

GIS Stewardship Survey Report



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Waheedullah YOUSAFI
GIS Consultant



Central Highlands Programme (CHP) is common initiative implemented by a consortium of three French NGOs (GERES, MADERA and SOLIDARITES INTERNATIONAL) funder by the Agency for French Development (AFD). The general objective of the programme is to increase the living standards and quality of life of rural mountainous populations by promoting balanced rural development and preservation of natural resources. The 3.5 years programme was launched in March 2014 in two provinces of the Central Afghanistan: Bamyān and Maydan-Wardak.



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Abbreviations

GIS	Geographic Information System
RS	Remote Sensing
GPS	Global Positioning System
AGCHO	Afghanistan Geodesy and Cartography Head Office
CSO	Central Statistics Office
LCA	Landcover Atlas
MAIL	Ministry of Agriculture, Irrigation and Livestock
AREU	Afghanistan Research and Evaluation Unit
MEW	Ministry of Energy and Water
NEPA	National Environmental Protection Agency
MADERA	Mission d'Aide au Développement des Economies Rurales
Solidarite	Solidarités International
GERES	Group for Environment, Renewable Energy and Solidarity
APR	Agricultural Prospect Report
FEWS NET	Famine Early Warning Systems Network
DEM	Digital Elevation Model
Topo Maps	Topographic Maps of Afghanistan
IPC	Integrated Food Security Phase Classification
MT	Metric Ton
UNFAO	Food and Agricultural Organization of the United Nations

Executive Summary

This report describes an assessment and findings on natural resource management in the three districts namely Behsud I and II and Yakawlang of Maidan-Wardak and Bamyan provinces respectively. The survey aimed at producing relevant knowledge through a detailed survey for producing GIS maps of the existing irrigation and watershed systems and infrastructure in the project areas, to be used in the program in order to ensure improved management of water resources, and to be disseminated to institutional stakeholders, NGOs and actors involved in designing and implementing the Provincial Development Plan.

Agriculture is the most important source of income for the households of the mentioned districts. In addition, these districts are predominantly rural in nature thus the development of rural areas is key to the development of the region. In turn, the development of rural area is not possible without developing the agricultural sector and water is vital for both irrigated and rainfed agriculture in the area.

The terrain of the area is mountainous with very little arable land available for cultivation mostly in the narrow valleys. The population relies primarily upon subsistence farming with irrigated and rain-fed wheat, barley and potato being the main crops grown, supplemented with small scale livestock rearing. Agriculture productivity is low, estimated as 1.89 and 2.08 ton/ha for irrigated wheat and 0.54 and 0.97 ton/ha for rainfed wheat in Bamyan and Maidan-Wardak provinces (APR 2016), with limited access of the population to certified seed, latest technology in the field and irrigation water.

During the survey 1035 canals were identified in the mentioned three districts, however, 853 of them (82.5%) have been surveyed. The remaining canals were not surveyed due to inaccessibility and security as advised by MADERA field office.

Less than 50% of the population has access to land and this limits their ability to grow adequate food for their own consumption. Non-agricultural capabilities are very limited, which makes income diversification to other commercial activities difficult on the short run. Both Maidan-Wardak and Bamyan provinces are wheat deficient based on the wheat per capita of 162 kg/head/year and a total population of 606,000 and 455,000 for year 2016. Furthermore, the comparison of landcover data from 2016 and 1993 shows increase in irrigated/ rainfed lands, while it shows decrease in barren and rangelands which are vital for livestock rearing communities. Marshes and water bodies also shrunk during the past twenty years based on the comparison.

In addition, land, water and vegetation of mentioned districts have been vital livelihood resources for local upland dwellers and nomadic pastoral communities for generations. Bamyan has plenty of water resources, it can suffice the irrigation needs of not only Bamyan province but other neighboring provinces if properly managed and there are many opportunities for agricultural improvement in the fields of animal husbandry, pasture improvement, agricultural productivity, watershed management and irrigation system improvement.

Therefore, the extracted information through this GIS stewardship survey can be used for planning of the rural communities within these districts.

The General Objective of the Survey

The survey aims at producing relevant knowledge through a detailed survey for producing GIS maps of the existing irrigation and watershed systems and infrastructure in the program areas, to be used in the program in order to ensure improved management of water resources, and to be disseminated to institutional stakeholders, NGOs and actors involved in designing and implementing the Provincial Development Plan.

1. INTRODUCTION

1.1 Background

MADERA, GERES and Solidarités International, three French NGOs working in Afghanistan, have come together to implement a 3.5 year program, funded by the French development agency (AFD). The aim of the program is to increase the living standards and quality of life for the rural population of the Central Highlands region, through the promotion of rural development and natural resources management.

The three districts of the two provinces selected for GIS stewardship survey belong to the central provinces of Afghanistan (Map 1). The central highland region is isolated, mountainous region of the country where majority of the population are farmers whose livelihood mainly depend on available natural resources especially land and water. However due to harsh climate in the region, combined with over exploitation of the land a substantial burden is being placed on already scarce natural resources, which necessitates finding sustainable solutions for frequent landuse conflicts and degradation of these resources (Comparison, table 2). The two provinces namely Bamyan and Maidan-Wardak, are located on an average altitude of about 3000m and in central mountainous agro-pastoral livelihood zone. They are severely affected by prolonged winter with heavy snowfalls which hinders coping mechanisms by limiting livelihood options, new practices and overall economic development of the rural people.

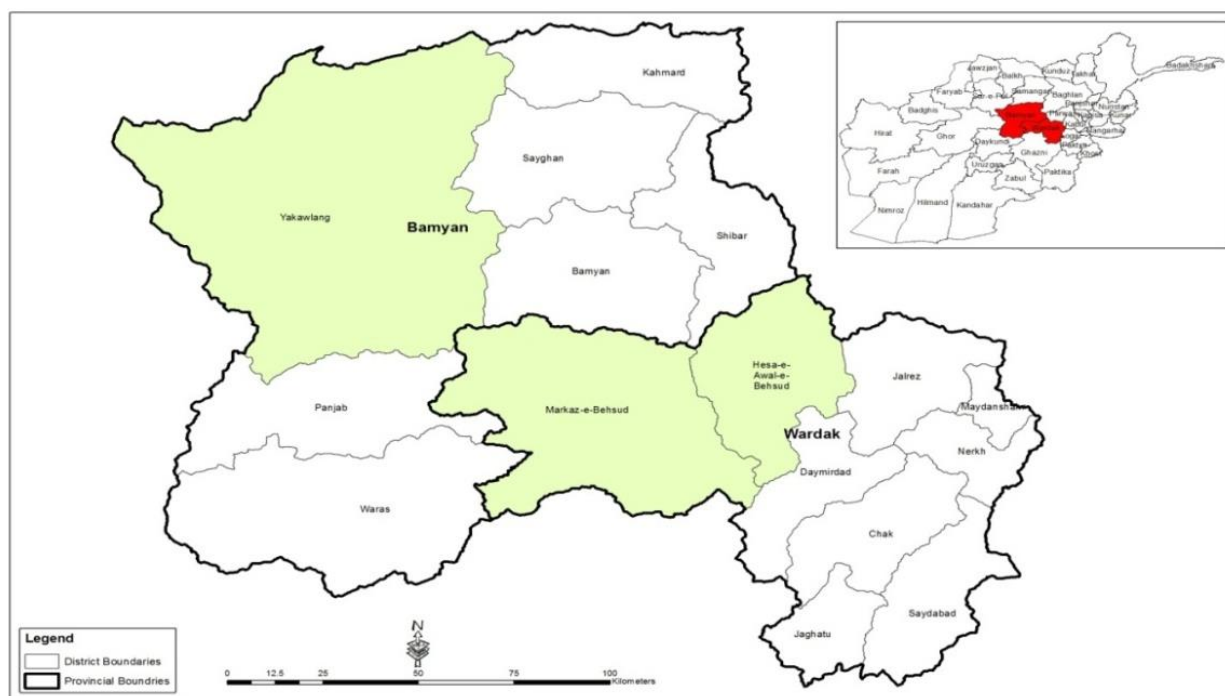


Figure 1: location map of target districts

According to the Central Statistics Organization (CSO) Wardak and Bamyan provinces has 606,077 and 454,633 population respectively. However the individual district level population is 90,747 persons in Yakawlang and 123,801 and 38,421 persons in Behsud II and I districts respectively.

Most of the population lives in rural areas where agriculture is the main source of income. The terrain is extremely mountainous with very little arable land available for cultivation. The population relies primarily upon subsistence farming with irrigated/rain-fed wheat and barley and potato being the main crops grown, supplemented with small scale livestock rearing. Agriculture productivity is low, with limited access of the population to seeds, technology and irrigation water.

Moreover, nonagricultural capabilities are very limited, which makes income diversification to other commercial activities difficult on the short run. There are high levels of unemployment and underemployment which contribute to increased food insecurity and growing poverty (food outlook 2016).

1.2 Geography

Bamyan and Maidan Wardak provinces are located in the central and eastern regions of Afghanistan respectively; bordering Baghland and Parwan to the north east, Wardak and Ghazni to the southeast, Daykundi to the southwest, Ghor to the west, Saripul in the northwest and Samangan to the north while Wardak borders, Kabul and Logar to the east, Ghazni to the south and Bamyan to the west. They are mountainous with plains and many valleys. The majority of its residents live in rural areas, with villages concentrated in areas with available irrigation and water resources.

1.3 Climate

Bamyan's and Maidan-Wardak climate is transitional between cold arid and semi-arid, with cold winters and warm, dry summers. Precipitation mostly falls in late winter and spring (from October to May). The province is characterized by a dry, mountainous climate, with a high propensity for microclimates within the numerous steep valleys.

2. SURVEY METHODOLOGY

2.1 Data Acquisition, Collation and Preparation

First phase of the survey commenced with utilization of GIS/RS technology. First all firsthand satellite data was collected, collated and prepared for analysis in ArcGIS software.

All the data required for this analysis was geo-referenced and suitable Image enhancements were applied to facilitate the delineation and interpretation of different thematic information at the mentioned districts/catchments.



Figure 2: Sample satellite image used for this survey

As an input to the ArcGIS software, latest 50cm and 1m resolution cloud free satellite imagery, 1:50,000 topo sheets, 30m resolution DEM and field survey data were used for identification, delineation, enrichment and mapping of canals and their respective command areas. In addition, latest available landcover data e.g. forest, rangeland, fruit trees, rainfed and irrigated land were derived from landcover Atlas of Afghanistan MAIL, 2016 and were enriched with data from this survey.

2.2 Coordination with MAIL GIS unit

All activities of the survey right from designing the questionnaire to the actual survey and the database creation was shared and consulted with MAIL GIS unit to ensure harmonization of both data and its attributes with the database already existing in MAIL GIS unit for national irrigation systems.

2.3 Training, Orientation and field exposure

Before the survey started, a two day survey orientation, in close consultation of Bamyan University and the consortium, was arranged in Bamyan province for the recruited surveyors and their respective supervisors. The surveyors were students of geoscience faculty of Bamyan University. There were 10 survey teams with six supervisors for these teams. Number of survey teams and supervisors were selected based on the total agricultural land of the respective district (Appendix I), accessibility and topography of the area. On the second day of the orientation the teams were taken to Bamyan city and showed them how to use the prepared map for each canal and collect the data using the pre-designed questionnaire. The questionnaire (Appendix II) was designed to collect all the data that was not possible to be extracted from the satellite imagery.

After the orientation the teams were sent to their respective districts along with prepared maps of the identified canals.

2.5 Field monitoring and quality assurance

Each survey team consisted of two members and one supervisor was available to oversee their daily work and propose on time corrective measures whenever required. The supervisor was responsible for assuring the quality of survey and data collection on daily basis. If there was an issue with data he had to send back the team and recollect the data where required.



Figure 5: Field data checking and preparing for next missions

2.6 Geodatabase Creation

A geodatabase was created for each district and a combined geodatabase for all the three districts of the two provinces and all the data related to irrigation canals, their command areas, length, village names, headwork type (stone masonry, concrete etc), source of water (spring, *karez*, *nawur*, river etc) and the name of *mirab* were all put into this database for future use and reference. This database is fully compatible with the national irrigation geodatabase created by Ministry of agriculture, irrigation and livestock at national level.

2.7 Preparation and Finalization of Maps

Once the survey completed and data were transferred back to the consultant, all the maps for the irrigation canals were edited/corrected based on the corrections from the field. These maps along with other map elements (like legend, scale, logos etc) were printed at different visible scales as final maps and were handed over to MADERA. Some additional data like, the landcover atlas, topo maps, soils layers, DEM of the area and some other layers were also handed over to MADERA for better planning and implementation of current and future projects.

3. SUMMARY AND DISCUSSIONS

Agriculture is the most important source of income for the households of the region (Bamyan and Maidan-Wardak provinces). In addition, the region is predominantly rural in nature thus the development of rural area is not possible without developing the agricultural sector and water is vital for both irrigated and rainfed agriculture in the area.

The terrain of the area is extremely mountainous with very little arable land available for cultivation. The population relies primarily upon subsistence farming with irrigated and rain-fed wheat, barley and potato being the main crops grown, supplemented with small scale livestock rearing. Agriculture productivity is low, with limited access of the population to seeds, technology and irrigation water.

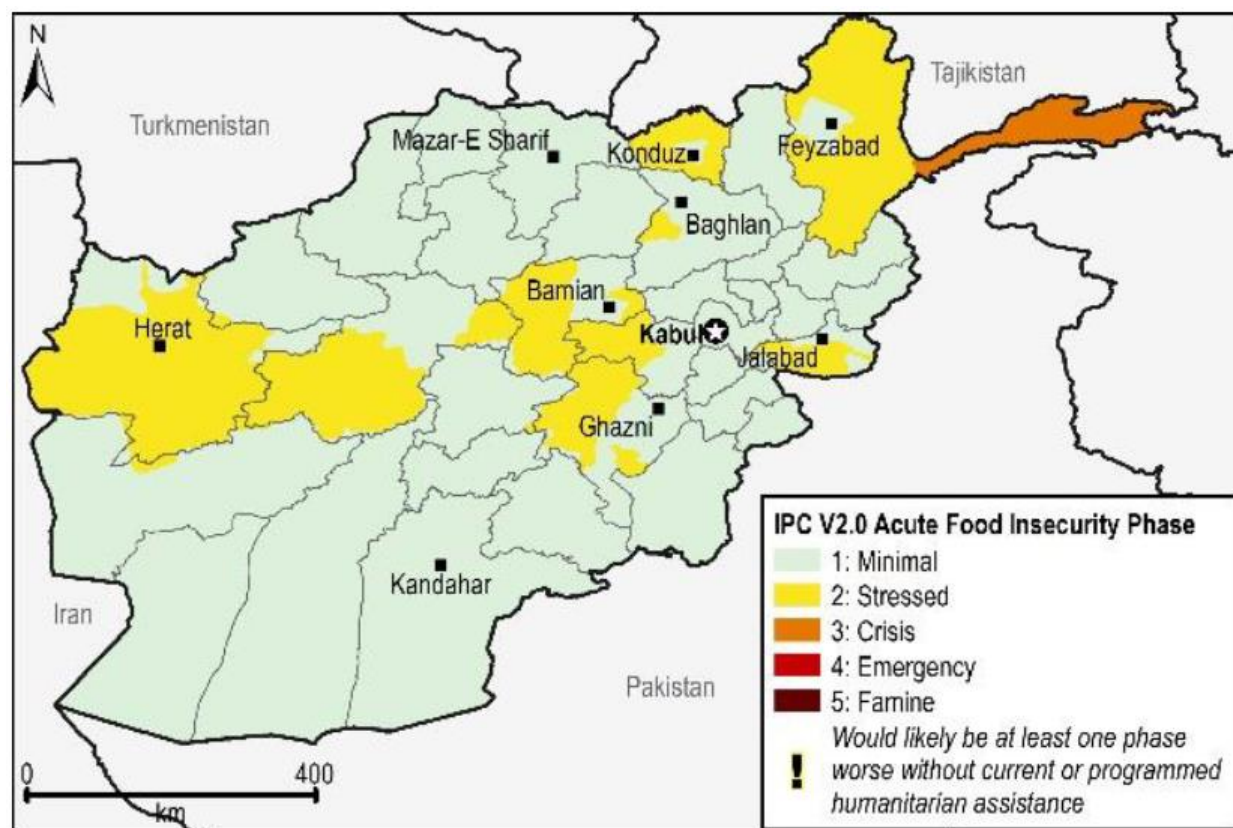
Less than 50% of the population has access to land and this limits their ability to grow adequate food for their own consumption. Non-agricultural capabilities are very limited, which makes income diversification to other commercial activities difficult on the short run. There are high levels of unemployment and underemployment which contribute to increased food insecurity and growing poverty.

Total wheat productions for the year 2015-2016 for Bamyan and Maidan-Wardak provinces were 60.23 and 50.68 thousand metric tons respectively while total wheat required by the population living in these two provinces are 73.71 and 106.92 thousand metric tons (1000MT) calculated for 162kg of wheat per head per year (wheat per capita, appendix V). In addition, as per wheat per capita consumption of 162 kg/year/head (FAOSTAT, 2016) both of these provinces are wheat deficient. The amount of wheat deficit in these two provinces are shown in table below:

S No.	Province	Total Population	Wheat per Capita Consumption	Total Required Wheat	Total Wheat Production	Deficit Amount
		in persons	kg/head/year	in 1000MT	in 1000MT	in 1000MT
1	Bamyan	455,000	162	73.71	60.23	-13.48
2	Maidan-Wardak	606,000	162	106.92	50.68	-56.24

Table 1: Maidan-Wardak and Bamyan wheat deficit/surplus

Similarly, food security outlook of June, 2016 (Map1-FEWS NET) shows that some parts of Bamyan province come in stressed areas where food shortage can be an issue especially during winter months as shown in the following map:



Map 1: Food Security Outlook June, 2016

3.1 Landcover Comparison 1993 vs 2016

Change detection is extensively used in proper distribution of natural resources and natural resource management, urban planning and many other fields. For this survey, Land cover data of 1993 and that of 2016 were compared which showed significant differences in some landcover types in the target districts.

The landcover change for Yakawlang district shows an increase in irrigated land while it shows a significant decrease in rainfed land, in addition, barren land has also increased may be due to the climate change (possibly due to the drought that hit whole Afghanistan from 1999 to 2001) as the water bodies and marshes has also shrunk significantly in the area. The rangeland from 1993 upto 2016 has significantly decreased mainly because of overgrazing and drought. Surprisingly the irrigated land has decreased and rainfed land has significantly increased in Hesa-e-Awal Behsud while rangeland and area under snow has shrunk to almost half.. Similarly, the irrigated agricultural land has decreased in Markaz-e-Behsud and so is rainfed land while barren land and rangeland has significantly decreased. The water bodies and marshland have significantly decreased throughout these years which impacted all other landuses. The summary of the comparison is presented in the following table:

District Land Cover Statistics (Hectares)										
District	Irrigated Ag. Land	Rainfed Ag. Land	Fruit Trees	Barren Land	Forests & Shrubs	Rangeland	Permanent Snow	Built Up	Water Bodies & Marshland	Years
Yakawlang	13,594.07	924.77	30.13	29,341.41	0.00	623,508.57	4,941.39	527.38	4,990.57	2016
Yakawlang	10,868.62	3,511.50	N/A	17,335.65	N/A	966,595.27	4,061.50	N/A	5,038.58	1993
Hesa-e-Awal-e-Behsud	11,535.65	3,962.79	149.05	913.27	0.00	136,610.90	3,257.29	126.50	783.15	2016
Hesa-e-Awal-e-Behsud	16,542.55	751.34	N/A	23.00	N/A	208,099.20	6,072.20	N/A	N/A	1993
Markaz-e-Behsud	20,068.17	17,134.81	142.25	4,880.88	0.00	285,614.60	5,218.43	418.15	1,012.40	2016
Markaz-e-Behsud	27,210.80	20,399.70	N/A	11,207.30	N/A	423,565.12	7,828.10	N/A	320.40	1993
Data Source:		MAIL								

Table 2: Landcover comparison of 1993 vs 2016

In addition, a total of 718 canals were identified in Hesa-e-Awal Behsud and Markaze Behsud and 317 canals were identified in Yakawlang district of Bamyan province, however, 853 (82.5%) of all these canals were surveyed due to either inaccessibility or security concerns as advised by field offices.

4. OBSERVATION AND RECOMMENDATIONS

1. The temporal comparison of the two landcovers for the years 1993 and 2016 showed, that irrigated area has increased and rainfed area has decreased
2. The amount of rangeland and barren land has decreased significantly in most of these areas
3. The two landcover comparison also shows, the marshland and water bodies in these areas has shrunk possibly due to climate change and increased use of water for irrigation
4. Main growing crops were wheat and potato in the project area
5. Average wheat yield (overall average of irrigated and rainfed wheat) was estimated as 1.89 and 2.08 tons/ha for Bamyan and Maidan-Wardak provinces respectively (APR, 2016)
6. Both Maidan-Wardak and Bamyan provinces are wheat deficit provinces of the country (Appendix III, wheat surplus and deficit provinces of Afghanistan)
7. Most of the canals were receiving their water from snowmelt (water harvested through small structures in the area e.g. ponds, bunds)
8. Some canals were receiving water from either spring or *nawur*
9. There are a total of 372 villages in Yakawlang, 776 in Behsud II and 361 villages in Behsud I districts respectively.
10. There were a total of 718 canals identified in Hesa-e-Awal and Markaz-e-Behsud while 317 canals in Yakawlang districts
11. Most of the villages in these districts are concentrated where land and water is available
12. As yield is very low in these areas, it can be increased through better water management and agricultural practices like laser leveling, lining canals, seed distribution etc
13. According to landcover atlas of Afghanistan, 2016, total irrigated areas are 13594.07, 11535.65 and 20068.17 ha for Yakawlang, Behsud I and Behsud II districts respectively
14. According to landcover atlas of Afghanistan, 2016, total rainfed areas are 924.77, 3962.72 and 17134 ha for Yakawlang, Behsud I and Behsud II districts respectively.
15. Wheat per capita consumption is calculated as 162kg/person/year for Afghanistan (FAOSTAT)
16. The access to irrigated land is rather high in some areas though one would have to look at the quality and nature of irrigation (seasonal versus perennial) and the size of landholdings.

5. APPENDICES

Appendix I: Amount of irrigated area and no of teams for each district

S No.	Province	District	Irrigated Agric Land (ha)	No of teams	No of Supervisors
1	Bamyan	Yakawlang	13,563	3	1
2	Maidan-Wardak	Markaze Behsud (II)	20,000	4	3
2	Maidan-Wardak	Hesa Awal Behsud	11,521	3	2

Appendix II: Irrigation Field Survey Questionnaire (Dari)

فورم سروی کانال آبیاری			
1	نام سروی کننده		ملاحظات
2	شماره تلفون		
3	نام سوپروائزر		
4	شماره تلفون		
5	نمره نقشه کانال		
6	نام کانال		
7	قریه ها		
8	نام میراب کانال		
9	ساحه تحت آبیاری		
10	منبع آب کانال		
11			
12	نوع کانال		
13	نوع سرپند کانال		

Appendix IV: Field Surveyor's TOR

Field surveyors TOR

Background:

MADERA is an international organization, active in AFGHANISTAN since 1988, promoting rural development and support to village communities. MADERA's actions are directed towards capacity building and initiatives which enable local communities to lead and manage the development of their territory. MADERA promotes, in collaboration with other partners, a participatory and community approach to development, developing with the population "integrated" programs which aim to take into consideration the diversity of their needs.

Overview of the program:

MADERA, GERES and Solidarités International, three French NGOs working in Afghanistan, have come together to implement a 3 1/2 year program, funded by the French development agency (AFD). The aim of the program is to increase the living standards and quality of life for the rural population of the Central Highlands region, through the promotion of rural development and natural resources management.

Main Responsibilities:

The field surveyor will work under the GIS survey team leader to collect all the information on irrigation canals of the assigned area using a proforma, handheld GPS and a digital camera where possible. He will work in a group of two and will report and handover his work to the GIS team leader on daily basis for review and validation. His/her duties will be as follows:

- Accurately track all the canals and their command areas, by walking through the length of canal, using a handheld GPS and digital camera etc
- Edit and correct the hardcopy maps according to the field conditions
- Accurately record field data into the proforma

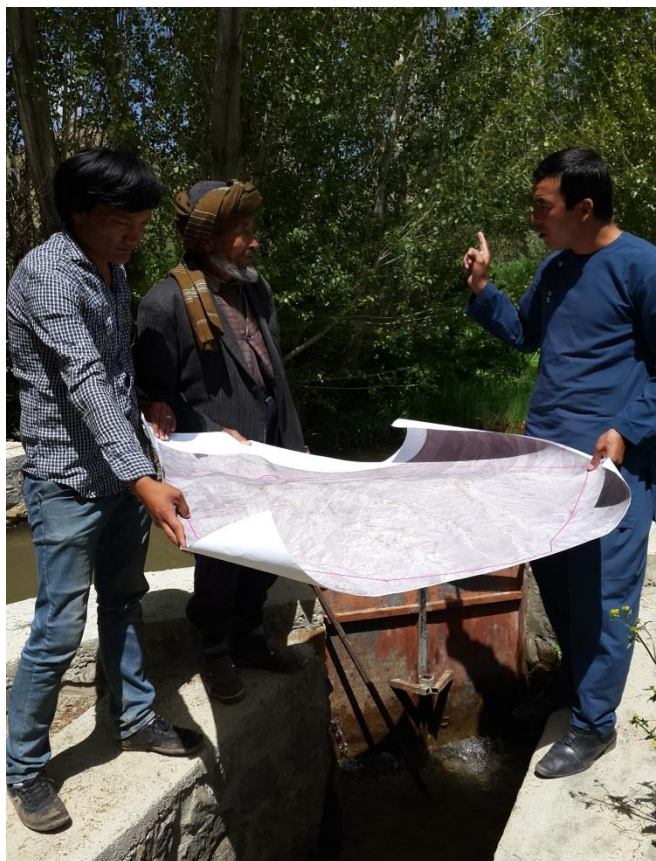
- Collect the name of *mirab*, how much area is being irrigated, what kinds of crops are grown in the command area, what villages they (the canals) serve and who funded construction or rehabilitation of this canal (if any)
- Any other information required by the project survey team

Qualifications:

- University student or recent graduate (Preferably from agriculture, geoscience faculties or any other relevant field)
- Good interpretation and recording skills
- Willingness to travel and walk through each irrigation canal in Behsud I, Behsud II and Yakawlang districts of Wardak and Bamyan provinces respectively
- Ability to understand, explain, and use field GIS maps of the area
- Ability to use a handheld GPS and digital camera
- Prior working experience in such surveys

To Apply: Please send your CVs and cover letter to _____ or bring your hardcopy applications in person to _____.

Appendix V: Glimpses from the field survey





Appendix VI: Wheat per capita consumption of Afghanistan and other regional countries

Wheat Consumption Per Capita (kg/capita/yr)			
country	year		
		item	2011
	Afghanistan	Wheat	161.9
	Indonesia	Wheat	23.5
	Iran (Islamic Republic of)	Wheat	152.3
	Kazakhstan	Wheat	94.4
	Kyrgyzstan	Wheat	138.0
	Malaysia	Wheat	52.4
	Pakistan	Wheat	113.8
	Russian Federation	Wheat	130.8
	Tajikistan	Wheat	127.9
	Turkey	Wheat	173.5
	Turkmenistan	Wheat	188.1
	Ukraine	Wheat	106.0
	Uzbekistan	Wheat	170.6
Source: FAOSTAT			

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