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ACRONYMS & GLOSSARY

ADB	Asian Development Bank
AUWSSC	Afghan Urban Water Supply Sewerage Corporation
CARD-F	Comprehensive Agriculture and Rural Development-Facility
CAREC	Central Asia Regional Environmental Centre
EU	European Union
GIROA	Government of the Islamic Republic of Afghanistan
GIS	Geographic Information System
GPS	Global Positioning System
HMRB	Harirud Murghab River Basin
IWRM	Integrated Water Resources Management
IRDP	Irrigation Rehabilitation Development Project
Karez	Traditional irrigation system from groundwater
Kuchi	Afghan Nomad
LHRB	Lower Harirud River Basin
MAIL	Ministry of Agriculture, Irrigation and Livestock
Mirab	A person responsible for irrigation water management in a community
NGO	Non-Governmental Organization
NEPA	National Environmental Protection Agency
OFWMP	On-Farm Water Management Project
SA	Situational Analysis
Shura	Traditional or Local Council
SWP	Smart Waters Project
USAID	United States Agency for International Development
WB	World Bank
WUAs	Water User Associations
MoRR	Ministry of Refugee and Repatriations
MoLSA	Ministry of Labor and Social Affairs
MoCI	Ministry of Commerce and Industries
MoPW	Ministry of Public Work
ANDMA	Afghanistan National Disaster Management Authority
AMD	Afghanistan Meteorological Department

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1. EXECUTIVE SUMMARY

1.1. Introduction

Water is an important part of our life and our natural environment. It affects all parts of our life directly or indirectly. Having adequate water is critical to our well-being, agriculture, and socio-economic development. Afghanistan is facing an acute water crisis which includes a lack of efficient institutional framework and adverse impacts of climate change on the water resources of the country. Luckily, the government of Afghanistan has adopted the Integrated Water Resources Management (IWRM) approach. Adopting the IWRM approach and stakeholders' participation in the management of water resources are steps in the right direction.

The basis of IWRM is the recognition of the interdependence of all types of water uses. With this approach, decisions on the allocation and management of water resources as well as considering the impacts of each type of water use on others are made jointly by all involved stakeholders. It is to ensure that sustainable development is achieved through socio-economic and environmental goals of basin development. The main goal of IWRM is sustainable management and development of water resources at any level. A significant important advantage of IWRM is the establishment of an interdepartmental effective coordination mechanism through the creation of basin councils from water users and other stakeholders. This approach ensures clear coordination and synergy of actions at all levels of river basin management. The first principle of IWRM - basin-level management based on hydrographic boundaries - is a guarantee of equitable water supply regardless of the location of the water user (upstream or downstream).

Active participants of the public in the planning process through public consultations or creating basin councils indicate that the interests of all water users are included. In this approach, it is recommended to raise public awareness on conservation of water resources and the introduction of incentives to increase the efficiency and productivity of water use.

As an important part of IWRM, development, and implementation of basin plans allows government and other organizations working in the management of water resources to take practical steps after comprehensive analysis and evaluation of the existing situation of water resources in river basins.

This plan provides extensive information about the current situation at Lower Harirod River Basin (LHRB) and the planning procedure for integrated management of water resources for the need of agriculture, water supply, energy generation, flood attenuation, support of ecosystem as well as economic and social development of communities in LHRB.

This plan was developed under the fourth component of the Smart Waters Project (SWP) by the Regional Environmental Centre for Central Asia (CAREC) in Afghanistan with financial support from the USAID to implement the principles of IWRM in LHRB.

This plan was developed after a detailed review of Situational Analysis for Basin Planning of the LHRB of Afghanistan conducted by the USAID's Smart Waters Project and through the outcome of five different trainings for the River Basin Council (RBC), key stakeholder, water users, governmental bodies and Water User Associations (WUA).

The study has covered eight districts of Herat city (Chesht-e-Sharif, Obbeh, Pashton Zargon, Guzara, Injil, Zanda Jan, Ghorian, and Kohsan), and focused on the following thematic areas:

- Surface Water Resources (including precipitation and surface flow)
- Ground Water Resources
- Agricultural use;
- Environment;
- Water Law; and
- Socio-Economic considerations.

In developing this plan, the following basic principles have been taken into consideration:

- Involvement of stakeholders in the development, discussion, and approval plan;
- Analysis of the existing water resources management situation in LHRB;
- Determination of specific goals and objectives, a system of indicators/performance indicators, as well as mechanisms for monitoring the implementation of the basin plan;
 - Setting clear priorities;
 - The roles to implement the plan, and control over its execution, preparation of the financing plan and the definition of time frames;
 - Focus on key constraints in water management;

2. BACKGROUND INFORMATION

2.1. River basins of Afghanistan

Afghanistan is a landlocked country in Central Asia with a total area of about 652 000 km². It is bordered by Turkmenistan, Uzbekistan, and Tajikistan to the north, China to the northeast, Pakistan to the east and south, and the Islamic Republic of Iran to the west. It is characterized by its rugged terrain and an average elevation of 1 100 m above sea level, ranging from 150 to 8 000 m. One-quarter of the country's land lies at more than 2 500 m above sea level. Although Afghanistan is located in a semi-arid environment, it is

still rich in water resources mainly because of the high mountain ranges such as Hindu Kush and Baba, which are covered with snow. Over 80 percent of the country's water resources originate in the Hindu Kush mountain ranges at altitudes of over 2 000 m. The mountains function as natural water storage, with snow during the winter and snowmelt in the summer that supports perennial flow in all the major rivers. (AQUASTAT Report – FAO, 2012).

Water Resources in Afghanistan has been divided into five major river basins:

River Basin	Area		Population	
	Sq. km	Percent	No.	Percent
Amu Darya	90,692	14%	4,449,000	16%
Harirud - Murghab	77,604	12%	3,694,000	13%
Helmand	262,341	41%	3,539,000	13%
Kabul	76,908	12%	12,115,000	44%
Northern	70,901	11%	3,927,000	14%
Non-Drainage Area	67,356	10%	152,000	1%
Total	645,802	100.00%	27,876,000	1487.00%

Table 1 Afghanistan River Basins

Source: (Afghanistan statistical year book, 2005)

2.2. Harirud-Murghab River Basin

Harirud-Murghab is one of the important river basins in Afghanistan with a drainage area of 39,000 km², originates from the western slope of the Koh-i-Baba mountain range (at 4000 meters above sea level) which is part of the Hindu Kush mountain system located in central Afghanistan. It flows westwards for 703 km to the Iranian border, turning off to the North delineating the border between Iran and Afghanistan and, further downstream, the border between Iran and Turkmenistan. The Harirud River Basin straddles Herat and Ghor provinces. Lower Harirud falls in Herat Province while Upper Harirud falls in Ghor.

The Harirud- Murgab river basin has three sub river basins:

- Sub basin of upper Harirud (Chaghchran)
- Sub basin of downstream Harirud (Herat)
- Sub basin of Murgab Harirud (Qala-e-naw).

The Harirud river basin has a narrow and elongated configuration with two main tributaries and some small tributaries which contribute seasonal flow to the main river. Due to the low precipitation in this part of the country, these river systems flow intermittently.

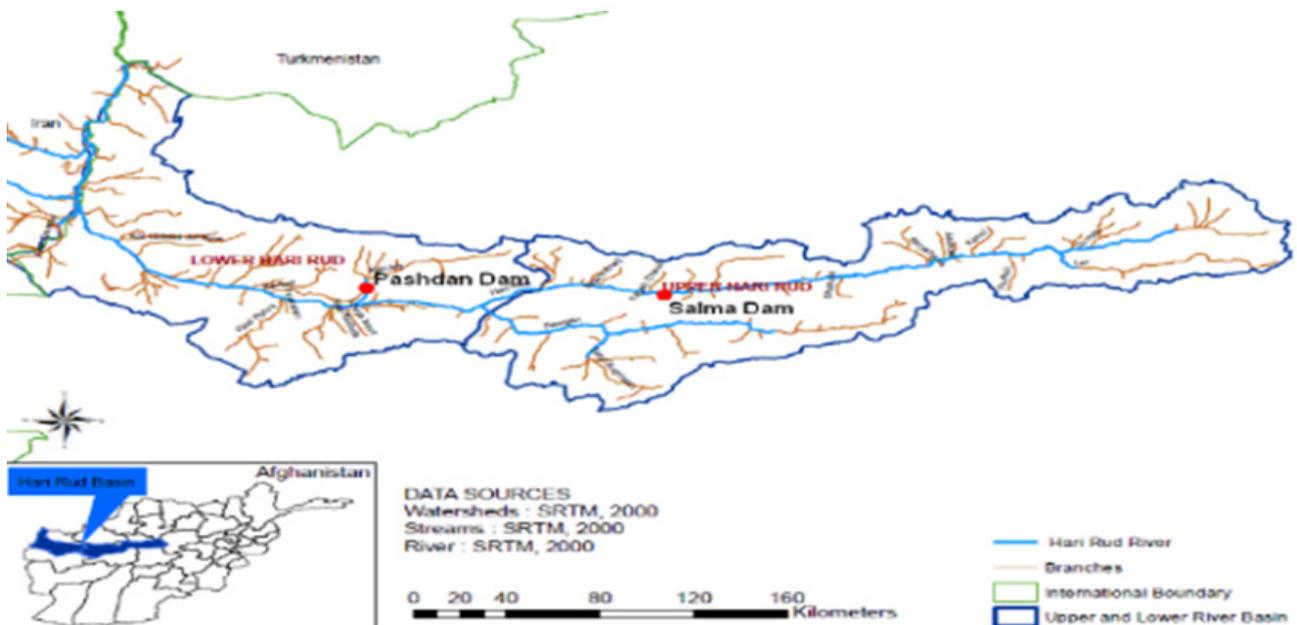


Figure 1 Lower & Upper Hari Rud River Basin Boundaries

2.2.1. Target Areas

Lower Hari Rud River Basin is located in western provinces of Afghanistan, Herat and is covering the following eight districts of Herat province:

- Ghorian
- Guzara
- Zendajan
- Obeh
- Chesht-e-Sharif
- Pashton Zargon
- Injil (Enjil)
- Kohsan

3. ANALYSIS AND ASSESSMENT OF THE CURRENT SITUATION

This section provides a summary of the current situation of targeted areas under LHRB considering the thematic areas in situational analysis. There is also a register of topical issues identified in the local areas that were discussed by the members of RBC and representatives of stakeholders during the group works and discussions. Detailed information on the current situation is already given in the situational analysis of LHRB.

3.1. Surface Water Resources

Snowmelt and surface runoff are the main sources of surface and groundwater in LHRB. While the increase in temperature in recent years causes early melt of snow. Figure 2 shows the snow cover map in March of 2000, 2015, and 2018. The snow coverage decreased each year, and there are signs of early melt of snow cover in the basin.

Previously the water produced by melting snow was used for irrigation in the summer. But the early melting of snow leading to some challenges including a decrease in water for irrigation in the summer period and flash flooding in the river.

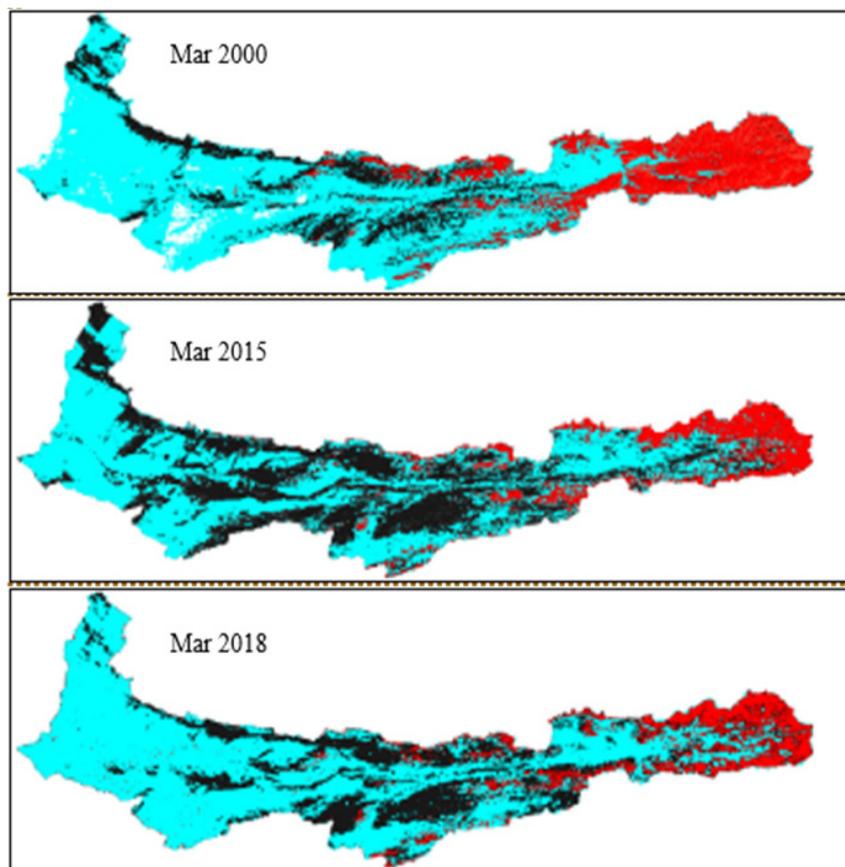


Figure 2 March Snow Cover Map of Harirud River basin (Red color represents snow cover)

Also, comparing and analysis of rainfall records in several stations show that there has been an extreme drop in the monthly flow at all sessions.

The biggest water demand in LHRB is for irrigation which accounts for 93%, while it relies more on surface water. Of the balance, 6% is for domestic and 1% is for industrial demand. Mostly the irrigation demand is met from surface water, while industrial and domestic demand relies on groundwater in LHRB.

Most of the irrigation water is distributed through canals which consist of the intakes, the open channels (primary, secondary and tertiary canals), and the irrigation structures on the canals. From all the canals recorded in the situational analysis of the basin, only 10 out of 134 main canals are built with modern intake structures, and the rest of the canals are with traditional

intakes taking water from two different locations based on seasonal variation in water levels. Therefore, the intake bed level varies seasonally.

Simulation and analysis of different scenarios estimate the irrigation water demand is more than the existing capacity of the Salma dam. The shortage in the month of June, July, and August are estimated which can be drastically mitigated by increasing irrigation efficiency by 5% in the canals and application efficiency in the farms. In LHRB, one effect of the change in temperature, rainfall, and snow patterns have been instances of routine flashfloods, even though, the mean monthly peak flow of the river has decreased.

The narrow long terrain geometry of the river basin has created networks of river tributaries (washes) that bring seasonal flow from snowmelt and rainfall to the main river.

Figure 3 shows the vulnerability of Herat city to flooding caused by adjacent washes.

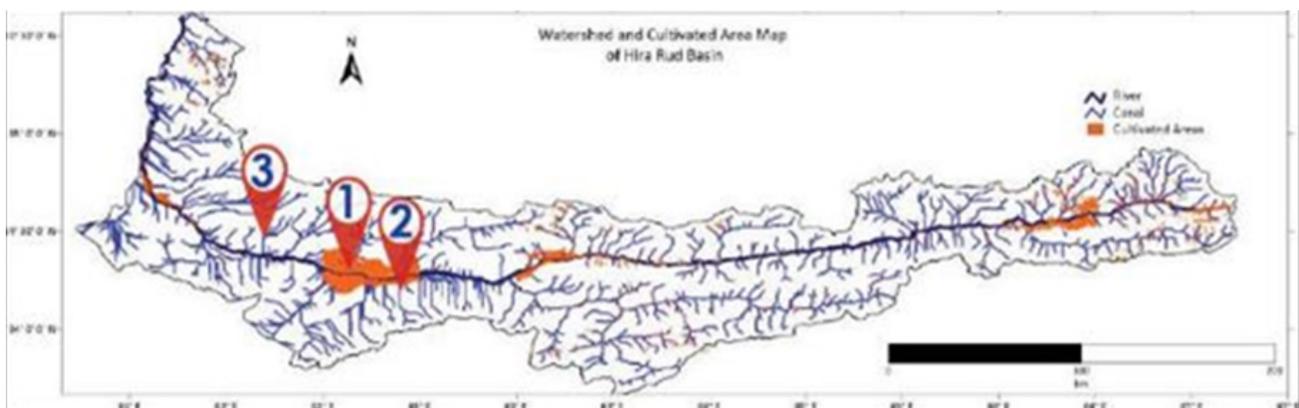


Figure 3 River Network of Harirud River Basin

The city floods each year, affecting thousands of people. The floods are due to washes located above the Joy-i-Now canal. After each rainfall, the wash waters enter and destroy the canal. Since the canal's capacity is not enough to carry the wash water to the river, the city gets flooded.

A second area that floods annually is Guzara canal. In this case, the Lar Manzel wash combines with excess water from the Kambarq canal to enter Guzara Canal, exceeding its capacity and destroying it.

The Third flooding zone is located in Islam Qala Road, where Wash crosses and destroys the road, and affecting the users yearly during the rainfall season. The negative impact of the flooding is reported yearly by the government. Other washes in the area create minor floods and get more harmful as the area gets more urbanized.

Since the storing of surface water is the main factor of better agriculture and productivity of crops, thus Salma dam is one of the most important structures for water storage and flood control in the LHRB.

3.2. Groundwater Resources

In areas under LHRB, groundwater has traditionally been developed and utilized for irrigation and domestic use through the use of Karezes, springs, and shallow hand-dug open wells. In more recent years, deep drilled wells have become a more common means of water extraction.

Groundwater is an under-utilized resource in certain parts of the river basin and, more than likely, over-utilized in others. There is a need to develop sustainability estimates for the principal aquifer systems in the river basin to allow for the wise and judicious development of this resource. This effort, together with a water resource management approach, is necessary to prevent over-allocation and serious depletion of the groundwater resources in the river basin.

It is estimated that 640 MCM (Uhl, 2003) is the annual recharge amount in Harirud basin. And the analysis of the updated data set of 2008 onward indicates a reduction in the amount of total annual recharge. The new data set result is estimated at 540 MCM. Uhl and Tahiri (2003) report that the Harirud River Basin was studied in the early 1970s in order to assess hydrogeological conditions in the basin, estimate groundwater reserves, and assess the feasibility of irrigating 16,500 hectares by groundwater irrigation. This study concluded that the groundwater reserves in the Harirud Valley were in the range of 4,000 MCM, and the dynamic or rechargeable reserves were estimated at 1,100 MCM/yr. It recommended that, of this amount, 700 MCM per year could be withdrawn for irrigation purposes. In the 1970s, UNICEF installed over 27 water supply wells in this valley. The same reference also concluded that a total of about 21,000ha are irrigated from groundwater resources (Karezes, springs and wells) in this area. This represents an annual demand of about 160MCM.

The table below shows the distribution of this irrigation (no. of units) for each irrigation type in Herat (Lower Harirud) and Ghor (Upper Harirud):

Pro- vince	Springs			Karezes			Shallow Wells			Total Groundwater	
	No.	Area (Ha)	%	No.	Area (Ha)	%	No.	Area (Ha)	%	Area (ha)	%
Ghor (Upper Harirud)	570	15,990	22	4	710	1	263	240	<1	16,940	23
Herat (Lower Harirud)	153	830	<1	228	1,650	1	450	1,370	<1	3,850 ¹	2.4
Total	723	16,820		232	2,360		713	1,610		20,790 ²	

Table 2 Groundwater use in Irrigation in Harirud Basin

¹ Corrected from source data erroneous total figure of 3,930 Ha for Herat

² Corrected from source data erroneous total figure of 20,870 Ha for both provinces.

Analysis of different rocks and the existence of groundwater come with a certain conclusion in Harirud river basin. It shows that groundwater in the Harirud river basin is present in rocks of different ages, from the pre-Cambrian metamorphic basement to Quaternary sediments. The natural groundwater systems are characterized by five hydro-geologic units:

- Crystalline rocks;
- Triassic – lower Cretaceous pressure thermal water;
- Upper Cretaceous- Paleogene (Cr-Pg) fracture-Karstic aquifers
- Neogene (Pliocene and Miocene) aquifer-aquitard system; and
- Quaternary aquifers.

3.3. Agriculture

Based on the calculation of crop cutting data from 117 canals, 175,000 Ton of wheat, 900Ton of Mung beans, 4,000 Ton of Apricot, and (26,155) tons of rice are produced in the eight districts of Lower Harirud River Basin in Herat province. Comparing the data of 2008 with 2018, there is a rise in the production of all the above products in LHRB.

The details regarding the crop output are shown below.

The karst aquifers seem to be the best sources for water supply and irrigation, which needs to be given the highest priority in the water supply programming and planning. Also, fractured-karst aquifers are the main aquifers for socio-economic development and environmental security in the Harirud river basin, therefore, they warrant further research.

In these canals, the outputs of cultivation in the canals are based on data from the canal walk-through survey. These outputs show crop yield in kg per hectare. Based on the findings, the average yield of wheat in eight districts of the lower Harirud river basin is about 5,000 kg/ha.

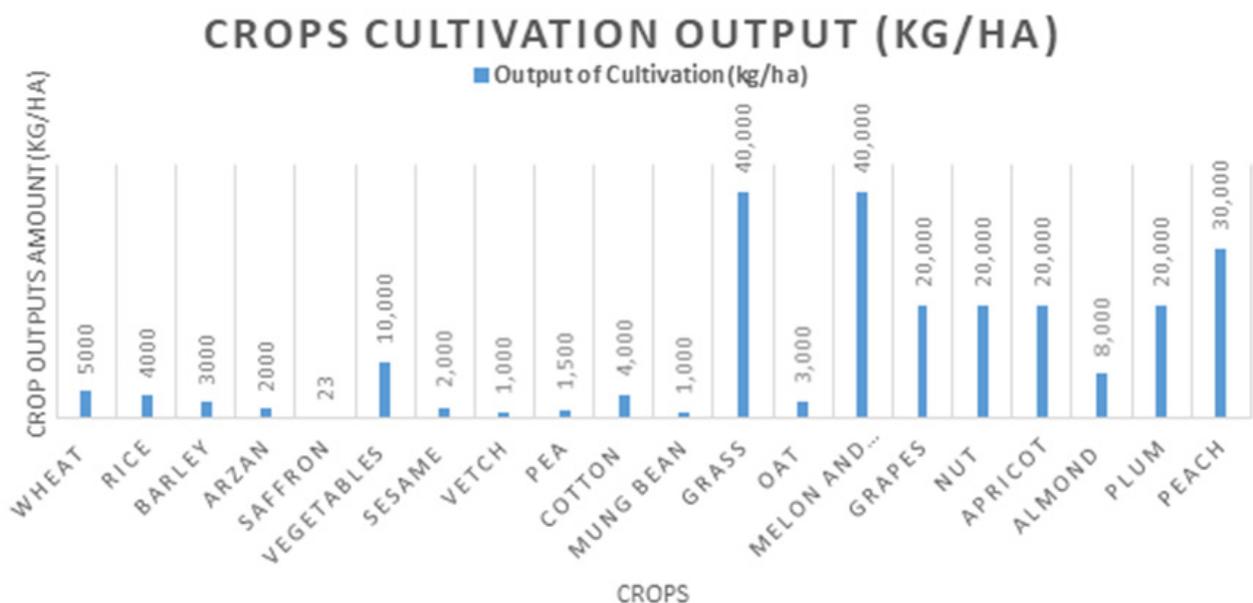


Figure 4 Crops cultivation output - Lower Harirud

Although the production cost differs from time to time, the production cost at farm gate during the study was taken from the walk-through survey.

The outcome is shown in below table:

Crop	Area (Ha)	Production Cost per Ha (Afn/ha)	Gross Cost of Production (Afn)	Gross Cost of Production (USD)
Wheat	3500	50,000	175,000,000	2,333,333
Rice	6539	120,000	784,680,000	10,462,400
Barley	3000	20,000	60,000,000	800,000
Sesame	1500	50,000	75,000,000	1,000,000
Cotton	843.5	60,000	50,610,000	674,800
Mung Beans	900	20,000	18,000,000	240,000
Grapes	6000	150,000	900,000,000	12,000,000
Apricots	200	100,000	20,000,000	266,667
Almonds	323	400,000	129,200,000	1,722,667
Total	22805.5	107,778	2,212,490,000	29,499,867

Table 3 Cost of production – LHRB

In LHRB, the most retained crops by volume are the grains and cereals. Among the fruits and nuts, grapes are retained most for home consumption. The percentage of production retained or consumed by the farmers ranges from 2% for cotton and almonds to 50% for barley. On average, about one fifth (22%) of the farmers' production is retained for home consumption.

From all productions, on average, just over three quarters (78%) of the farmers' production is sold off at the local markets. The most marketed crops by weight are wheat and grapes, while cotton and almonds are most marketed by percentage.

Over three quarters (78%) of the farmers' production is sold off at the local markets. The most marketed crops by weight are wheat and grapes, while cotton and almonds are most marketed by percentage.

Additional details are shown in the charts below.

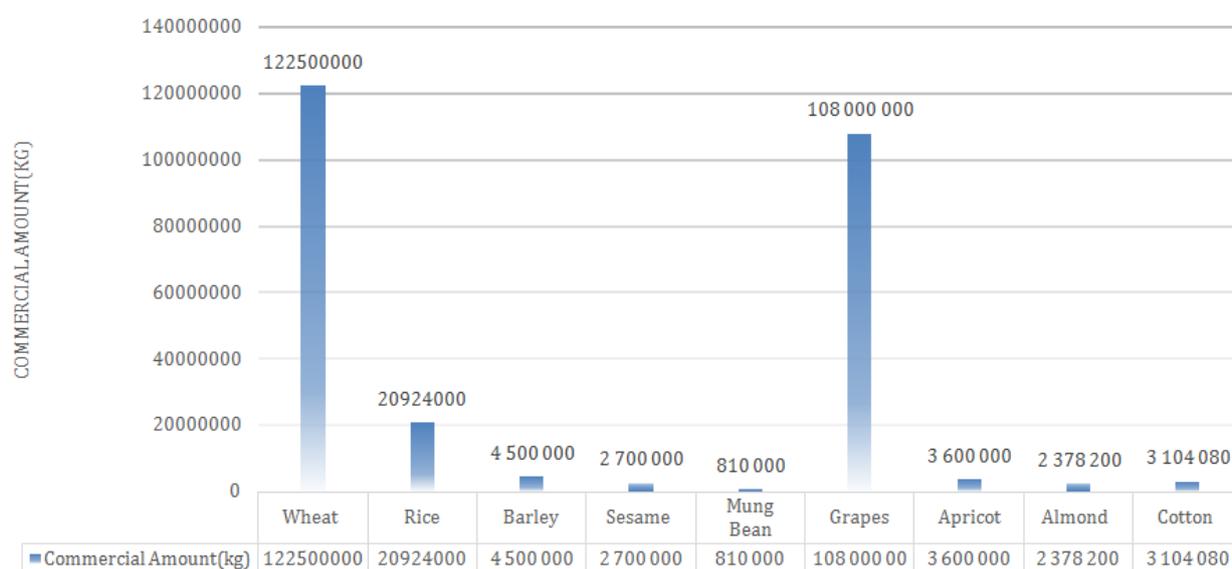


Figure 5 Amount of Commercial Cropping by weight - Lower Harirud

Crop	Crop Cutting Data (kg)	Marketed Amount (kg)	Marketed Amount (Ton)	Percentage Marketed (%)
Wheat	175,000,000	122,500,000	122,500	70%
Rice	26,155,000	20,924,000	20,924	80%
Barley	9,000,000	4,500,000	4,500	50%
Sesame	3,000,000	2,700,000	2,700	90%
Mung Bean	900,000	810,000	810	90%
Grapes	120,000,000	108,000,000	108,000	90%
Apricot	4,000,000	3,600,000	3,600	90%
Almond	2,585,000	2,378,200	2,378	92%
Cotton	3,374,000	3,104,080	3,104	92%
Total	344,014,000	268,516,280	268,516	78%

Table 4 Lower LHRB-Crops commercial percentage

3.4. Environment

Around 80% percentile of the population in LHRB depends directly on the natural resources. The principal resources are land and water. Lack of other basic natural resources, such as potable water, water for irrigation, and adequate pasture land, has affected the quality of many rural livelihoods.

Environmental river flow is a major component of the environment in LHRB. The comparison of current and historical data indicates a decrease in the river's minimum monthly flow. The study of three-stream gauging sites (Ranat-t-Akhund, Pol-e-Hashemi, and Tirpul stations) to determine the in-stream flow using IHA software shows a decrease in the river's minimum monthly flow and it indicates a severe impact on the riverine ecosystem, including flora and fauna.

Similar to other parts of the country, keeping livestock is an important part of households' lifestyle in LHRB.

Many households keep livestock to supplement agricultural farming, grazing the animals on pastures on their land. The exceptions are the Kuches, a nomadic group of people located in many provinces. The Kuches nomads, who practice vertical seasonal migrations between the dry plains and the summer pastures in the mountains, exploit much of the basin's pastureland on a rotational basis.

The Kuches' pastures are typically open communal or public ranges of land. The remaining forest and rangeland areas offer a variety of ecosystem services, like watershed protection, prevention of erosion and siltation as well as the provision of timber and non-timber products, including fuelwood and roots, forages for livestock, and fishing grounds (ADB, 2002). Current trends are locally limiting environmental services such as the availability of medicinal plants, water purification, and the regulation of groundwater tables.

District	Total Households	No. of Kuche Households	
	No.	No.	%
Pashtun Zargon	26,830	262	1%
Karukh	22,415	167	1%
Kohsan	18,515	49	0%
Zendajan	12,318	352	3%
Obeh	25,677	0	0%
Farsi	13,860	0	0%
Total	119,615	830	5%

Table 5 Proportion of Kuche Households in LHRB

The extent of communal grazing lands in the lower Harirud Basin has decreased over time due to overgrazing, fuelwood collection, and encroachment due to population growth, drought, and desertification (Bhattacharyya et al. 2004; UNEP, 2008, MAIL, 2009a). In LHRB, floodplains are located in the low-lying areas along the river, and the flood risk is high in March and June as a result of rain and snowmelt. The situational analysis in LHRB identifies the vicinity of the river and the communities settled close to steep mountain slopes as the vulnerable to flooding in this area.

The risk in the Herat province is especially high in Guzara, Pashton Zargon, and Herat City. According to the Flood Contingency Plan (FCP) of the Inter-Agency Contingency Planning (IACP)-Mission in 2013, about 3000 families were threatened by floods in the Province of Herat.

Seasonal wetlands areas are created during the flooding season in the Harirud river basin. The comparison of the land cover map from 1980 to 2017 shows that most of the seasonal wetlands are dry due to climate change, excavation of surrounding soil, and over-extraction of groundwater.

There are many other seasonal wetlands in the lower reaches of the river basin which are dry due to the impact of climate change. In spite of this, however, there are still some everglade areas across the downstream river which lack environmental protection.

There are also more than 20 unregistered wetlands in the Harirud river basin which were previously used as pasture to feed livestock. Due to the drawdown of the water table over the last few years, some of these wetlands are urbanized while others are occupied by local people who have converted them to agricultural land.

Along the lower Harirud, many areas of the river basin showed signs of land degradation. The types of land degradation processes identified include erosion, vegetable loss, decreased soil fertility, and hill-side slumping (landslides). The erosion has been caused by either water (gully erosion and sheet erosion) or wind.

Deforestation is another common problem in LHRB resulting from unregulated exploitation of local forest as a source of fuel, lack of proper heating alternatives in harsh winters, and lack of fuel for cooking purposes. In many parts of LHRB, there has been a drastic reduction

in forests, most particularly in Pashton-Pul. On the other hand, the comparison of 2001 and 2018 maps in Pul-e-Hashemi indicates an increase in forestation. The implication from these two scenarios is that this positive forestation can be further developed by cultivating suitable trees in the adjacent wetland west side of Pol-e-Hashemi. There is a lack of registration, rehabilitation, protection, and the proper management of forests and green areas.

Land in LHRB is mainly used for agricultural farming. Irrigated cropping is the most common type of agriculture. While planting nuts and fruits trees as well as greening for grazing of livestock is another type of land use in LHRB. There are also rain-fed farming on approximately 30% of the surveyed areas. The remainder of the land consists of open land which was neither farmed nor settled.

The morphology of the Harirud River between Obek and Kohsan has changed considerably over the last 50 years. At many places, the river channels are encroaching on the banks, resulting in erosion and increasing bed width while forming several unstable river channels. This action of the Harirud River has negatively affected a series of irrigation intakes along both river banks. As a result, the operation of the affected irrigation systems has become a major challenge.

Five major causes of land degradation were considered and looked at for the surveyed areas:

- Overgrazing
- Bare/exposed slopes due to firewood collection
- Hillside slumping of unprotected or steep slopes,
- Deforestation, and
- Land degradation arising from agricultural activities

Another major environmental challenge in LHRB is the quality of water that has generally changed and it contains types of pollutants in various areas. The surface water pollution is caused by indiscriminate disposal of untreated industrial and domestic effluents, and the discharge of household and street waste into streams. The groundwater is polluted due to the lack of a centralized sewage disposal system.

3.5. Existing legislation and Institutional Framework

The water management institutional framework has been developed based on the water law of Afghanistan. After adopting the well-known concept of Integrated Water Resources Management, the water management institutional framework was divided into five major river basins. Along with river basin management (RBM). There was also multi-stakeholder participation, pushing towards greater devolution of decision-making power from the central and provincial governments to sub-basin institutions as well as to strengthen associations and individual water users.

Looking specifically at one of the Major River Basins (Harirud-Murghab River Basin) the Harirud-Murghab river basin is managed under three sub-basins:

- Lower Harirud
- Upper Harirud, and
- Murghab

The institutional framework differs at provincial levels. The institutional set-up for Harirud Basin has been illustrated in the chart below:

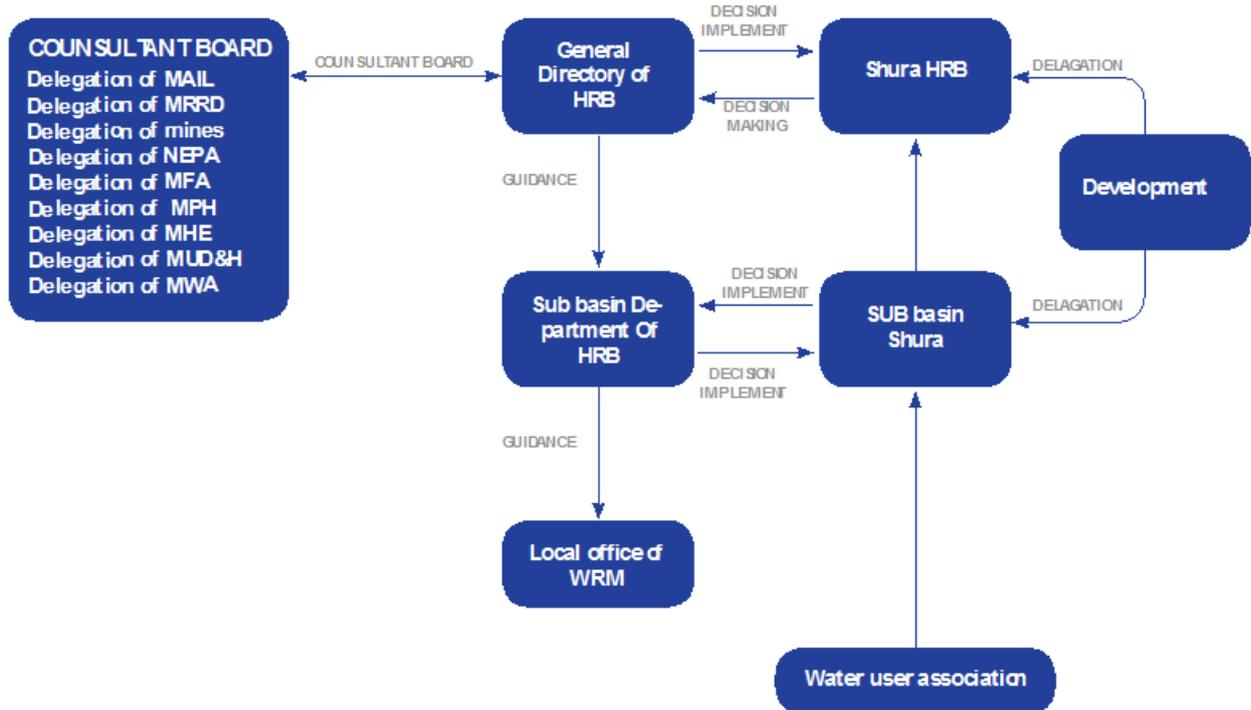


Figure 6 Organizational set up of the Harirud River Basin

Various projects have been completed or are ongoing at LHRB. The interviews with representatives of government, projects, and donor agencies, together with a review of completed and on-going projects led us to the following conclusion:

- Due to lack of appropriate incorporated organizational structure in central directorates and the donor projects, there have been frequent overlaps and mix-ups in functionality in many levels of government and project offices, and the manner of project selection may not always be clear.
- Marginalizing of various governmental bodies in the process of drawing up the ADB master plan. It indicates the plan does not reflect their needs and challenges and thus they do not utilize or update new models.
- National staff was not involved in many projects and thus lack of a sense of ownership led to the unsatisfactory implementation of policies and strategies.

The existing water management situation in Afghanistan, as well as the current national water management policies in LHRB, led to the following conclusion:

Groundwater: Few factors led the basin to groundwater resources deterioration, which needs specific policies to regulate the extraction level and conserve the water quality.

3.6. Socio-economic Situation

The socio-economic situation is another major component to consider in river basin planning. For developing the plan, in some sections, the government socio-economic data was only available for four of the lower Harirud districts - Obeh, Pashton Zargon, Zendajan, and Kohsan. No data were obtained for Chesht-e-Sharif, Guzara, Ghorian, and Injil districts in some sections.

There are overall 217 healthcare facilities in the above four districts. These healthcare facilities are district hospitals, health posts, health sub-centers, family health houses, basic health centers, and comprehensive health centers.

Similar to other parts of the country, there are four categories of institutions: four – primary, secondary and high schools, and universities. Over 90% of these institutions are government-funded, and more than 50% are co-educational i.e. enroll both boys and girls.

- Over-exploitation of groundwater in LHRB has caused a drop in the water level;
- Groundwater in the Harirud river basin is populated by point and non-point sources;
- Need for a review that creates a holistic strategy to measure existing groundwater use, along with identification of sources of recharge;
- Introducing groundwater use licenses for the users in order to manage the number of users and the amount of extraction in the river basin.

Surface Water: Need for clear policies and strategies to regulate the management of surface water:

- The current water resources have no defined specific allocations of water for irrigation, domestic, industries, or environment.
- A unique subsurface flow in the Harirud river basin stores water and prevents it from evaporation in the summer season. A lot of this flow is through sand, yet currently, the river's sand is being extracted in large amounts for construction.
- The river basin is stressed and requires infrastructure to restore the required water levels.
- After construction of the Salma dam, farmers use earthen blocks to divert water to their irrigation canals in summer and utilize the subsurface flow of water for irrigation, which causes conflicts between users.

Among the districts under LHRB, Injil is the most populous district, with over half of the total population, while Chesht-e-Sharif has the lowest population. On average, four-fifths of the people along the surveyed canals have access to its water, with the highest proportion being in Guzara (95%) and the lowest being in Obeh (74%).

Sources of household income for the dwellers of all eight districts is 70%, the highest source of income is from irrigated agriculture. The lowest source is rain-fed agriculture at about 3% to 5%. And the landless households account for 22% of all households in LHRB. These households earn family income as shop-keepers, laborers, and government workers. Almost 60% of the income is from shopkeeping.

Roads are required in order to access markets for agricultural produce and the district headquarters for government services. considering the distances from the canal intakes to the district headquarters, we come to the conclusion that nearly 40 percent of HQs are

located 10 km far away from canal intakes and about 27% are at a distance greater than 20 Km from intakes. The roads of Guzara and Pashtun Zargon are good but Ghorian roads are in bad condition. Overall, nearly 70% of roads are in fair condition and 14% of roads are poor. It also covers the road condition of all eight districts which are generally in fair condition.

Lack of cold storage is another challenge for the residence of LHRB, there is no record of any standard cold storages and thus farmers lose around 23% of the value of fresh fruits and vegetables and 40 percent of the products lose some value before reaching the final market.

Conflicts over water and land are another important part of the socio-economic situation in LHRB, the majority of disputes over water are solved through mediation of the shura, water user associations, and head of villages. The following conflicts are recorded in LHRB:

- After the construction of the Salma Dam, the downstream irrigation water users of Kohsan, Ghorian, and Zendajan districts face water shortages in different seasons of the year, especially during the dry spell.
- Water users in Gozara and Pashtun Zarghon districts face conflicts over water rights due to issues arising out of using traditional intakes.
- Injil district irrigation water users also face the same type of conflicts, albeit at a reduced scale.

Luckily, there are a limited number of conflicts over land in LHRB, only one-third of conflicts were in the Injil district alone. Most of these conflicts were solved with the interference of people, CDCs, and governmental authorities.

4. REGISTER OF PROBLEMS IDENTIFIED IN THE LHRB

Problems in Lower Harirud River Basin, existing in different directions and dimensions, including surface water resources, groundwater resources, agriculture, environment, socio-economic, administrative, organizations, and legislative institutions. The problems and the relationships between various problems were identified through a comprehensive situational analysis of the current situation of water resources management, which is the first stage of basin planning. A situational analysis of the current status included data collection, surveys (interviews), training for SBC as well as a thorough analysis of quantitative and qualitative secondary data in five different thematic areas.

The identified problems and its prioritization are based on criteria such as the impact on water resources, population growth in the future, an increase in the demand for irrigation, the fulfillment of the established indicators of socio-economic development, and consideration of SBC expectations.

The Table below list the registered problems in Lower Harirud River Basin in the following areas:

- Planning and implementation of water resources management
 - Agriculture
 - Environment
 - Socio-economic Issues
 - legislation and Institutional Framework

Problem #	Problem identified	Negative consequences and risks	The reasons
1. Planning and implementing water resources management			
1	Over the past decade, flow along the Harirud River has reduced. The river's peak flow decreased after the construction of the Selma Dam in downstream. Flow records of the river's downstream stations indicate issues in properly managing the Salma dam release.	As a result of this, the downstream water users are dissatisfied with the levels of service and there have been recorded water shortages. Water shortage in downstream negatively affects the agriculture as well as lead to conflicts over water.	-The changes in snow and rainfall patterns -Excessive use of water in upstream of Salma Dam -There is no observation station up-stream of Salma dam to develop the yearly operation curve. -Current release/operation of Salma dam does not meet the current downstream irrigation demand.
2	Flashfloods are due to change in temperature, rainfall, and snow patterns. The flooding happens in the city, Guzara canal area, Islam Qala road, and more areas with less harmful floods.	The highest likelihood of damage of floods exists in the vicinity of the river, as well as in communities that are settled close to steep mountain slopes, with poor housing conditions. Every year, flooding not only damage crops and destroy houses and livestock but it destroys canals and intakes as well.	-Low capacity and the destroyed condition of canals especially in above Joy-i-Naw canal -The Lar Manzel wash combines with excess water from the Kambarq canal to enter Guzara Canal, exceeding its capacity and destroying it. -Wash crosses and completely destroys the road along Islam Qala road, affecting the users yearly during the rainfall season.

Problem #	Problem identified	Negative consequences and risks	The reasons
3	The majority of the Canal intakes do not regulate and manage water demand.	<p>As a result, the consumers are dissatisfied with the amount of water they receive for their agriculture.</p> <p>The canals loss a large amount of water. And the capacity of the canals cannot carry the water during rainy seasons and thus lead to flooding in various parts of LHRB.</p>	<p>-They are not built to the appropriate engineering design standards. Some of the canals even have spring and summer intakes in two separate locations.</p> <p>-Upstream canals currently receive the water directly from the river when they need, but downstream canals take water based on their water right and turn. The rights are managed based on water availability.</p>
4	There is a drop in the groundwater table in the basin especially in Herat City, Guzara, Injil, and Ghoryan districts.	Lack of drinking water for domestic purposes	<p>The drop in the groundwater table is due to:</p> <ul style="list-style-type: none"> -Over extraction of water for drinking and agriculture propose; -Dramatic extraction of groundwater in the industrial city of Herat; -Decrease in the total amount of available surface water;
5	Excessive removal of aggregates for construction and city development. which harms nature and the environment.	<p>It harms the nature and environment</p> <p>Causes the change of river course and leads to flooding</p>	<ul style="list-style-type: none"> -Illegal removal of sand aggregates for construction purposes in the city; -The local government does not have control over it;
6	Change in groundwater quality or water contamination.	<p>Lack of access to equitable drinking water.</p> <p>Increase in water-borne diseases due to the biological contamination of groundwater which is the only source for domestic purpose.</p>	<ul style="list-style-type: none"> -Constructing of a large number of sewer wells in the river basin, posing an actual or potential source of pollution; -Groundwater is also polluted from Karbar canal which currently has a city sewer diversion at two sources (from Shar-e-Now toward Khowja Kala - Darwaze Eraq - Soltan Aqa, and from Drawaze hosh, Spen Ade, Darwaze Qandahar, toward Soltan Aqa);

Problem #	Problem identified	Negative consequences and risks	The reasons
2. Problems Identified in Agriculture			
1	Waste of a large amount of water in agriculture.	The water consumers do not receive the amount of water needed for irrigation, and consequently, it led to the reduction in agricultural products	Low irrigation efficiency. A slight increase in irrigation efficiency would result in saving large amounts of water. Therefore, increasing irrigation efficiency and cultivating proper cropping patterns to meet the river basin food security and strategic economical goals are vital for the region.
2	Lack of markets for the agriculture products of LHRB	Th drastic fluctuation of prices saffron and other crops in the Afghanistan market; 23% of the value of fresh fruits and vegetables is estimated to be lost because products are not refrigerated. Forty percent of the products lose some value before reaching the final market.	<ul style="list-style-type: none"> -Lack of cold storage facilities -During the harvest period, the city receives large amounts of grains, vegetables, fruits, nuts etc., from neighboring countries at a cheaper price than the local produce. -Weakness in transportation or the improper condition of roads -Weak exporting policies by the government
3	Insufficient provision of agricultural machines for timely and high-quality implementation of agricultural activities.	Hill-side slumping; Reduction of the fertility of agricultural land;	<ul style="list-style-type: none"> -High occurrence of wind -Vegetation loss -Excessive agriculture activities -Over-grazing -Firewood collection -Deforestation
3. Environment			
1	Land degradation processes in the LHRB	Hill-side slumping; Reduction of the fertility of agricultural land;	<ul style="list-style-type: none"> -High occurrence of wind -Vegetation loss -Excessive agriculture activities -Over-grazing -Firewood collection -Deforestation

Problem #	Problem identified	Negative consequences and risks	The reasons
2	Impacts of climate change on water resources	Climate change, however, is a reason for flooding in Herat city and districts under LHRB, it has also impacted the amount of water in LHRB; Degradation of wetlands;	-Lack of clear-cut climate change adaptation strategies and water storage infrastructure -There is no institutional framework inside the HMRB agency to address the current issues and future challenges to the relevant climate change funding agencies.
4. Legislation and Institutional Framework			
1	Lack of mechanism on water allocation for dam release	Unbalanced distribution of water between users for irrigation, domestic and industrial uses.	Lack of input on dam utilization Inequities in the water release downstream of the Salma dam.
2	Lack of legislative control on use of ground water	Lack of equitable water for domestic uses.	There is no administrative or legislative control on groundwater usage in the basin which is impacting the groundwater table due to over-extraction.
3	Issues with Water Law (Amendments in the Water Laws are needed with a major focus on the management, protection, and use of Afghanistan's water resources. In particular provisions in the Water Law on water user associations (WUAs), irrigation water rights, responsibility for irrigation infrastructure, irrigation tariff setting must be adequately covered.)	The dissatisfaction of WUAs with the amount of water they receive; Overlap of activities between stakeholders; Increasing conflicts over water allocation;	Based on these reasons, there is a need for amendment in Water Law: <ul style="list-style-type: none"> • Existing water resources have no defined specific allocation of water for irrigation, industries and environment; • The WUAs and irrigation association are not strong enough and lack enough skills of technical knowledge to contribute to the implementation of local and national level policies. • Increasing change in the quality and quantity of water resources in LHRB. • Some policies and law are not implemented or enforced. • Less control on protected areas and wetlands; • Lack of Provisions on inspection and enforcements;

Problem #	Problem identified	Negative consequences and risks	The reasons
4	Conflicts over water in LHRB	Major conflicts are solved through mediation of the shura, WUA, and head villages, these entities are not empowered with negotiations and mediation knowledge and skills and thus their decisions do not help the settlement of disputes in the long-terms.	The lack of transparency and the absence of established practices governing customary water rights renders informal dispute mechanisms vulnerable to external influences and pressures. These concerns are particularly relevant to disenfranchised groups such as women and children whose voices often are not heard in Afghanistan's traditionally male-dominated society. The incapability of people involved in conflict resolutions.
5. Socio-economic issues			
1	Roads and transportation facilities are required in order to access the markets for agricultural products and the district headquarters for governmental services	The governmental services, as well as agriculture products, are not managed on time	The existing roads are not in good condition; Almost 40% of headquarters are located 10 KM away from canal intakes 27% HQs are located at a distance greater than 20 KM from intakes
2	Lack of cold storage facilities in LHRB	23% of the value of fresh fruits and vegetables is estimated to be lost because products are not refrigerated 40% of the products lose some value before reaching the final market.	Although MAIL planned to build cold storage in Herat, there is not real cold storage to refrigerate products

Table 6 Register of topical issues and problems identified in Lower Hairud River Basin

5. ON-GOING AND IMPLEMENTED PROJECTS IN LHRB

Afghanistan witnessed a developing era after 2001 where most of the sectors were analyzed and developed on emergency basis- In LHRB. The section below provides information about the projects of various donor organizations aimed at the development of water, agriculture, livelihood, environment and socio-economic situation in LHRB. These projects are taken into account in the development of RBP for LHRB.

In past, donor agencies have worked in the Harirud river basin, and some of the activities are still on-going. The projects which have been completed along with their output are presented in the table below:

No	Donor	Project name	Project Outcome / Recommendations	Status
1	World Bank	Emergency Irrigation Rehabilitation Project, EIRP	Construction of irrigation scheme structures	Completed
2	World Bank	Irrigation Restoration & Development Project, IRDP	Survey, design & construction monitoring of irrigation scheme Installation of hydro meteorological station Development of legislative documents	On-going
3	World Bank	On Farm Water Management, OFWM	Construction and lining of small irrigation canals Laser leveling of cultivated land	On-going
4	Asia Development Bank	Harirud River Basin Master plan	Master plan of 2012	Completed
5	ADB	Studies of two new canals (backside of the airport) under Hashemi bridge)	Studies of new canals under Salma dam	Completed
6	IDBD	Development of selected Kawgan river and Harirud river canals	Development of 3,450 ha new lands	On-going
7	GIZ	Master planning and reform	Future planning and river basin development strategies	On-going
8	JICA	Data gap filling and capacity building	Gap filling of missing data 1980-2006	On-going
9	USAID	Smart Waters Project	Watershed management practice, capacity buildings, Transboundary water management, in Central Asian countries including Afghanistan	On-going

Table 7 List and Status of Donor Projects in LHRB

5.1. On-Farm Water Management (OFWM) Project

The objective of this project is to improve agricultural productivity by enhancing the efficiency of water used. The project has four components:

- Irrigation Rehabilitation and Management in the Five Regions.
- Support for Enhancing Productivity:
- Institutional Strengthening and Capacity Building of the MAIL.
- Project Management, Coordination, and Monitoring and Evaluation.

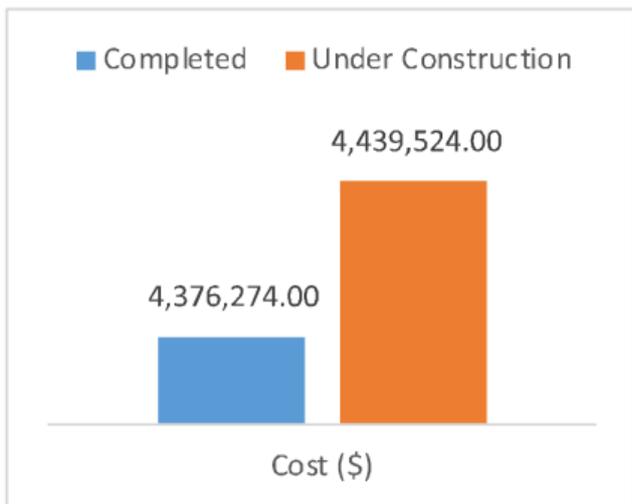
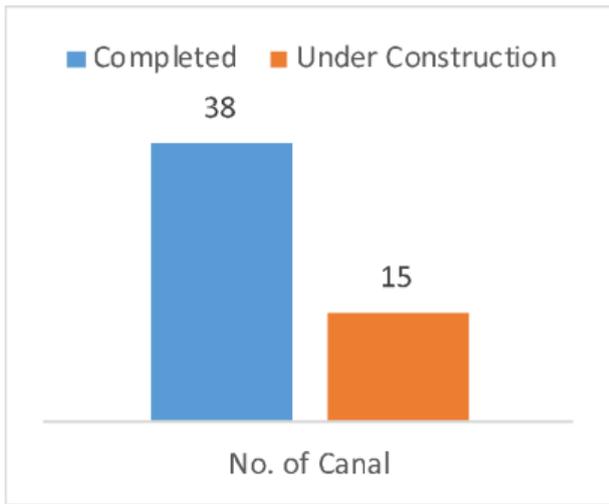


Figure 7 Indicative data on OFWM project.

5.2. Horticulture and Livestock Project (NHLP) Project

The objective of the NHLP project is to improve the livelihoods of rural households through stimulating production and productivity. The project has a number of components: Horticulture, Livestock, Farmer Organization Development (FOD), Institutional Capacity Building (ICB), Gender Mainstreaming (GM), ESSF, M & E and Service Sections.

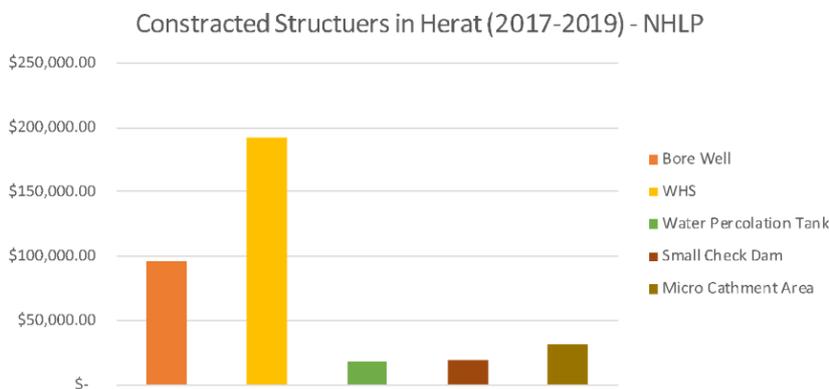
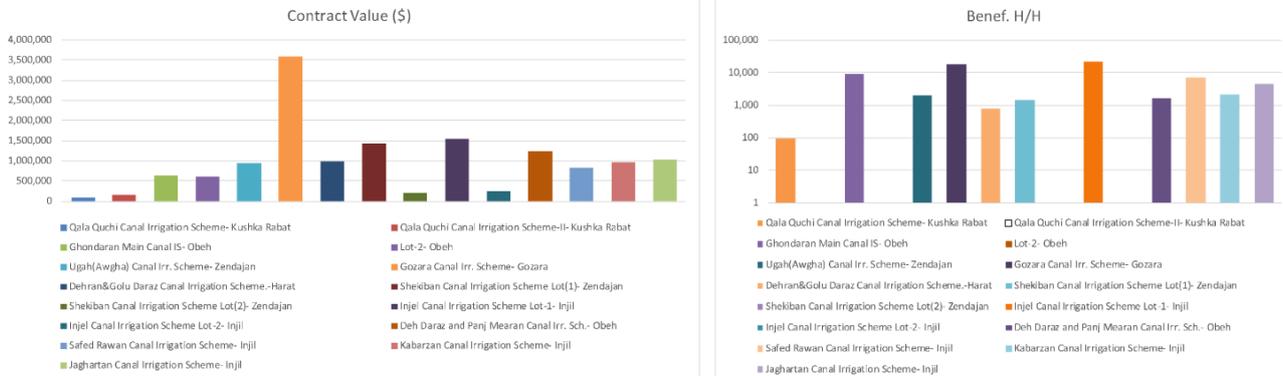


Figure 8 Value of NHLP activities in Herat, 2017-2019

5.3. Irrigation Restoration and Development Project (IRDP) - WorldBank



The IRDP has many on-going activities in LHRB, as illustrated in the charts below.

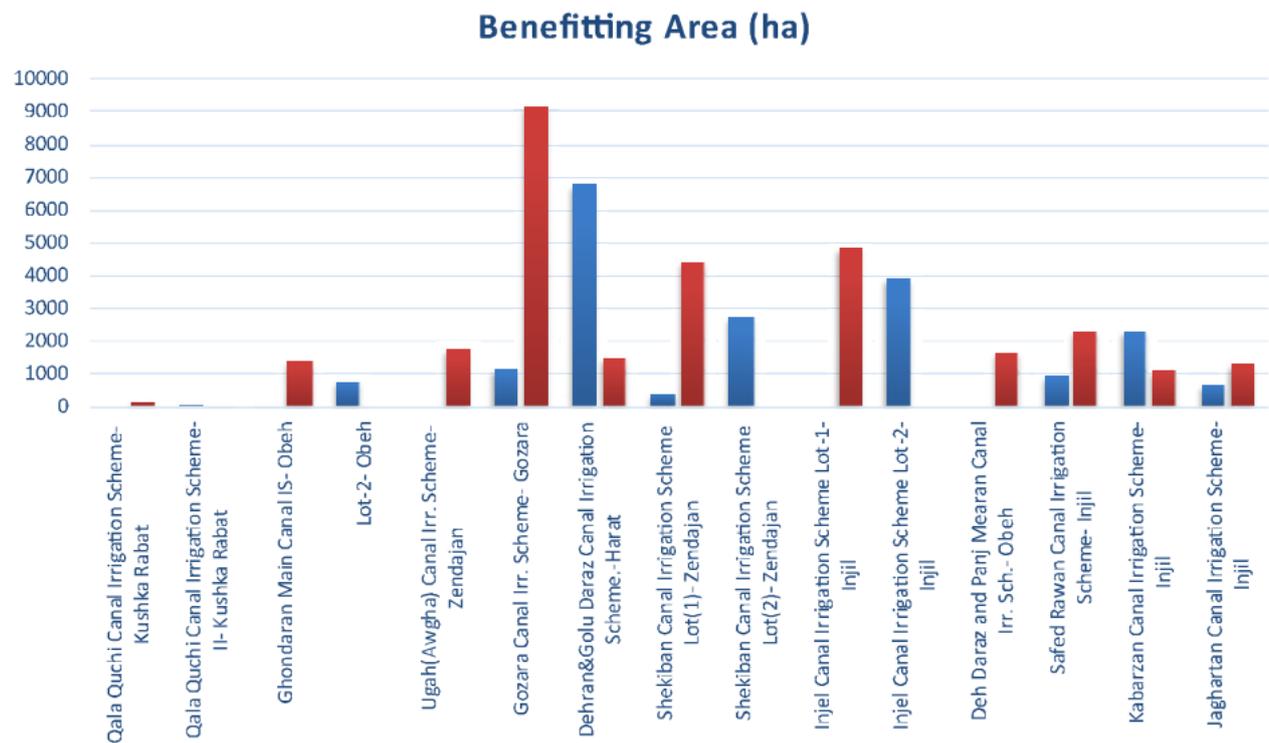
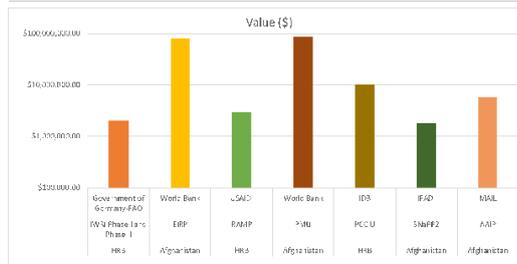


Figure 9 IRDP contract value, number of beneficiary households & benefiting area (ha)

There are many other donors and projects active in the Harirud basin. As indicated in the figure 10 below, this includes the Asia Development Bank, DANIDA, DFID, Italian Cooperation, World Vision, and a number of United Nations agencies (International Office of Migration, UNOPS and the World Food Program, WFP). A sizeable number of these activities are in the agriculture and livestock sectors.

MAJOR DONOR FUNDED PROJECTS IN HRB AND AFGHANISTAN



OTHER DONORS IMPLEMENTED WATER RELATED PROJECTS IN HRB

- Italian Cooperation
- World Vision
- IOM - International Organization for Migration
- WFP - World Food Program
- UNOPS - United Nations Office for Project Services
- CRS - Catholic Relief Services
- PRT Herat - Provincial Reconstruction Team

OTHER DONORS IMPLEMENTED WATER RELATED PROJECTS IN HRB

Agriculture Market Infrastructure Project (AMIP) - ADB

Outcome: Development of more efficient livestock and horticulture agribusinesses

Support to National Priority Program 2 (SNaPP2) - IFAD

The goal of Program is to contribute to improving the food security and economic status of poor rural households in three pilot provinces, Balkh, Herat and Nangarhar. The project will reach at least 57,000 households consisting of 427,500 people in these provinces.

Community Livestock and Agriculture Project (CLAP) - IFAD

The long term goal of the project is to contribute to reduce poverty in rural Afghanistan and its short term goal to improve food security of 169,500 rural households in selected districts in the provinces of Kabul, Parwan, and Logar by increasing agriculture and livestock productivity.

Horticulture Cooperatives Development Project (HCDP) - AFD

The aim of the Project is to increase horticultural production in the regions of the periphery of Kabul, to promote the quality and marketing of such production, to improve supplies to the capital, and possibly to increase exports and therefore contribute to reducing poverty.

Comprehensive Agriculture and Rural Development-Facility (CARD-F) - DFID & DANIDA

CARD-F's mission is to identify, design and implement agriculture & rural development interventions that have the highest potential and contributions toward the economic growth and economic development of Afghanistan in the most transparent, fair, and equitable manner and to achieve the best value for money for donor funds.

Figure 10 Other major donor-funded irrigation and agriculture projects in LHRB

6. LONG-TERM VISION OF LOWER HARIRUD RIVER BASIN

6.1. The vision of the Lower Harirud River Basin

Improvement of the legislative, economic, and institutional conditions considering the growing impacts of climate change ensure effective management and rational use of water resources. Strengthening and implementing IWRM principles in the use and management of water resources is one of the most effective ways to achieve a long-term vision in LHRB.

Even though the Afghanistan government is trying to implement the concept of IWRM in all major river basins of the country, the current framework has a centralized management approach in this sector. The institutional framework in the Harirud river basin is organized based on the IWRM concept; yet the overall management, planning, and policies are practiced by the central government. The basin institution has minimal decision-making powers, which has created friction between different stakeholders and decreased the development process in the basin.

On the other hand, the government's priorities for national development correctly recognize the crucial role agriculture plays in Afghanistan's future economic growth and the well-being of its people. It is also without a doubt a recognized fact that water is the major element that drives the agricultural sector.

Strengthening the institutional framework, the involvement of stakeholders in water management, training of experts, and construction of appropriate standard engineering water infrastructures in LHRB lead to integrated management of water resources that ensure that demand for water for agriculture, domestic and industrial purposes are met in upcoming years.

The technical condition of the irrigation and reclamation infrastructure will improve, the organizational and technical losses of water in the irrigation network will significantly decrease, and the efficiency of the canals will increase. The accuracy and availability of information on the volume of water resources and water use are ensured in all districts under LHRB. Farmers have equal and timely access to irrigation water, and water-saving technologies are widely used in agriculture.

The volume of production and export of agricultural products will increase due to the introduction of modern technologies, building cold storage facilities, increased productivity in agriculture, and access to markets.

Another major outcome will be that the population under LHRB is fully provided with high-quality drinking water and water use efficiency will increase in all domestic uses.

7.PURPOSE AND OBJECTIVES OF THE BASIN PLAN

7.1. Expected results from implementation of the plan

This plan was developed to ensure the sustainable development and use of water resources in Lower Harirud River Basin through the implementation of integrated water resources management approach, taking into account possible effects of climate change and other predictable challenges.

An important element in the process of development basin plan for LHRB was the facilitation of stakeholder's contributions as well as the creation of RBC and involvement of RBC members. A series of five trainings, discussions and group works with the participants and the findings of situational analysis led to identify and prioritize the major problems in LHRB. Given the identification of priority problems, the main objectives of the short- term and long-term plans for the LHRB are:

- 1.Planning and implementation of water resources management
- 2.Improvement in agriculture products through improvement in the technical condition of irrigation and reclamation infrastructures
- 3.Improvement in Legislation and Institutional Framework
- 4.Improving the socio-economic conditions of residence in LHRB
- 5.Improvement in Environmental related issues

Objective 1: Planning and implementation of water resources management

- Development of a plan for water consumption and water use;
- Ensure the balanced use of water and achieving the efficiency of water use;
- Ensure that water users are satisfied with the water they receive;
- Constant monitoring of the quantity and quality of water;
- The number of WUAs who are dissatisfied will decrease, as well as a reduction in conflicts between water users;
- The water supply will improve and the consumers receive the right amount of water at the right time;
- The potential of WUAs and RBC members will improve to contribute to the management of water resources at local levels.
- The satisfaction of downstream users will be achieved by managing the Salma Dam water release through developing a real-time model to control the

supply and the demand of the Salma dam.

Objective 2: Improvement in agriculture products through improvement in technical condition of irrigation and reclamation infrastructures

- Kawgan dam across Kawgan River and Pashdan Dam across Karukh River which are under construction will meet the three new proposed canal demands. (South Main Canal, Pul-i-Hashemi Irrigation Project, and New Canal under Pashdan Dam);
- Farmer training centers will be active in each district so the farmers can better understand the cropping patterns and consider efficient utilization of water during irrigation;
- Cultivation of proper cropping patterns will help to meet the basin food security and strategic economical goals;
- All major points of water discharge for irrigations are equipped with water regulation and water measuring structures;
- Increasing the productivity of crops and the productivity of water and land;
- The demand of Joy Sultani and Palpiry Canal will be met by Pashdan Dam. and the upcoming Pashdan and Kawgan dams.;
- Traditional intakes will transform into engineered intakes to better manage water utilization;
- A database center for real-time data will be created to collect, analyze, and record data for various purposes.

Objective 3: Improvement in Legislation and Institutional Framework

- The legislative framework will ensure the allocation of water all irrigation, hydropower, domestic, industries, and environment;
- Groundwater usage will be managed through an administrative or legislative framework;
- The profitability of agriculture will increase and the level of well-being of the population will improve;
- A large amount of water will be saved as a result of a slight increase in irrigation;
- Annual plans for the maintenance of water facilities be developed based on the results of field surveys of the technical conditions;
- Transparency in water distribution is ensured, the established procedure for water distribution is observed;

Objective 4: Improving the socio-economic conditions of residence in LHRB

- Additional jobs will be created;
- Various cold storage facilities will be built to avoid losses in cost and products.
- RBCs will be trained with negotiation skills to settle the conflicts over water and land;
- Decrease in disputes over water and land;
- Decrease in illegal immigration of dwellers to neighboring countries in LHRB by increasing employment;

7.2. Mechanism of measures implementation and sources of financing

The responsibility for implementation of this plan rests on National Water Affairs Regulation Authority, Directorate of Harirud Murghab River Basin, Lower Harirud River Basin, Water User Associations, River Basin Council, and farmers as well as other interested organizations and donor agencies.

The source of funding for the activities listed in the Basin Plan will be funded from the budget of the government of the Islamic Republic of Afghanistan, grants from international donors, and contribution of the private sector.

Objective 5: Improvement in Environmental related issues

- Holistic watershed management and planning will be improved to meet the current demands;
- Prohibition of excessive removal of aggregates for construction and city development will control the destruction of floods;
- Increase the capacity of canals to carry the wash water to the river and will control the destruction of canals during flooding;
- Natural-based approaches will be taken to recharge groundwater and ensure the quantity and quality of groundwater;
- Mitigation measure will be taken to reduce climate change impacts on the environment;

The Directorate of LHRB and HMRB in coordination with other stakeholders prepare the concepts for construction and reconstruction of the check dams, irrigation network, water supply networks in LHRB. The concept after sharing with NWARA be included in the 10-year program of construction, reconstruction, and modernization of irrigation and land reclamation infrastructure on the territory of LHRB.

8. PLAN OF ACTIONS FOR DEVELOPMENT OF LHRB BY IMPLEMENTING THE PRINCIPLES OF IWRM

The implementation plan is developed considering the problem identified and prioritized within the trainings and discussion with stakeholders, RBC members, and technical staff of LHRB. The tasks are the break-down of all the problems listed in Table 6.

Implementation plan (2021-2030)

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
1. Improving the planning and implementation of water resources management				
1.1. Drawing up plans for water consumption and water use	Conducting training on preparation of water consumption, and water use plans	LHRB	March – June, 2021	Governmental Budget
	Creation and Enrichment the database of water quality, quantity, water demand and WUAs, with annual updates.	HMRB	2021 with regular updates	Governmental Budget
	Creation of a database to collect and record data from irrigation networks with annual adjustments	HMRB and MAIL	2022 with regular updates	Governmental Budget
	Conducting trainings for WUAs, RBC, and LHRB staff on water use in irrigation and domestic uses	LHRB, MAIL and AUWSSC	March – June, 2021	Governmental Budget
	Drafting water consumption and water use plans	HMRB and AUWSSC	2021-2022	Governmental Budget
1.2. Drawing up a plan for increasing the efficiency in irrigation	Conducting a survey for the assessment of irrigation network efficiency in LHRB	MAIL and LHRB	July 2021	Governmental Budget
	Collecting an accurate geodetic survey of the irrigation system and placing it in a central database available to all government ministries and projects for planning purposes	ANSA, MAIL and NWARA	2021- 20211	Governmental Budget
	Analyze the data and preparing a final report from the irrigation networks situation	ANSA, MAIL and NWARA	End of 2022	Governmental Budget
	Conducting training on water use efficiency in irrigation for the technical staff	MAIL and LHRB	Regularly	Not required
	Conducting workshops for farmers to introduce them to efficient use of water in irrigation	MAIL and	Regularly	Not required
	Developing the final plan for increasing efficiency in irrigation	MAIL and LHRB	August, 2020	Governmental Budget

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
	Improving infrastructures (Reducing losses, regular maintenance)	NWARA	Constantly	Governmental Budget
	Enabling water users and managers to better match supply to demand	HMRB	Regularly	Not required
	Improving technical/productive/product-choice efficiency at local levels	MAIL	Constantly	Governmental Budget
1.3. Developing plan for proper management and operation of Salma dam	Survey and analysis of the supply and demand in Salma Dam	NWARA	March 2021	National Budget or attracting the budget from interested donor agencies
	Observation station is required in the up-stream of Salma dam to develop the yearly operation curve		2021-2022	
	Developing a new operation curve based on realistic demand for proper operation of Salma dam		2022	
	Developing a real-time model to control the supply and demand of the Salma dam		2022	
	Creating of monitoring stations on each intake structure of the canals and monitoring wells on each leak point of the river; all these shall be synced with dam release		2023	
1.4. Increasing the potential of WUAs and RBC	Providing legal documents for the organization's and council activities	NWARA	2021	Government Budget
	Providing guidance documents for the implementation of the functional tasks of river basin plan development, monitoring, and maintenance of structures in local areas of WUAs and RBC members.	NWARA	2022	
	Development of training programs and performing trainings for different target groups of WUAs and RBC	NWARA	Regularly	
	Involving WUAs and RBC members in water management issues in LHRB.	LHRB	Constantly	

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
1.5. Introduction of water-saving technologies	A set of measures to improve water supply for domestic uses and increasing the technical level of irrigation systems and the widespread introduction of water-saving technologies	NWARA and AUWSSC	Throughout the RBP implementation	Governmental Budget
2. Improvement in agriculture products through improvement in technical condition of irrigation and reclamation infrastructures				
2.1. Equipping water-regulating and water-measuring facilities of water discharge points of WUA and water sources	Construction of water regulating facilities at the points of water intakes	NWARA	2023 -2025.	Governmental Budget
	Construction water measuring structures in points of water intakes		2023 -2025	
	Construction of water regulating structures at the points of water outlets for water consumers.		2023 -2025	Governmental Budget and possible Financial support from donor agencies
	Providing advisory services to farmers on determining and improving soil fertility, conducting agrotechnical measures at the optimal time and at the proper level, and taking measures to combat the spread of pests.	MIAL and NWARA	Regularly	Governmental budget
2.2. Creating a database of real-time quantitate data of agriculture products in LHRB	Establishment of a central database in LHRB to collect, record, and analyze various types of data from agriculture products.	MAIL	Dec 2021	Governmental Budget and possible Financial support from donor agencies
	Conducting various surveys in districts for collecting the data		By 2025	
	Comparison and merging of the data from different sources		March 2026	
	Making the data easily accessible for researcher and donor projects		Constantly	
2.3. Improvement the condition of irrigation structures	Phasing out the traditional intakes and replacing them with well-designed engineering intakes.	NWARA	By 2027	Governmental Budget and possible Financial support from donor agencies

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
	Resolve water flow to Ayesha land by following one of the options: <ul style="list-style-type: none"> • Prioritize the downstream user demand and to at least maintain their previous water use. • Or providing them yearly water to cultivate their Ayesha land; • Or development of new canals. 	HMRB	2024	Governmental Budget and possible Financial support from donor agencies
	Increase in irrigation efficiency by introduction new technologies, reconstruction of irrigation of infrastructures and training for water users in local level.	MAIL, LHRB	Constantly	Not required
	Conducting trainings for farmers and other water users for their contribution to the maintenance of irrigation structures.	LHRB	Regularly	Not required
2.4. Drawing up a plan for technical maintenance of water facilities	Inspection of the technical condition of water facilities and drawing up a plan for its improvement	HMRB	2024	Governmental budget
	Drawing up a plan and cost estimate for the maintenance of water facilities, and approval in the finance departments of districts and regions	NWARA	2021-2030	Governmental Budget and possible Financial support from donor agencies
	Compilation of address lists for the inclusion of donor agencies and private sector for the construction and reconstruction of irrigation facilities	MAIL and MoCI	2023	Governmental Budget and possible Financial support from donor agencies
2.5. Markets for agriculture products in different seasons	Identifying markets for products and the number of cold storages in districts near to the agricultural lands	MAIL and MoCI	2023	Governmental Budget and possible Financial support from donor agencies

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
	Development of recommendations to the government on the need to control the prices of imported agricultural products.	MAIL and MoCI	Regularly	Governmental budget
	Involvement of the private sector to invest in cold storage facilities		Regularly	Not required
	Construction of cold storage facilities and providing transportation facilities	Private sector and MAIL	By 2028	Private Sector and Governmental Budget
	Providing practical assistance to the procurement team in the selection and purchase of agricultural machinery and auxiliary equipment for the timely implementation of agricultural activities	MAIL and private sector	Regularly	Governmental Budget
	Publication in the mass media of the regions of the agricultural products and the prices based on the analysis of prices in the world market with a quarterly update	MAIL		Governmental Budget
	Publication on a periodic basis of information about the expected harvest, the state of development of crops, the volume of products in warehouses in the context of regions for the information of buyers	MAIL		Governmental
3. Improvement in Legislation and Institutional Framework				
3.1. Developing of mechanism on water allocation	Developing recommendations for NWARA to develop proper water management and legislative framework to allocate the water for all irrigation, hydropower, domestic, industries and environment.	NWARA, HMRB and other relevant stakeholders	2023	Governmental budget
	Developing detailed maps of agriculture lands, determination of types of agriculture products in every district, and allocation of water based on their demand.	NWARA and MAIL	2023-2024	Governmental budget

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
	Determination of the demand for domestic and industrial uses and allocation of water based on demand	NWARA and MoCI	2024	Governmental budget
3.2. Developing Administrative or legislative control on groundwater usage	Providing recommendation for developing an administrative or legislative control on groundwater in the basin to avoid the drop in the table of groundwater due to over-extraction	LHRB and HMRB	2025	Governmental budget
	Control over the use of solar pumps in various areas that extract an unnecessary amount of groundwater	LHRB and RBC	Regularly	Not required
	Introduction of water use efficiency technologies in domestic uses	AUWSSC and HMRB	Constantly	Not required
	Conducting seminars and public awareness workshops and seminars in local areas for women and children to reduce water wasting in households	LHRB	Regularly	Governmental Budget and possible Financial support from donor agencies
	Recommending provisions in the water law on WUAs	SCoLWE and NWARA	By 2027	Not required
	Recommending provisions in the water law on irrigation water rights			
	Recommending tariff setting in Water Law			
	Recommendation on developing formal conflicts resolutions mechanism among water users			
	Suggestions on creating a legal mechanism for establishing and improvement of WUAs and RBCs			
	Strengthening the institutional framework to address the current issues due to climate change and future challenges to the relevant climate change funding agencies	NEPA and HMRB	Constantly	Governmental Budget and possible Financial support from donor agencies

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
4. Improving the socio-economic conditions of residence in LHRB				
4.1. Increase in employment	Increase in employment by creating additional jobs through the development of new lands and the use of resource-saving technologies, creating an infrastructure for the storage and processing of agricultural products, through an investment program for the development of regions	NWARA, MAIL and MoLSA	By 20208	Governmental Budget and possible Financial support from donor agencies
	Retraining and advanced training based on the real needs of the labor market	HMRB	Regularly	Governmental Fund
	Reduction in the percentage of illegal immigration of dwellers in LHRB to neighboring countries.	NWARA, MAIL and MoRR	Constantly	Not required
4.2. Improving water supply and sewerage networks	Creating jobs through construction of water supply and sewerage networks and the use of wastewater for agriculture purposes after a treatment.	AUWSSC and NWARA	Regularly	Not required
4.3. Improvement in settlement of disputes over land and water	Providing recommendation on developing a formal mechanism for stakeholder engagement for the development of dispute resolution mechanisms.	LHRB and HMRB	2023	Governmental Budget and possible Financial support from donor agencies
	Promote greater transparency, the traditional practices, and customs relating to water rights and dispute resolution		Constantly	Governmental Budget
	The dispute resolution documents will be made public and easily accessible along with copies of formal and informal decisions made by administrative bodies, courts, and Mirabs.	HMRB	Constantly	Governmental Budget
	Conducting trainings for WUAs and social leaders to empower them with negotiations and mediation knowledge and skills.		Regularly	Governmental Budget

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
4.4. Improvement roads condition in LHRB	Construction of roads to reduce the distance between headquarters and canal intakes	Herat Municipality, MoPW	By 2030	Governmental Budget
	Reconstruction and maintenance of existing roads	Herat Municipality and Districts HQs	Regularly	Governmental Budget
5. Improvement in Environmental related issues				
5.1. Developing natural-based solution for flooding	Developing flood emergency warning system	ANDMA, AMD and NWARA	By 2027	Governmental Budget
	Preparation of detailed maps of areas under the risk of flooding	HMRB	2026	Governmental Budget
	Increase the capacity of canals to carry the wash water to rivers, especially the Joy-i- Naw Canal	NWARA and MAIL	By 2027	Governmental Budget
	Prevent the construction of residential houses and other facilities in the vicinity of the river	MolA and RBC	Constantly	Governmental Budget
	Building sand dams or natural water retention structures (earthen ponds) in front of wash in the desert area.	NWARA	By 2030	Governmental Budget
5.2. Improvement in quality and recharge of groundwater	Control on over-extraction of groundwater in Herat city, Injil and Ghorian districts	HMRB in coordination with MolA	Constantly	Governmental Budget
	Prevention of sewer well construction in LHRB		Constantly	Governmental Budget
	Treatment of Karbar Canal effluent and city sewer which is diverted to this canal	AUWSSC	2022 - 2025	Governmental Budget
	Control on excessive and unnecessary use of solar pumps.	HMRB	Constantly	Governmental Budget
	Use of seasonal lakes in basin as a source of groundwater recharge. Kole Jang at Guzara and Tezan canal can be upgraded, by restructuring the area and diverting flood water to it. It will be a recharge source for the industrial area and Herat city.	HMRB	By 2027	Governmental Budget
	Construction of central sewer system and treatment plant in Herat city and construction of wastewater treatment plant for the industrial city	AUWSSC	By 2030	Governmental Budget

Tasks	activity	Responsible executors	Terms of implementation	Source of financing
	Protection of groundwater recharge boundaries from urbanization by identification, mapping, and protection of these areas.	NWARA and District HQs	Constantly	Governmental Budget
5.3. Prohibition of excessive removal of aggregates from the river bed	Enforcing the prohibition of sand aggregates removal from the river bed for construction purposes	MolA and WUAs	Constantly	Not required
	Preparing maps to determine the boundaries of the river.	HMRB	By 2028	Governmental Budget
	Conducting training on impacts of excessive removal of sand from the river bed in local areas.	LHRB	Periodically	Not required
5.4. Control of land degradation and improvement of the environment	Developing mechanisms to reduce land degradation in LHRB	NEPA and DM of Land Management Affairs at MUDL		Governmental Budget
	Launch public awareness campaigns to protect green areas and pastures.	NEPA	Regularly	Governmental Budget
	Control of excessive loss of green areas or vegetation	NEPA	Constantly	
	Control on overgrazing	MAIL and NEPA	Constantly	Governmental Budget
	Decrease in firewood collection and deforestation	NEPA	Constantly	Governmental Budget
	Minimizing the impacts of agriculture on land degradation	MAIL	Regularly	Governmental Budget
5.5. Mitigation the impacts of climate change on the environment	Registering existing wetlands and seasonal lakes in LHRB as part of environmental heritage	NEPA or UNEP	2022-2023	Governmental Budget
	Involvement of women groups into the social setup, to better use this resource in water use efficiency and the environment restoration, dedicated efforts to be done in ways that are traditionally and culturally acceptable and beneficial	UNEP and NEPA	Regularly	Governmental Budget

Table 8 Implementation Plan

9. MONITORING AND REVISION OF THE IMPLEMENTATION OF THE PLAN

Monitoring and evaluation (M&E), both during the implementation of the plan's activities in the short term and the long term, is an integral part of the Basin Plan. Without M&E, it will be impossible to obtain and apply the lessons necessary to ensure the improvement and development of the water management situation in LHRB.

The efficiency and effectiveness of the Basin Plan depends on the timely and high-quality execution of the measures. For this, it is necessary to carry out M&E over the implementation of all measures and their impact on the situation in the basin as a whole. Monitoring of the implementation of activities and assessment of its results is carried out both by quantitative (measurable) and qualitative indicators at a certain frequency by representatives of NWARA or relevant organizations/ stakeholders.

At the same time, in order to assess the level of achievement of the goals or quantifiable measures of the Basin Plan, data are collected from those organizations that will ultimately benefit from the implementation of the basin plan. The assessment of qualitative indicators is carried out through a survey and interviews with representatives of a particular organization. Most of the indicators for monitoring the implementation of the Basin Plan are of good quality. For example, to assess the indicator "Assessment of the report from irrigation networks", the person responsible for data collection visits the WUAs and LHRB directorate and checks that the plans are in place.

Monitoring indicators to assess the effectiveness and efficiency of the implementation of measures can be adjusted during the implementation of the Basin Plan. At the same time, any adjustments or replacement of one indicator for another should be discussed and agreed with representatives of all stakeholders. It should be noted here that the efficiency and effectiveness of the Basin Plan depends on the reliability and quality of data processing, i.e. representatives of organizations responsible for collecting and processing data are required to be accurate in collecting and evaluating data. The proposed indicators for monitoring the implementation of the Basin Plan activities are given in Table 9, where the names of indicators, baseline and target values of indicators, frequency and source of data collection, as well as those responsible for collecting and processing data are written.

When monitoring and evaluating the implementation of the Basin Plan activities, the main responsibility will be assigned to LHRB, HMRB and other water management organizations, consisting of representatives of interested stakeholders.

The final version of the Basin Plan should be printed in the required quantity so that every member of the RBC/stakeholder representative has the opportunity to familiarize himself with it and study it thoroughly.

It should be remembered that the Basin Plan is a "living" document. Therefore, based on the results of monitoring and assessment, the Basin Plan should be periodically or on a regular basis revised by HMRB, i.e. there is a possibility of making adjustments or additions.

9.1. Indicators for monitoring the implementation of the Basin Plan activities

Indicators	Unit	Base values	Target values by the date specified in the Plan	Frequency of data collection	Data source	Responsible for data collection and processing
1. Improving the planning and implementation of water resources management						
Number of WUAs, RBC, and LHRB staff passed trainings to develop water consumption and water use plan and the percentage of their satisfaction from trainings	Qty	0	35	At the end of each training session	LHRB and the report of the Consultant	LHRB
	%	0	100			
Database of water quality, quantity, water demand, and number of WUAs updated annually	Yes/No	No	Created	2021 with Annual updates	HMRB	LHRB
Number of central database centers for irrigation networks with annual adjustments	Yes/No	No	Yes	2 times a year	MAIL	HMRB
Number of WUAs, RBC, and LHRB staff who have completed trainings to assess the water use efficiency in irrigation and domestic uses and the percentage of those satisfied with the trainings	Qty	0	35	At the end of each training session	MAIL, AUWSSC and LHRB	HMRB
	%	0	100			
Evaluated the efficiency of the water use or consumption in irrigation and water supply networks after the plan implementation	Yes/No	No	Yes	Once a year	MAIL and HMRB	HMRB
Assessment of the report from irrigation networks	Yes/No	No	Yes	Once a year	WUAs and HMRB	LHRB
Number of farmers attended in workshops about the efficient use of water in irrigation and the percentage of those satisfied with workshops	Qty	0	100	At the end of workshop	MAIL and LHRB	LHRB
	%	0	100			

Indicators	Unit	Base values	Target values by the date specified in the Plan	Frequency of data collection	Data source	Responsible for data collection and processing
Evaluated the improvement in infrastructures' efficiency and maintenance	%	0	80	Once in a year	HMRB	LHRB
Number of surveys to analyze the supply and demand of Salma dam	Qty	0	1	2021	HMRB	LHRB
Observation of stations in upstream of Salma Dam	Yes/No	No	Yes	Weekly for one year 2021-2022	LHRB	LHRB
Evolution of Salma dam operation to meet the realistic demand	Yes/No	No	Yes	Quarterly	LHRB	LHRB
Assisting WUAs, RBC, and other stakeholders by providing legal documents about their activities	Yes/No	No	Yes	Quarterly	WUA	LHRB
Developing a training program and conducting trainings for WUAs and RBC members for building their capacity	Yes/No	No	Yes	Annually	WUAs and RBC	HMRB
Uniform distribution of water between water consumers located in upstream and downstream of Salma dam	Yes/No	No	Yes	Quarterly	Water consumers	HMRB
Irrigation of crops in compliance with the optimal elements of irrigation technique	Yes/No	No	Yes	Quarterly	MAIL	LHRB
Strengthening the material and technical base of WUAs	Yes/No	No	Yes	2 times a year	WUA	HMRB
2. Improvement in agriculture products through improvement in technical condition of irrigation and reclamation infrastructures						
Equipping water intakes with water regulating and water measuring structures by their construction	%	0	80	Once between 2023-2025	RBC and WUAs	LHRB

Indicators	Unit	Base values	Target values by the date specified in the Plan	Frequency of data collection	Data source	Responsible for data collection and processing
Equipping water outlets of water consumers with water regulating structures	%	0	80	Once between 2023-2025	RBC and WUAs	LHRB
Number of trainings for farmers to improve soil fertility and combat the spread of pests	Qty	0	4	Annually	RBC	HMRB
Number of central databases to collect, record and analyze data from agricultural lands and products with regular updates	Qty	0	1	December 2021 with annual updates	LHRB	HMRB
Accessibility to data relevant to agricultural lands and products	%	0	80%	Annually	WUAs and organizations with relevant projects	HMRB
Percentage of traditional intakes replaced by well-designed engineering intakes	%	0	90%	By 2027	WUAs and RBC	LHRB
The satisfaction of water demand in downstream for Ayesha land	Yes/No	No	Yes	Once a year	WUAs in downstream	LHRB
Number of WUAs and farmers trained for maintenance of irrigation structures and the percentage of their satisfaction from trainings a	Qty	0	100	Annually	Farmers	LHRB
	%	0	100%			
Inspections to evaluate the technical condition of water facilities	Yes/No	No	Yes	Annually	LHRB	HMRB
Reconstruction of irrigation facilities	Yes/No	No	Yes	Once in two years	LHRB	HMRB
Construction of cold storages	Qty	0	8	By 2026	MAIL	HMRB

Indicators	Unit	Base values	Target values by the date specified in the Plan	Frequency of data collection	Data source	Responsible for data collection and processing
Number of procurement officers trained to understand the selection and purchase of agricultural machinery and auxiliary equipment for the timely implementation of agricultural activities	Qty	0	10	Once a year	MAIL	HMRB
Publication in the mass media of the regions of the agricultural products and the prices based on the analysis of prices in the world market with a quarterly update	Yes/No	No	Yes	Quarterly	MAIL	HMRB
3. Improvement in Legislation and Institutional Framework						
Proper water management and legislative framework developed to allocate the water for all irrigation, hydropower, domestic, industries, and environment.	Yes/No	No	Yes	Once	NWARA	HMRB
Maps created from agricultural lands on types of agriculture products to help in the allocation of water for it	Yes	No	Yes	Once in 2 years	LHRB	HMRB
Control on over-extraction of groundwater and excessive use of solar pumps	Yes/No	No	Yes	Quarterly	WUAs and RBC	HMRB
Water use efficiency technologies introduced in domestic uses for local people	Yes/No	No	Yes	Twice a year	Local communities	HMRB

Indicators	Unit	Base values	Target values by the date specified in the Plan	Frequency of data collection	Data source	Responsible for data collection and processing
Provisions in the water law on WUAs	Yes/No	No	Yes	Once	NWARA	HMRB
Provisions in the water law on irrigation water rights						
Responsibilities for irrigation infrastructures						
Introducing of tariff setting in Water Law						
Developing formal conflicts resolutions mechanism among water users						
Creating legal mechanisms for establishing and improvement of WUAs and RBCs						
4. Improving the socio-economic conditions of residence in LHRB						
Increasing employment of the economically active population through the creation of additional jobs through the development of new lands and the use of resource-saving technologies, the creation of infrastructure for the storage and processing of agricultural products, through an investment program for the development of regions	%	30	80	2 times a year	MoLSA	LHRB
Retraining and advanced training based on the real needs of the labor market	Yes/No	No	Yes	2 times a year	MoLSA	HMRB
The mechanisms developed for conflict resolutions	Yes/No	No	Yes	Once	NWARA	HMRB

Indicators	Unit	Base values	Target values by the date specified in the Plan	Frequency of data collection	Data source	Responsible for data collection and processing
Reduction in the percentage of conflicts over land and water	%	0	90	Two times in a year	LHRB	HMRB
Number of WUAs, social leaders, Mirabs, and RBC members trained with negotiation and mediation knowledge and skills and the percentage of their satisfaction from trainings	Qty	0	30	At the end of training	WUAs, social leaders, Mirabs and RBC members	LHRB
	%	0	90			
5. Improvement in Environmental related issues						
Flood emergency warning system developed	Yes/No	No	Yes	Once	LHRB	HMRB
Vulnerable areas to flooding identified	Yes/No	No	Yes	Once a year	LHRB	HMRB
Increase in capacity of canals to carry the wash water to rivers, especially the Joy-i- Naw Canal	%	0	90%	By 2027	RBC	HMRB
Control on over-extraction of groundwater in Herat city, Injil and Ghorian districts	Yes/No	No	Yes	Quarterly	RBC	LHRB
Prevention of sewer well construction in LHRB	Yes/No	No	Yes	2 times a year	Local people	HMRB
Number of central sewer system and treatment plant in Herat city and construction of wastewater treatment plant for the industrial city	Qty	0	2	By 2030	AUWSSC and NWARA	HMRB
Protection of groundwater recharge boundaries	Yes/No	No	Yes	Twice a year	RBC	LHRB
Percentage of decrease in aggregate and sand removal from the river bed	%	0	80	Annually	RBC	LHRB

Indicators	Unit	Base values	Target values by the date specified in the Plan	Frequency of data collection	Data source	Responsible for data collection and processing
The number of trainings for local people framers, WUAs, and RBC members to reduce land degradation, protection of green areas, pastures and avoid overgrazing and deforestation.	Qty	0	4	Annually	NEPA	LHRB

Table 9 Indicators for monitoring the implementation of the Basin Plan activities