Adaptation capacity of a remittance-based livelihood in the arid Fon mountains: facing double uncertainty

Climate Vulnerability and Resilience Assessment

Christine ORIOL

Iskanderkul watershed
Fon Dario Jamoat, Ayni, Tajikistan
2014

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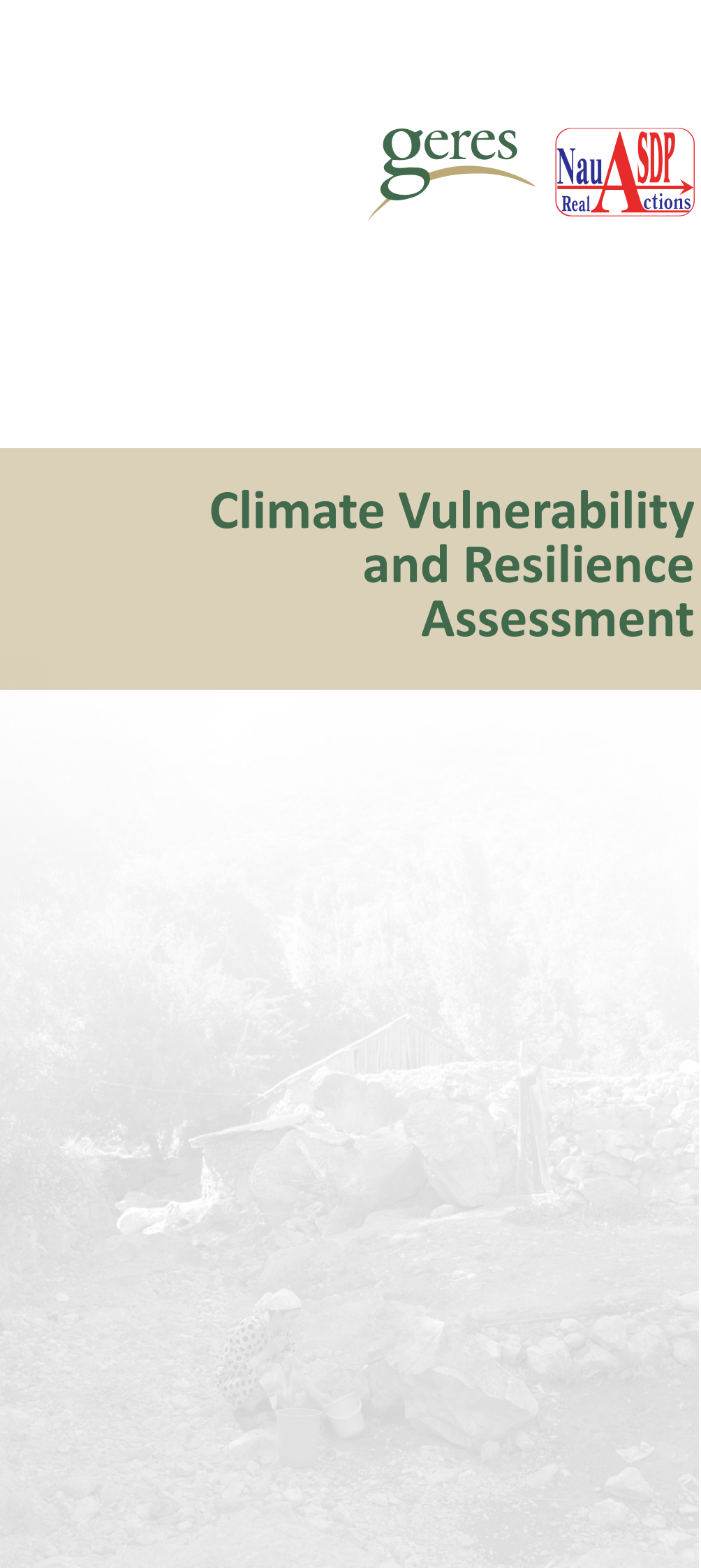

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TABLE OF CONTENTS

TABLE OF ILLUSTRATIONS

1 EXECUTIVE SUMMARY

The vulnerability and resilience assessment was conducted in the valley of Iskanderkul by analyzing quantitative data from previous assessments carried on GERES (baseline survey and socio-economic assessment of domestic practices) and from the hydrometeorological institute (meteorological data from 1930-2013), and qualitative data gathered in summer 2014 through focus groups and interviews with the population of the valley and the local authorities.

The area has been exposed to climate change, with an increase of +0,7°C in the decade 2000-2009 resulting mostly from increased spring temperatures (+1,8°C). The increase of temperatures affected the hydrology of the area; glaciers have been receding by 7 meters per year from the 80s, Iskanderkul maximum water level has increased by 60 cm.

After two main shifts in livelihoods over the last century, the population now makes a living out of remittances and still relies on agriculture (livestock and gardening) as a safety net.
Climate change mostly impacts the safety net of the households by putting pressure on the ecosystem (fodder for livestock, more risks on vegetable and fruit crops). It therefore puts at risk the most vulnerable families.
More than half of the population only relies on remittances and agriculture to eke out a living; which are both dependent on factors which are out of the control of the households (state of the global economy, changes of the climate).
The responsibility of the degrading ecosystem (pastures, forests) of the valley rests upon both human pressure and climate change, but the share of each is difficult to untangle.

The population has been showing adaptative capacity to the most urgent needs (water supply) but with no long term vision of their own needs. Villagers lack the information to take adequate decisions and organizational support to implement actions, while the governmental structures (xukumat, jamoat), who own appropriate information, lack the financial means to cover up this need and provide organizational support.

This gave evidence to the need of including the local authorities into the process of designing adaptation plans at the national level.

2 INTRODUCTION

Although Tajikistan doesn't rank amongst the 10 most vulnerable countries to climate change on the planet, eastern Asia (with Bangladesh (1st and most at risk), Africa and a few islands (such as Haiti) having been assessed as the most vulnerable[1], it is considered as a country at high risk and is part of the worldwide program **PPCR**[2] (Pilot Program for Climate Resilience).

Indeed, Tajikistan's territory is composed by 93% of mountains, which are considered as "hotspots" in regards to climate change: thawing glaciers, increased changes of temperatures, changing patterns of precipitations modify the ecosystems on which the population relies.

The 5th report of the IPCC releases in 2013 a gloomy forecast for the world general temperature: from a +1.5°C increase for most scenarios to + 4.8°C by the end of the century if no effort is made on reduction of greenhouse gas emissions.

As for **Central Asia**, it warns for an increase of the mean surface air temperature **between +0.7°C to +3°C,** while on the long term, "the number of frost days will decline in all regions while significant increases in tropical nights are seen […] in central Asia.[3]".

The increase of temperature is the factor that will mostly transform Tajikistan's ecosystems and impact livelihoods. Tajikistan is a mountainous country of which **glaciers represent 6%** of the territory[4] and provide water for Central Asia.
An early IPCC report of 1997 stated that "water is an important limiting factor for ecosystems, food and fiber production, human settlements and human health in this arid region of the world"[5].

Supply and access to drinking and irrigation water will become more variable, putting at stress the rural **population (73 %** of the total population in Tajikistan lives in the countryside[6], where water access and supply is not organized) and the agricultural sector (25% of GDP).
The high dependence on remittances adds another variable to a system already misbalanced by the pressure on natural resources and by the uncertainties of climate change.

Climate change is tackled at the national level: Tajikistan is active on the international scene on the subject since 1997 and has released three reference documents (the first, second, and soon to be third communications on climate change) and a national mitigation plan in 2002 to be complemented this year at the governmental level with a national adaptation strategy.
Nevertheless these strategic documents **haven't trickled down into actions at the local authorities' level.**

Similarly, studies on climate change vulnerability in Tajikistan have been conducted at the national level, but few present the actual impacts of climate change at **the level of a watershed.**
It was therefore chosen to study the vulnerability of one valley, its population and the ecosystem, with the constraints of the imparted time and resources, to detail the impacts of climate change at the local level and provide data and resources to propose local adaptation measures.

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1 http://maplecroft.com/portfolio/new-analysis/2014/10/29/climate-change-and-lack-food-security-multiply-risks-conflict-and-civil-unrest-32-countries-maplecroft/

2 http://www.ppcr.tj/

3 IPCC, Near-term Climate Change: Projections and Predictability, fifth report, (p1269)

4 Kayumov A, Glaciers resources of Tajikistan in condition of the climate change,

5 p18, IPCC Special report, The regional impacts of climate change: an assessment of vulnerability,

6 TAJSTAT, Численность населения Республики Таджикистана на 1 января 2014 года

3 OBJECTIVES OF THE STUDY

The aim is to study the changes and variability of the climate in the Iskanderkul valley and the capacity of the population to adapt to these changes.

- **Definition of the notion of climate change**

«Climate change» means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.[7]

- **Vulnerability and resilience assessment to climate change**

Vulnerability and resilience assessments are studies that allow to outline the capacity of a specific entity (community, ecosystem, country…) to face climate change. Vulnerability is assessed as a function of exposure, sensitivity and adaptive capacity, which mathematically writes as vulnerability = f (Exposure, Sensitivity, Adaptive Capacity).

In the chosen methodology, we assess the exposure, the sensitivity and the adaptive capacity of the population of the valley[8].

Exposure to climate variability and change:

It refers to the degree of climate variability and change that the community and ecosystem experience.

The study aims at gathering people's perceptions of climate change, to then compare them with scientific data and provide scientific and local feedback on the reality of the changes of the climate at both the local and national level.

Sensitivity to climate shocks and stresses:

It is an assessment of the amount of impacts that climate factors have on Iskanderkul valley, it allows to understand the impacts of climate change on the livelihoods.

Adaptive capacity:

The adaptive capacity describes the ability of the community of Iskanderkul valley to manage the negative impacts and take advantage of any opportunities that arise.

Outcomes

The study aims at:

- Providing a local assessment and data on the impacts of climate change at a watershed level
- Being a tool for the jamoat and population of Iskanderkul valley to adapt the jamoat plans and propose adaptation measures to the population and work towards better resilience,
- Serving as a basis for training to local authorities,
- Sharing results with local authorities (mahalla, jamoat, xukumat) and at the governmental level,
- Raising awareness on the needs to take into account local voices to draft national strategies.

7 *From the United Nations Framework Convention on Climate Change*

8 *CARE, Understanding Vulnerability to Climate Change, Insights from Application of CARE's Climate Vulnerability and Capacity Analysis (CVCA) Methodology,*

4 METHODOLOGY BASED ON QUANTITATIVE AND QUALITATIVE DATA ANALYSIS

The methodology is based on the analysis of quantitative and qualitative data gathered through extensive field work.

GERES has been working since 2011 in the jamoat of Fon Dario by supporting agriculture activities and fuel saving technologies.

It therefore benefits from data on the current livelihoods of the population, gathered for a baseline study in 2011 and a socio-energy assessment on domestic practices (SEADEP) in 2012.

Data from these reports were used to draw the general livelihoods situation, the income structure analysis, and the question on fuel use.

Furthermore, to gather data for the analysis of climate change impacts on the population, CARE and ICIMOD[9] handbooks have been used as a basis for developing the methodology.

The PSD (Participatory Scenario Development) methodology was not chosen, as it would have been very time consuming to cover all villages.

Field work was conducted in Iskanderkul valley in July 2014 with a translator, more interviews were conducted with the relevant administrations (statistics, education, forest management, land committee) in September 2014.

Focus groups were the chosen mean to assess people's knowledge of climate change, their perceptions of climate change, and the impacts on their daily lives.

It was decided to conduct focus groups with different types of people: the elderly and women separately. A specific group, only gathering men who went in migration, was planned, but was not possible to realize.

Different techniques were used to foster group discussions:

• participatory mapping: a map is drawn in common by the group, spotting the main landmarks of the village (mosque, bridge, road, shops, schools), the water sources (irrigation channels, springs), and the main directions where from natural hazards may come (avalanche, mudflow, flood, rockfall); this was done with men.

FIGURE 1 MAP OF THE VILLAGE OF MAKSHEVAT

9 CARE Handbook, Climate Vulnerability and Capacity Analysis, ICIMOD, Framework for Community- Based Climate Vulnerability and Capacity Assessment in Mountain Areas,

- community historical timeline: a time arrow is drawn in common with the landmarks that have marked people's minds (electrification, construction of the road, shift from wood to coal for heating), and the main changes in livelihoods such as departures to migration, end of cultivation of tobacco…this was done with men's groups.
- seasonal calendar: a yearly calendar divided by months is drawn on a flipchart, for each month is drawn the usual tasks performed by ladies and the resources that are used. Then are discussed the changes that have been occurring over the last years and the reasons of change. This was realized with the groups of women.
- vulnerability matrix: this exercise was proposed to women's groups. The most important elements of their livelihoods are chosen and crossed with the elements that put them the most at risk.

For interviewees who could not be gathered in a group (administration officials, shepherd, summer pastures users), an open question interview was conducted (see in annex the list of questions).

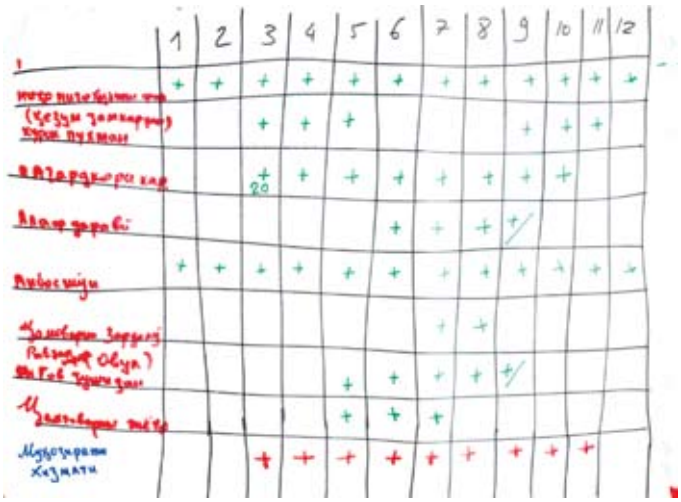


FIGURE 2 SEASONAL CALENDAR FOR THE VILLAGE OF TUDA

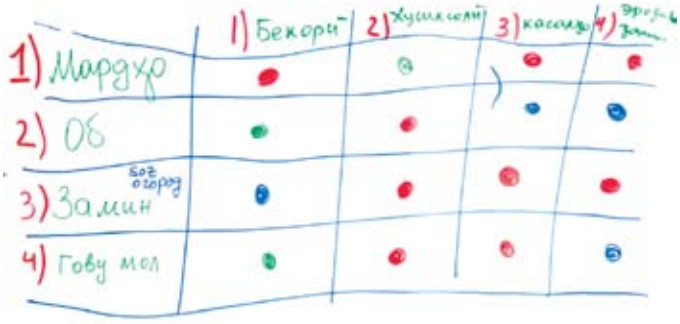


FIGURE 3 VULNERABILITY MATRIX FOR THE VILLAGE OF NARVAD

Participants to survey	Types of interviews
Jamoat authorities	open questions
Forest department	open questions
Land committee	open questions
Elderly men	historical timeline, community mapping
Women's groups	livelihood seasonal calendar, vulnerability matrix, open questions
Shepherds	open questions
Summer pastures users	open questions
Local forest department manager	open questions
NGOs working in the area	open questions

FIGURE 4 INTERVIEWED ACTORS DURING THE CVRA

5 DESCRIPTION OF THE VALLEY OF ISKANDERKUL

5.1 Localisation of the jamoat of Fon Dario

Landlocked in Central Asia, surrounded by Uzbekistan, Kyrgyzstan, China and Afghanistan, Tajikistan is constituted of 2 mountain ranges: the Alay and Pamir ranges.

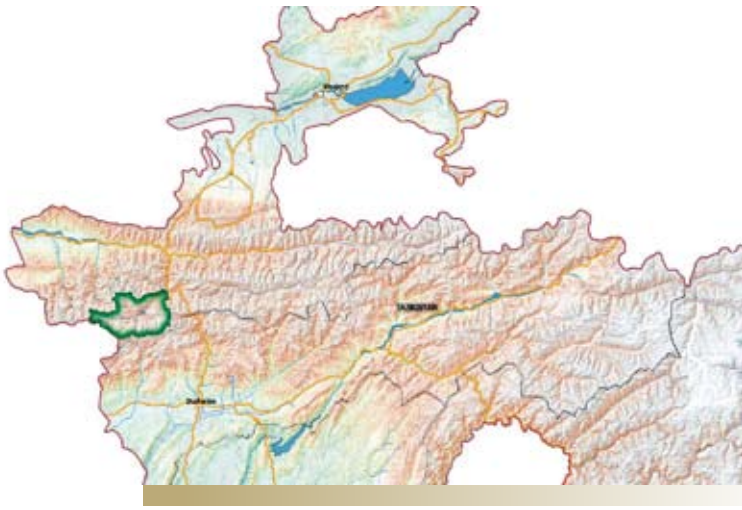


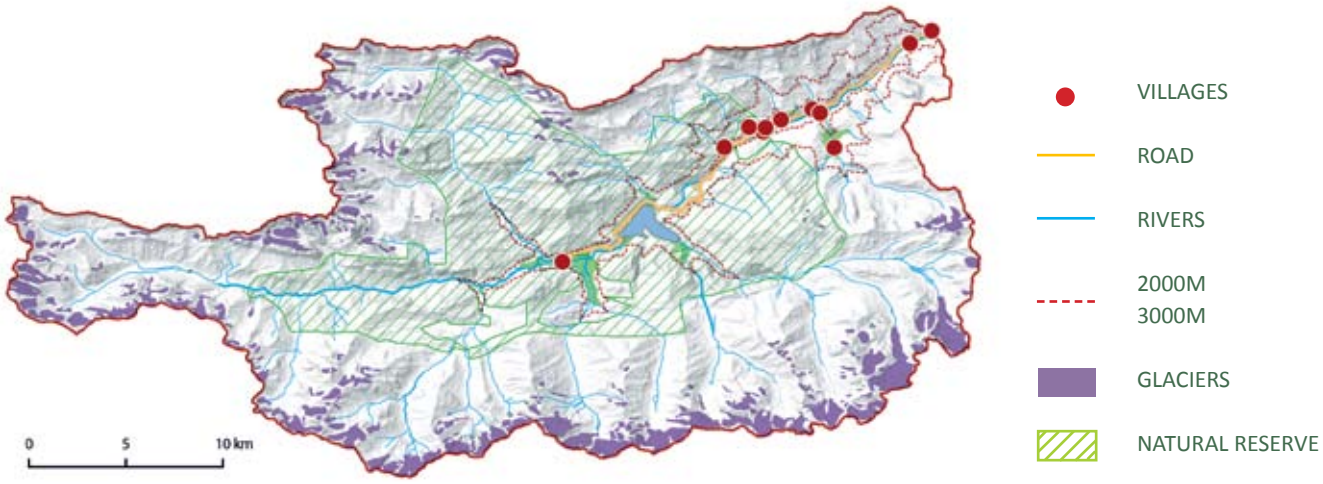
FIGURE 5 LOCALIZATION OF THE FON DARIO JAMOAT IN TAJIKISTAN

The jamoat of Fondario is situated in the district of Ayni, in the Sughd region, north of Dushanbe.
It consists of two steep and narrow valleys: Iskander Dario valley and Pasrud Dario valley. These two valleys are separated by the Zinax mountain range that culminates above 5000 meters. The lowest elevation in this jamoat is 1600m.

Iskanderkul valley is 50 km long, and 28 km wide, broadly oriented from west to east.
The western basin gathers snowmelt water from small glaciers that gather into Iskanderkul, a glacial lake. From the lake, the main river "Iskanderdario" runs into the river Fon, later on adding its waters to the Zeravshan river that flows to Uzbekistan through Penjikent and finally into the Amu Daria.

The valley being orientated from west to east, it means that glaciers on the left bank of the river are facing south, while glaciers situated on the right bank of the river are facing north.

FIGURE 6 MAP OF ISKANDERKUL VALLEY



5.2 Localization of the villages of the Iskanderkul valley

	population in 2014
Haironbed	**621**
Mahshevad	**1945**
Tuda	**988**
Dijik	**1035**
Narvad	**447**
Saratog	**280**
total	**5316**

There are 6 administrative villages in the valley, which regroup also new settlements. Rui Ob and Kanapo are administrated under Makhshevat's authority, and Chordam and Nurabad are part of the village Dijik. This counts as a total of 10 villages in the valley.

Historically, villages were built mostly on the slopes, not along the main river and are using the water from springs or rivers resulting from snow and glaciers melting. These are the older villages of Makshevat, Dijik, Narvad.

FIGURE 7 VILLAGES AND THEIR POPULATION

Only the village of Xaironbed, which is quite old since already being quoted in a traveler's diary in 1838, is historically situated along the main river Iskander.

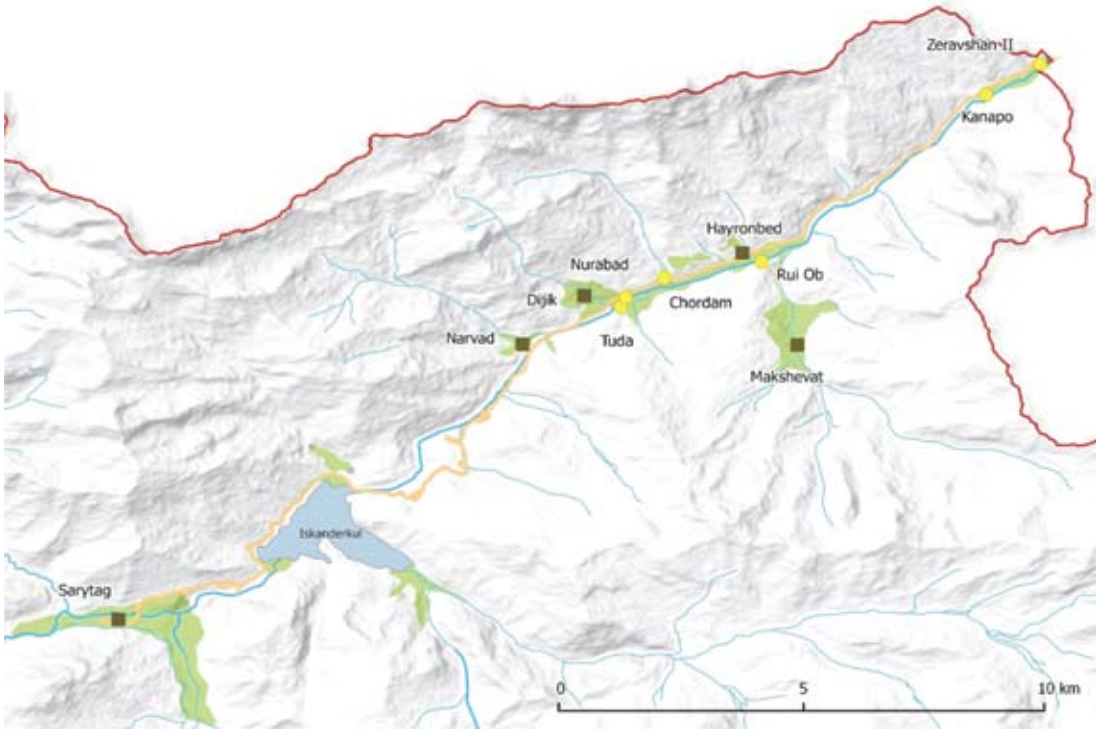


FIGURE 8 MAP OF OLD AND RECENT VILLAGES

The younger villages that were created because of population increase and lack of land in the old villages or as an answer to a risk of natural disaster were installed on the riverbanks of Iskander river (Nurabad in 1966, Tuda in 1974, Rui Ob in 1990, Shordam in 2000, Kanapo in 2010).

5.3 Iskanderkul – the lake of Iskander

Iskanderkul is a 70-meter deep lake, with an area of 3,4 km², at the altitude of 2100 meters.

The lake is famous for its legend which recounts that Alexander the Great and his army rested on its shore, Alexander (Iskander in Tajik language) gave its name to the lake.
It has become a high place of tourism during the soviet time. A tourist base is installed on its banks, next to the meteorological station. The lake is the destination for week-ends outing for the urban population of Dushanbe.

FIGURE 10 "DIARY OF A JOURNEY TO ISKANDERKUL", 1870

FIGURE 9 "PICTURE OF ISKANDERKUL ILLUSTRATING THE BOOK "KUHISTAN, COUNTRY OF MOUNTAINS", 1939

The area around the lake is a natural reserve "zakaznik" of grade IV according to the classification of IUCN, which protects the area while allowing sustainable use of resources: hunting is prohibited for species that belong to the Red Book (snow leopard, bear,..), for other species, the number of killings is limited every year (mountain goat…).

In theory, cutting wood is limited to "sanitary cuts", when trees are sick or dead. In reality, villagers fetch their wood fuel in this area.

The valley of Iskanderkul is part of the Fon mountains which host numerous endemic species.[10]

The site of Iskanderkul therefore shelters not only great landscapes that have been appreciated over the last centuries, but also rich biodiversity.

10 Nowak Arkadiusz and Nobis Marcin, Tentative list of endemic vascular plants of the Zeravshan Mts in Tajikistan: distribution, habitat preferences and conservation status of species,

6 CHARACTERISATION OF THE CLIMATE OF ISKANDER DARIO STATION

Climatic data was taken from the archives of the Hydrometeorological institute in Dushanbe, covering the period from 1930 to 2013. Data is gathered from the meteorological station in Iskanderkul which is located at the altitude of 2187m.

Iskanderkul climate is a Mediterranean continental climate with warm summers and cold winters, and a highland climate.
The next diagram is based on the average of temperatures and precipitations over the 83 years of data coverage and reflects the average climate during this timespan.

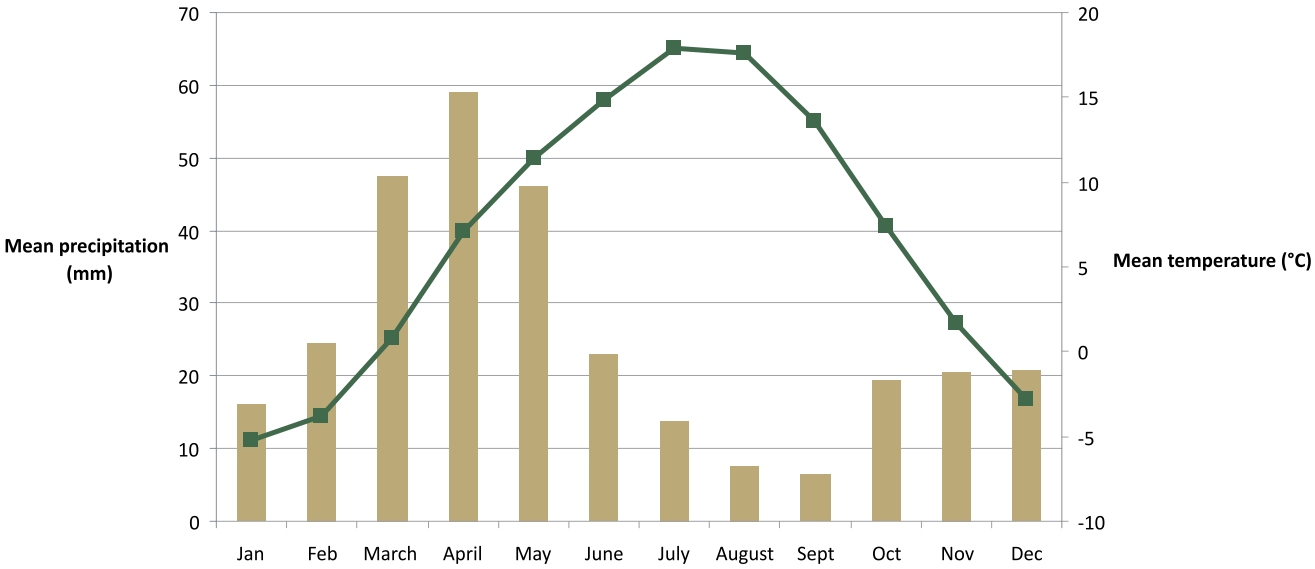


FIGURE 11 OMBROTHERMIC DIAGRAMM OF ISKANDERKUL CLIMATE[1]

According to Köppel classification, the climate is:

- *Continental:* coldest month below 3°C (January: -5°C), 3 months with below zero average monthly temperatures (December to February).

Average temperature of the hottest months (July-August, 18°C) above 10° C.
The climate can be considered Mediterranean at lowest altitudes when the average temperature of the coldest month goes above -3°C.

- *Dry summers:* average annual precipitations= 306mm

Dry season in the summer: summer month the less wet receives less than 30mm of precipitations (August and, September) and wettest winter month receives 3 times more than drier summer months.
It can almost be considered as arid as the actual precipitation is only slightly a threshold value set equal to the potential evapotranspiration.

- *Most precipitations in spring:* 50% of the precipitations fall in spring (March, April, May).

11 See in annex for the data in a table

7 PEOPLE AND LIVELIHOODS

7.1 Development of Iskanderkul valley: from subsistence to industrial society with the soviet state (1930s to 1992)

Some villages are old settlements that have proof of existence since the 1800s but that are probably a lot older.
Villagers used to live off the land, growing cereals (wheat and barley), fruit trees (apricots) and eating dairy products from their livestock which also provided meat. Villages were constituted of few households, ten to twenty, men working in agricultural activities, women taking care of the households.
In 1928 Tajikistan lost its status of autonomous part of Uzbekistan and became part of the USSR. The first schools were built in two villages between 1930s and 1940s.

In the 1960s, demography took a sharp rise in the villages according to the elders' words, the road was built between villages and reached the last village, Saratog in 1965.
Industrial activities (mining, geologocial exploration) hired the men, women were working in the kolkhoze, in the tobacco fields. The main bazaar and the smaller village shops supplied food and equipment, as people stopped growing their main source of food. Vegetables were introduced by Russian families who came to work there and the population of the valley started to grow small gardens of vegetables at this time.
Tajik rural families began relying less on their own agricultural activities as the primary source of food. Instead, they bought food that was supplied by the soviet state.
The population stopped relying on subsistence agriculture.

Electricity arrived in the 1970s, Saratog, the last village of the valley, was electrified in 1978.
Most schools were rebuilt between 1975 and 1985.

The collapse of the Soviet Union started to have a direct impact on people's lifes as soon as 1992. The national agricultural plans stopped and in Fon Dario, women replaced the culture of tobacco for vegetables in their household plot and cereals on their outer fields.

7.2 The situation since the collapse of the Soviet Union (1992-present): present livelihoods

The population, when asked to identify the fundamental elements to their livelihoods, gave in the following order: migration, water, gardens and orchards, and livestock.

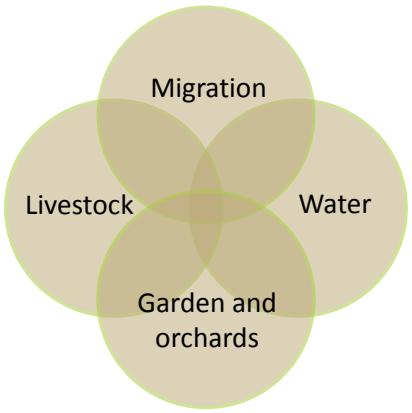


FIGURE 12 GRAPH OF KEY LIVELIHOOD ELEMENTS

- **Migration**

After the collapse of the USSR, the land reform did not happen in Fon Dario jamoat and is still not implemented.
The high demography rate had increased the population in such a matter that going back to subsistence agriculture was not possible anymore as it would not provide enough food to feed the actual population. The villages had also expanded to the detriment of arable lands.
As a coping strategy to the recent unemployment and the impossibility to go back to subsistence agriculture, men started to migrate.
The first wave of migration happened in 1994-95 when savings were gone, the first men who left identified some cities (Moscow, Ekaterinburg, Surgur, Tiumen) where they could find work, opening then a channel for relatives and men from the same village.

Migration is polymorphic. Men can leave early in their twenties, stay several years in Russia, come back to get married and go back again. Men who already have a settled family in Tajikistan sometimes manage to go to Russia only when construction is possible there, during the warmest months and come back for the winter months in Tajikistan. They mostly find employment in the construction or sale sector.

The main source of income is remittance from Russia

In 2011, the local statistical data from the jamoat calculates that 18% of the men in age of working (25 to 50 years old) are in migration, but the local population estimates that 75% of the men in age of working are in migration.
The men who stay in the villages work as teachers, doctors, in governmental institutions and as taxi drivers, salesmen.
Women commenting about their husbands in Russia stated that migration was the only way to feed their families:
"We'd better keep the long-distance relationship with our husbands or we will starve to death"

- **Water**

Water is used for drinking, for household chores and for irrigation.

Villages rely on springs for their drinking water.
Some villages benefit of a drinking water system that connects the source to other parts of the village with pipes. The system connects the main spring of the village with regular water faucets that deliver water in the streets. There is no sewage system.

villages	Drinking water system
Kanapo	no
Xaironbed	yes, installed 30 years ago
Makshevat	no, directly from the spring
Rui ob	yes
Shordam	yes
Nurobod	no
Narvad	yes, since 2013, or river in winter because spring freezes
Tuda	yes, from far away spring
Dijik	partially
Saratog	no

FIGURE 13 DRINKING WATER SYSTEMS IN THE VILLAGES

The population will take water from the faucets in the main streets unless they are too distant from their house. In this case, they might choose to get connected themselves to a nearer spring or even pump up the water from the main river. Spring water will be always preferred to river water for drinking.

Villages rely on gravity for irrigation water

Irrigation water is brought to the fields and household plots through a system of channels. Therefore the water will always come from a higher point than the village, mostly from streams fed by snow and glacier melt. Channels can be more than two km long and require significant maintenance.
Spring waters, which debits are limited, are not used for irrigation.

Two villages out of ten, which don't benefit from higher up streams, have to pump their irrigation water from the main river.

The main river (Iskanderdario) is therefore used as an alternative to the lack of springs or snow-fed streams.

- **Gardens and orchards: agriculture is not a subsistence mean, nor a source of income, but a safety net and a complement for diet**

Subsistence farming has been defined by Barnett et al [12] as "farming and associated activities which together form a livelihood strategy where the main output is consumed directly, where there are few if any purchased inputs and where only a minor proportion of output is marketed."

In this case, agricultural activities in the jamoat of Fon Dario cannot be considered as subsistence as the family does not live off agriculture anymore.
Most products are bought: wheat for bread, oil, sugar, pasta, rice. 75% of 5000 somonis/year (minimal budget for a family of six people[13]) are spent on foodstuffs. Only vegetables and fruits will not be bought from the bazaar.

Indeed, the household plot measures in average 0,05 ha (500m²), vegetables are grown in the garden adjacent to the house, fruits are produced in the home garden and orchard.
Gardens and orchards supply fresh vegetables (tomato, cucumber, belt pepper, chili peppers, pumpkin and aromatics –basil, parsley, dill…), and fruits (apricots, apples, cherries, peaches) during the harvest season, root vegetables (potatoes, carrots, onions, beetroot, turnip) are stored and consumed during the cold season. The surplus of tomatoes, cucumbers and cabbage and part of the fruit production is canned. Canning of vegetables and fruits coincides with the end of the soviet time, around fifteen years ago, when the population needed to start to worry about the availability of food.

Gardening complements the diet and allows to alleviate the uncertainty of remittances: excess vegetables and fruits can be sold.

The supplementary plot that is mostly rented from the dekhan farm measures 0,15 ha with a variance of 0,04 and crops grown there are mostly wheat and barley to feed the animals. Wheat and barley are sown in spring

12 *Morton John F., The impact of climate change on smallholder and subsistence agriculture*

13 *GERES, Lienhart & Oriol, Baseline SRD report*

and harvested in August. They are grown for the straw that will be given to the animals, the grain itself is used mostly as seeds for the next year.
Mills are not used anymore as people's taste turned towards refined white flour that is available at the bazaar. A family can spend from 1500 to 4300 somonis per year in the purchase of flour according to its size and consumption of bread (flour price = 120 somonis for 50 kg).

- **Livestock**

The number of animals will vary per family according to its wealth. The wealthiest own 2 cows, which enables to have milk every year. In average, households own 3 sheep and 3 goats which will provide meat when needed. Villagers very rarely buy meat and dairy from the bazaar but consume their own dairy products and animals.
Wool is not sold and rarely transformed into a added value product. It used to be transformed into carpets in the past, but the know-how is diseapparing.
Livestock fills a function of money savings and is indispensable for social celebrations.

Cows and small ruminants (sheep and goat) are separated for being herded. In the winter time, cows are given a specific shepherd (usually a young lady) who takes them to graze in specific areas.
At the beginning of the summer, in late spring (May), cows are taken to the summer pastures called "Aul" to be milked until end of September. The dairy products are taken down to the villages (dried cheese (kurut), yogurt, cream). The dried cheese is consumed all year long and is a basis from some dishes.
Sheep and goats graze around the village during the winter months, every day, in turn, a different person is in charge of taking the animals for grazing. For the spring and summer months, a shepherd is paid by all villagers to take the animals to the summer pastures (which are different from the cows'pastures).
The approximate number of livestock (cows, sheep, goats, horses, donkeys) is about 8 000 heads for the zone of study without counting the herds that graze in the mountains in the summer time and that come from Penjikent or Khatlon.

The number of animals privately owned seems to have increased at the end of the Soviet time although the number of heads collectively owned was superior during the Soviet time. Fodder was brought for free from other regions of the Soviet Union to feed the livestock during the winter time. With the end of the importations, the animals have been having a great toll on the vegetation, overgrazing pastures.
Making hay is a summer activity for the women, who try and gather as much fodder as they can to cover livestock needs in the winter time.

7.3 Demography dynamics

Since 2002, the popuplation of the jamoat of Fon Dario has been increasing by 5% every 3 years[14].
With limited arable and building land, new households find difficulties to settle down.
New villages have been created since the 70s but land is becoming scarce.

7.4 Overall wellbeing

- **Access to medicinal services**

Infant mortality in Tajikistan is 65 per 1000, in Fon Dario jamoat in 2013, it is 23 deaths for 1000 births.
A hospital is available within 25 km from the furthest village.

- **Literacy**

The USSR increased the literacy rate significantly. It is considered that 99% of the population is literate.

- **Infrastructure**

Ayni district is locked in the Fon mountains and has access to Khujand on the north through the Sharistan pass and to the south to Dushanbe through the Anzob pass. The road was asphalted in the 1960s, but was

14 Data from the jamoat of FonDario

impassable during the winter time, putting the mountaineers in isolation. The only way out was through Penjikent and Samarkand.
With the end of the Soviet union, roads that lead to the villages are not maintained any more and slowly degraded into dirt roads.
In the early 2010, a tunnel was opened to replace the road through Anzob pass and in 2012, a tunnel was also built under the Sharistan pass to allow winter access to Khujand, opening Ayni district to the nearby cities all year round. At the same time, in 2011, the border with Uzbekistan was closed in Penjikent.
All villages are connected to electricity, but with the shortage of electricity in Tajikistan in winter time, electricity is only delivered to households 8 hours per day (during the main meal times, breakfast, lunch, diner).
The overall appreciation by elders is that life has improved a lot: food is available, there is more comfort.

7.5 Gendered division of work and access to and control over resources

The division of work is clearly divided between men and women although the frontiers are slowly moving with the men being in Russia. Women are in charge of the domestic space while men act mostly in the public space.

Household chores, such as cooking, cleaning, taking care of the children, gardening, fetching water, taking care of the animals (milking, taking out to the fields), are done by women. Irrigation of the fields is traditionnally a man's job[15] but more women are getting involved.
Men have the responsability of providing and building a house for the family and then providing the financial means for the household to subsist.

Women in theory benefit from an equal access to education. For example, the presidential grant is a scholarship offered to twenty students of Ayni district to pursue college education: those scholarships are evenly divided between girls and boys.
In the villages that are part of our reference zone, 53%[16] of the registered school children are girls.

Conclusion

Within the past century, the Fon Dario Jamoat's population has lived two major livelihoods shifts in relation with the rise and fall of the Soviet Union (i) first, from a rural subsistence-based model to an industrial society with the Soviet modernization, and (ii) second, from a locally-based employment model to an economy based on remittances from seasonal migration to Russia since the fall of the Soviet Union.

15 *Bossenbroek Lisa and Zwarteveen Margreet, Irrigation Management in the Pamirs in Tajikistan: A Man's Domain?,*

16 *Data from the administration of Fon Dario jamoat from 1/1/2014.*

8 EXPOSURE TO CLIMATE CHANGE: HOW MUCH CLIMATE HAS CHANGED?

8.1 Perception of climate change by the population: "If the glaciers are done, we are done too"

Temperatures: warming up

The interviewed people during the focus groups expressed that temperatures were warming up.
The perception of the local population on the changes of temperature are the following:

- Winters are warmer: Iskander kul stopped freezing entirely after the 1985s. Some people recollect having crossed the frozen lake in 1980,
- Spring is warmer, but a few people also mentioned that spring is colder,
- Summers are warmer (more specifically: July and August are warmer), although some people said that it was not the case as summers are also more cloudy,
- There is no mention of autumn.

Precipitations: overall decrease of precipitations, less snow

The perception of the local population on the changes of precipitations are the following:

- Decrease of rainfall,
- Softer rain, but some people say stronger rains,
- Increase of rain in comparison to snow,
- Irregularity of the precipitations: it used to rain in March, now it rains in April,
- Snow quantities have been decreasing since the 50s,
- Drier winters.

Extreme events were

Dry years:
1976, 1983, 1985 to 1990, 1992, 1994, (it got drier after independance, 1992), 2014

Very wet year
Lot of snow in 66-67, 1974 was a very wet year.

Very hot years
1985, 2013, 2014.

Very cold years
2008-2009, 2009-2010.

Seasons are changing

- Winter comes earlier (10 days), spring comes later and is shorter, winter is longer (November to April),
- Winter is longer, spring is shorter,

Men and women show a different recollection of the climate: men have more facilities in remembering which years were abnormal and remarking the longer trends in climate change, women recollect more easily the immediate previous years.

Glaciers retreat

Glaciers and snowfields are the main water reservoir of the area, most of the glaciers are small glaciers.
Most interviewed people, except the population of Makshevat who has a glacier in view of the village, haven't noticed glacier retreat but acknowledge their dependency to them.
Shepherds, on the contrary, go near the glaciers during the summer time and see that the glaciers are "getting black and smaller".

8.2 Perception of natural hazards

During the focus groups information on natural hazards was gathered about floods, mudflows, avalanches, rockfalls. By order of importance, mudflows are the most frequent natural hazards while floods almost never happen.
Natural hazards have rarely an impact on human lives, but usually damage the infrastructures (roads, bridges) and houses.

Mudflows

Mudflows happen in all villages except in Saratog. Some villages (Makshevat and Narvad) experience mudflows every year. For the other villages, they are more seldom, happening every 3 to 4 years. Villagers say that the occurence of mudflows has been decreasing with less precipitations.

Avalanches

Narvad and Makshevat are the only villages prone to avalanches. The last events that the population remembers date back to 2000 for Makshevat when one shepherd and 15 cows died.
In Makshevat, villagers reported that there are more avalanches now than in the past. In 2004, Narvad lost 1 ha of land due to an avalanche that covered arable land with debris and rocks.

Rockfalls

3 villages (Makshevat, Saratog, Dijik) are prone to rockfalls. Villagers say that rockfalls are correlated with rain, since there is less rain, there are less rockfalls.

Floods

Floods do not represent a big threat in the area. Villages have no flooding history except Tuda, where the last flood in 2000 damaged the bridge and the road.

According to the people's perceptions, it seems that there is not a significant increase of natural hazards and that there is no occurence of exceptional phenomenon.

There is no available records of natural hazards at the jamoat level.

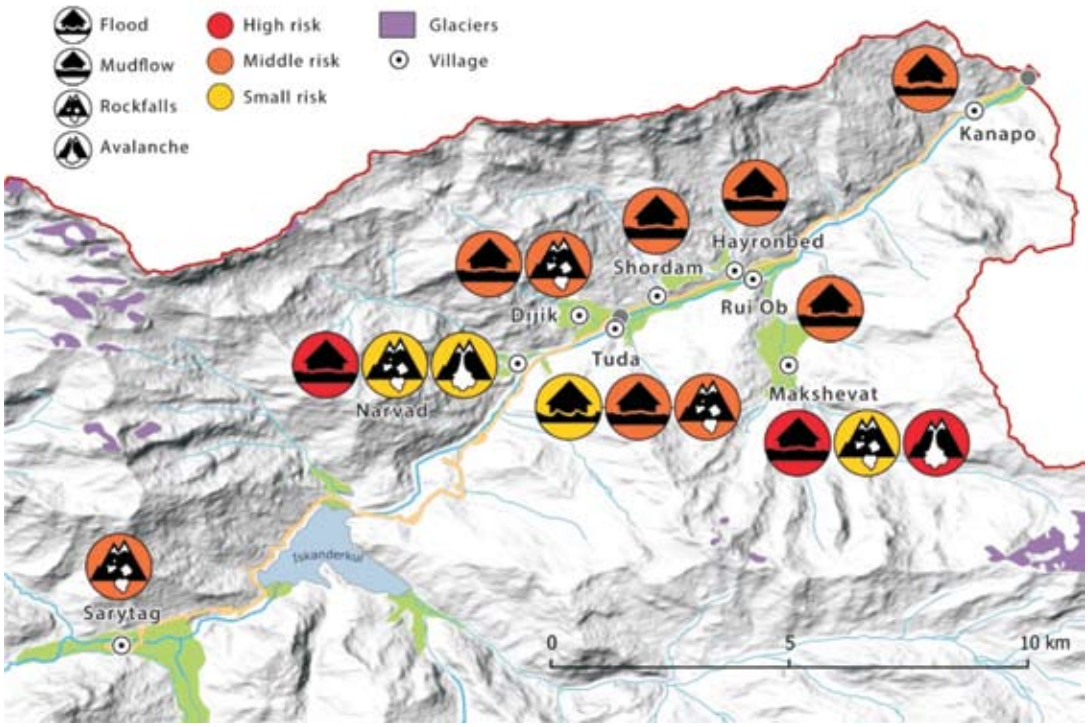


FIGURE 14 MAP OF THE VILLAGES WITH NATURAL RISKS

8.3 Scientific records on climate change

Climatic data is gathered at the meteorological station of Iskanderkul (2187 meters above sea level), and then centralized at the Hydro-meteorological Institute of Dushanbe.
Available data covers the time span 1930-2013.
The methodology used to analyze climatic data was based on the student T Test, which shows if the anomaly is significant enough[17]. Each decade has been compared with the other one, first comparing mean annual temperature, then mean monthly temperatures.

- **Change in temperatures**

Change in annual yearly temperature for 2000-2009: +0,7°C
Over the time span 1930- 2013, the decade 2000-2009 has been the hottest.
It shows an increase of temperature that is significant and proves climate change, the mean temperature of this decade has increased by +0,7°C from the mean average temperature over 80 years.
It matches the conclusions of the analysis of the Hydro-meteorological Institute prepared for the 3rd communication of the government on climate change.

Change in mean monthly temperature in spring for 2000-2009: +1,8°C

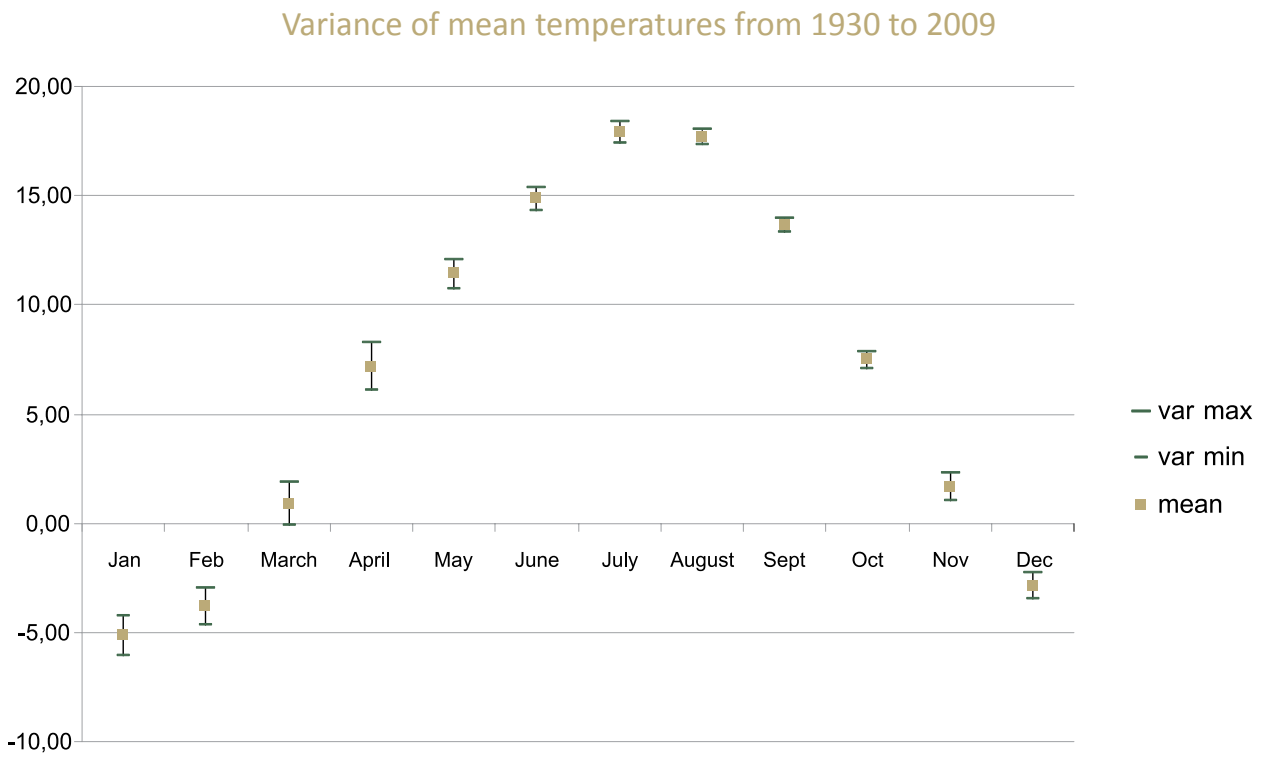


FIGURE 15 MONTHLY MEAN TEMPERATURES AND THEIR VARIANCE

	1930-1939	1949-1949	1950-1959	1960-1969	1970-1979	1980-1989	1990-1999	2000-2009
march	-0,20	0,82	0,60	0,98	-4,03	0,56	-0,20	2,85
april	6,10	7,04	6,70	5,83	7,42	7,04	6,53	9,37

FIGURE 16 MEAN MONTHLY TEMPERATURES IN MARCH AND APRIL OVER THE PERIOD 1930-2013

17 *Han Hugh and Kurtz Richard, An Investigative Analysis of Climate Change Using Historical and Modern Weather Data*

student T-test		Mean monthly temperatures		
		March	April	
years of comparison		p-value		significance
2000-2009 versus	1930-1939	0,0029	0,0027	yes
	1949-1949	0,0211	0,0187	
	1950-1959	0,0079	0,0113	
	1960-1969	0,0495	0,0006	
	1970-1979	0,0043	0,0355	
	1980-1989	0,0134	0,0189	
	1990-1999	0,0014	0,0044	

FIGURE 17 SIGNIFICANCE OF THE STUDENT T TEST ON MEAN MONTHLY TEMPERATURES FOR THE DECADE 2000-2009 RELATIVE TO THE PERIOD 1930-2013

Spring (March, April, May)

The increase of temperature of the decade 2000-2009 can be attributed to the increase of temperatures of the months of March and April. There is statistical evidence that these months have witnessed a significant and unusual rise of temperatures: +2°C for each month.

The general trend of the last decade 2000-2013 goes towards an increase of temperature of the months of March and April: +1,8°C in comparison to the overall mean 1930-2013.

Winter (December, January, February)

The month of January was significantly colder in the decade 1930-1939 and 1970-1979.

There is no significant change on the winter months temperatures, although the general trend goes towards an increase of temperatures and more variability of the mean temperatures during the winter months.

Summer (June, July, August).

Summer months don't show a significant change of pattern.

Autumn (September, October, November).

There is no significant changes in autumn months mean temperatures.

Mean extreme temperatures: the cold season is getting hotter!

Extremes temperatures are changing during winter, spring and autumn.

Summers are not getting hotter.

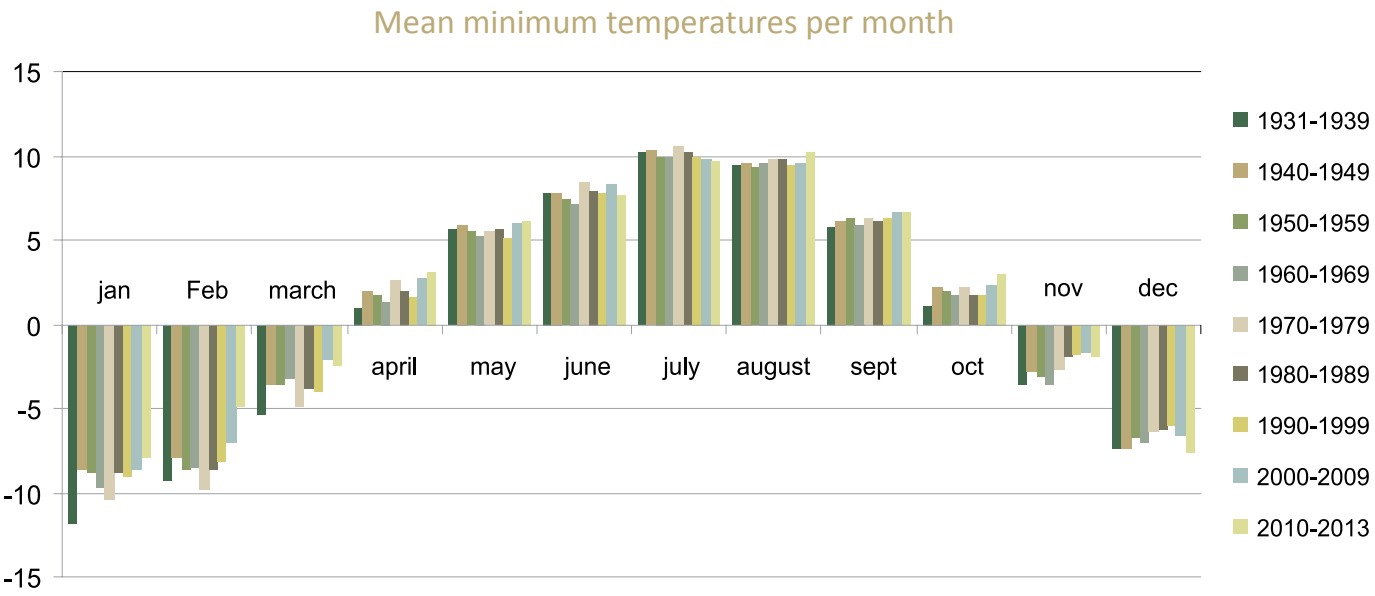


FIGURE 18 MEAN MINIMUM TEMPERATURES PER MONTH

Note that the decades 1931-1939 and 1970-1979 had colder winters.
The extremes cold temperatures are getting hotter in January, February and April over the last 3 decades.

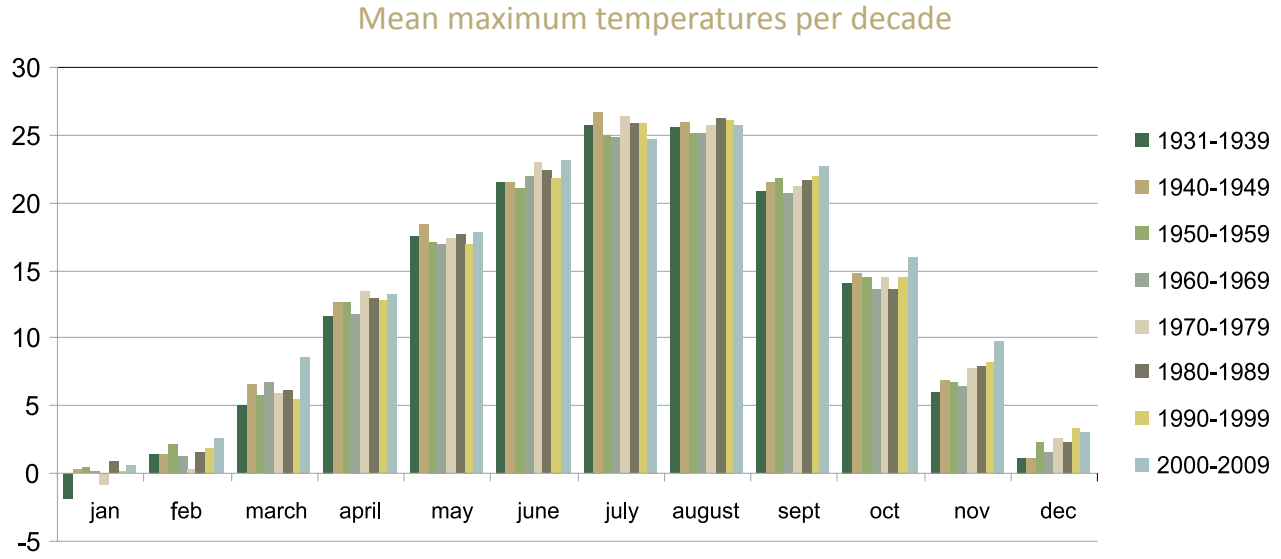


FIGURE 19 MEAN MAXIMUM TEMPERATURES PER DECADE

The mean maximum temperatures are increasing for autumn and winter (September, November and December, February).

Conclusion on temperatures

- The decade 2000-2009 was the hottest since 1930.
- There is an increase of the annual mean temperature +0,7°C in 2000-2009 coming mostly by a sharp increase in spring temperatures (+1,8°C).
- Winter average temperature has not yet significantly changed but there are strong signs: increase of the average minimum and the average maximum temperatures.

- **Changes in precipitations: rain + snow**

Precipitations show great variability over the overall period of study, the months of March and April show the greatest variation in precipitations.

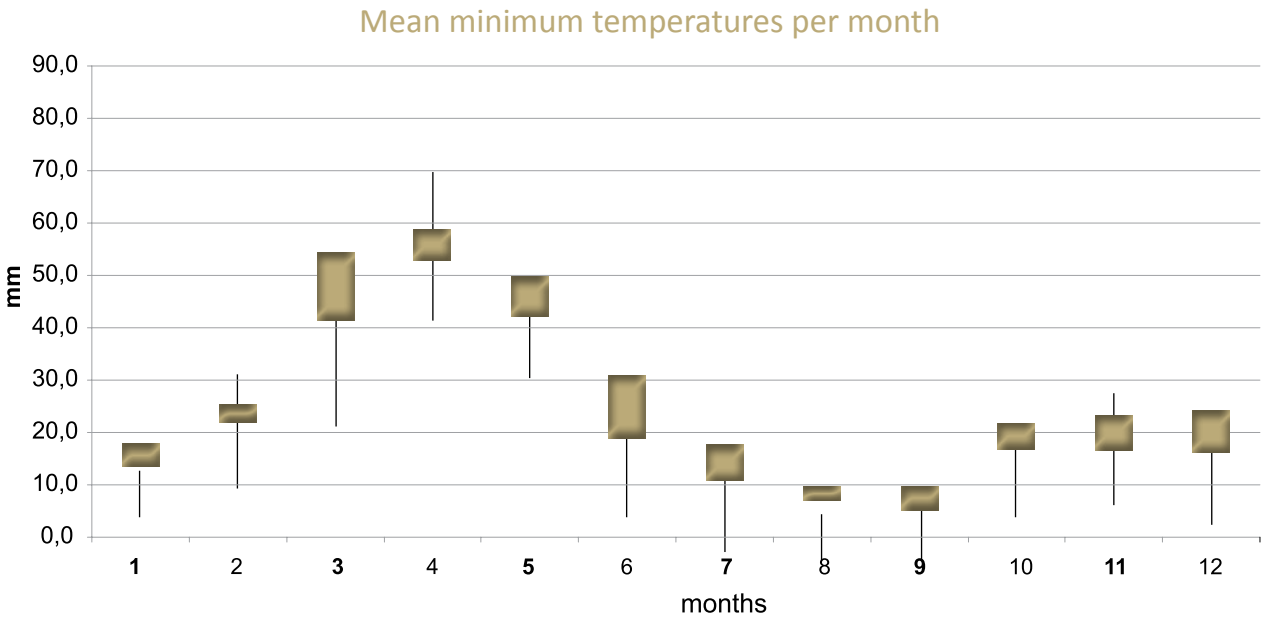


FIGURE 20 DISTRIBUTION OF MONTHLY MEAN PRECIPITATIONS FROM 1930 TO 2013

There is no statistical evidence that there is a change in the pattern of the precipitations.

Conclusion on precipitations

- Variability is a trait of the climate
- There is no significant change over the 83 years of study

- **Changes in precipitations: snow**

The analysis of snow precipitations does not show a significant change over the period 1930-2013.

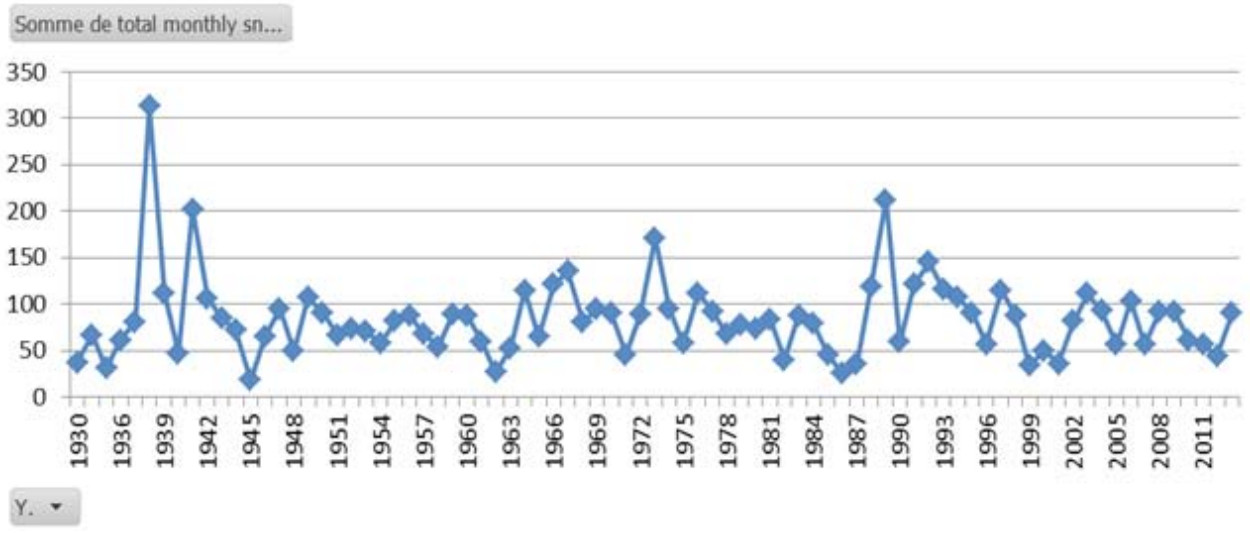


FIGURE 21 SNOW PRECIPITATIONS 1930-2013 IN CM/YEAR

- **Hazards trend**

There is no scientific record available of the natural hazards.

- **Glaciers retreat: 1985 to 2013**

Empirical evidence using Russian topographic maps of 1985 and google images of 2013 on three glaciers in the Hissar-Alai range demonstrates that glaciers have been receding of 7 meters per year (200 meters over 28 years).

Bibliography on the subject shows that glaciers variations in Hissar Alaï vary a lot: some glaciers disappeared,

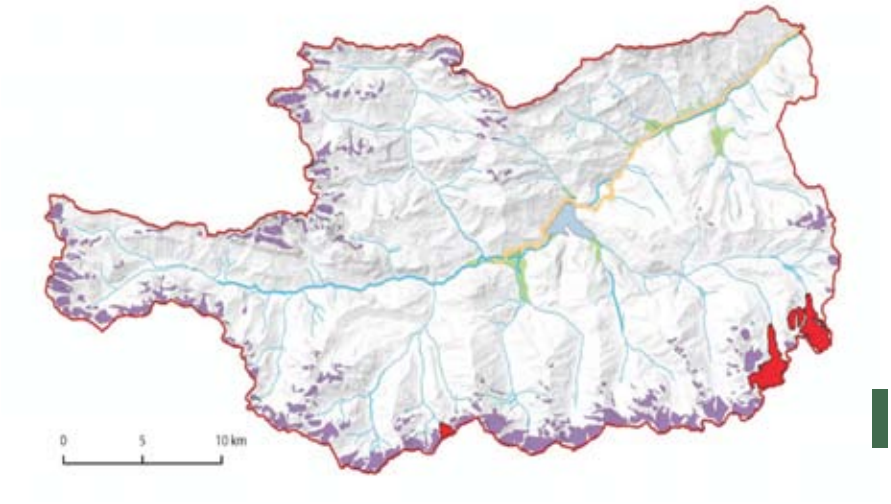
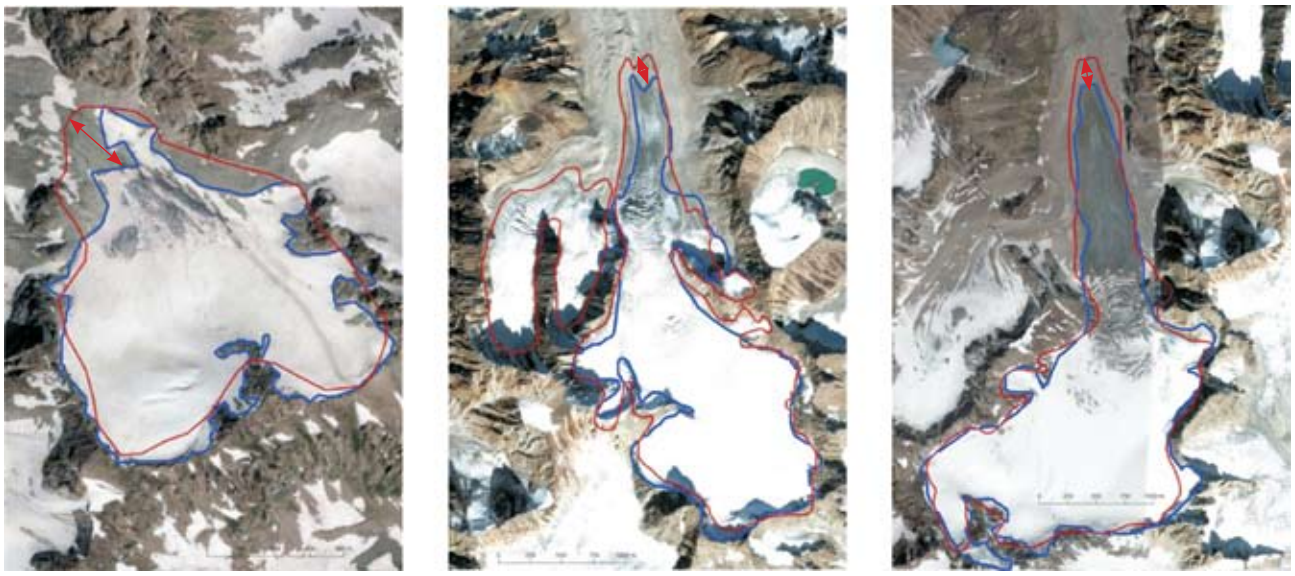


FIGURE 22 OVERVIEW MAP OF STUDIED GLACIERS

Mura glacier receded of 3m/year, some don't move at all.



LIMIT OF GLACIER IN 2013

LIMIT OF GLACIER IN 1985

FIGURE 23 RETREAT OF GLACIER TONGUES IN ISKANDERKUL WATERSHED

The situation of the glaciers (facing north or facing south) impacts their melting.

- **Dynamics of Iskanderkul**

FIGURE 24 ISKANDERKUL AND ITS DATA COLLECTION POINTS

Discharge river level: Saritag

Data seems not reliable since 2000.

Lake water level: Iskanderkul

The minimum and maximum levels of the lake have been increasing since 1930 with a significant increase since the end of the 1970s. The lake is filling up with the melted glacier waters (+60cm of its maximal level).

River outflowing of the lake: Iskanderdario

The water level of the river outflowing from Iskanderdario in winter time (January) has gradually increased since 1930, gaining 15 cm, but the maximum level of the river in summer time hasn't been changing.
The river reaches its highest level some years in June, some years in July.
The increase of the minimum level is correlated with the increase of the waterlevel of the lake.

Conclusion

- Iskanderkul waters have been increasing significantly since the 1980s, resulting in an increase of the minimum water level of its outflowing river.

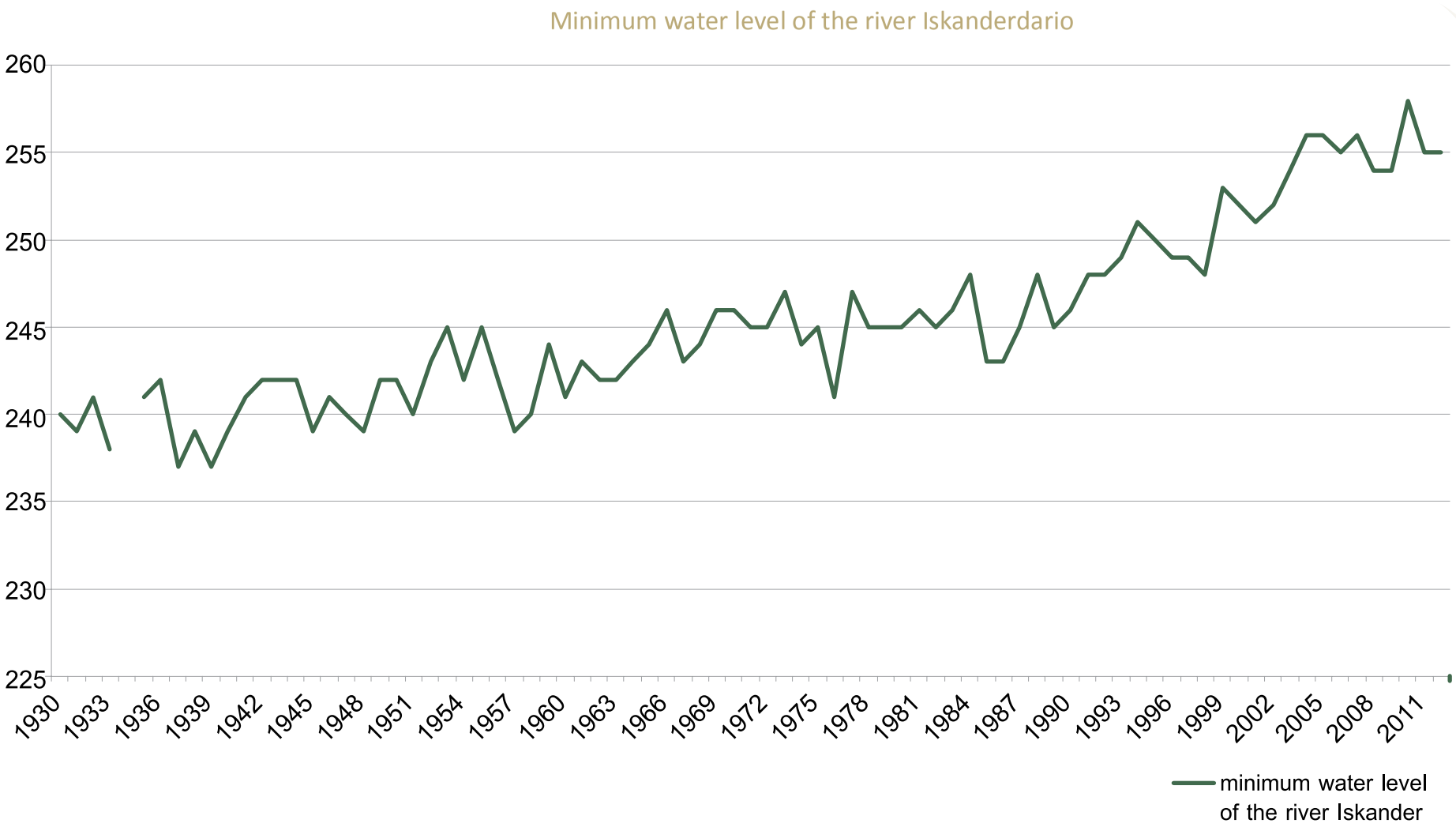


FIGURE 25 VARIATIONS OF MINIMUM AND MAXIMUM WATER LEVEL OF ISKANDERKUL

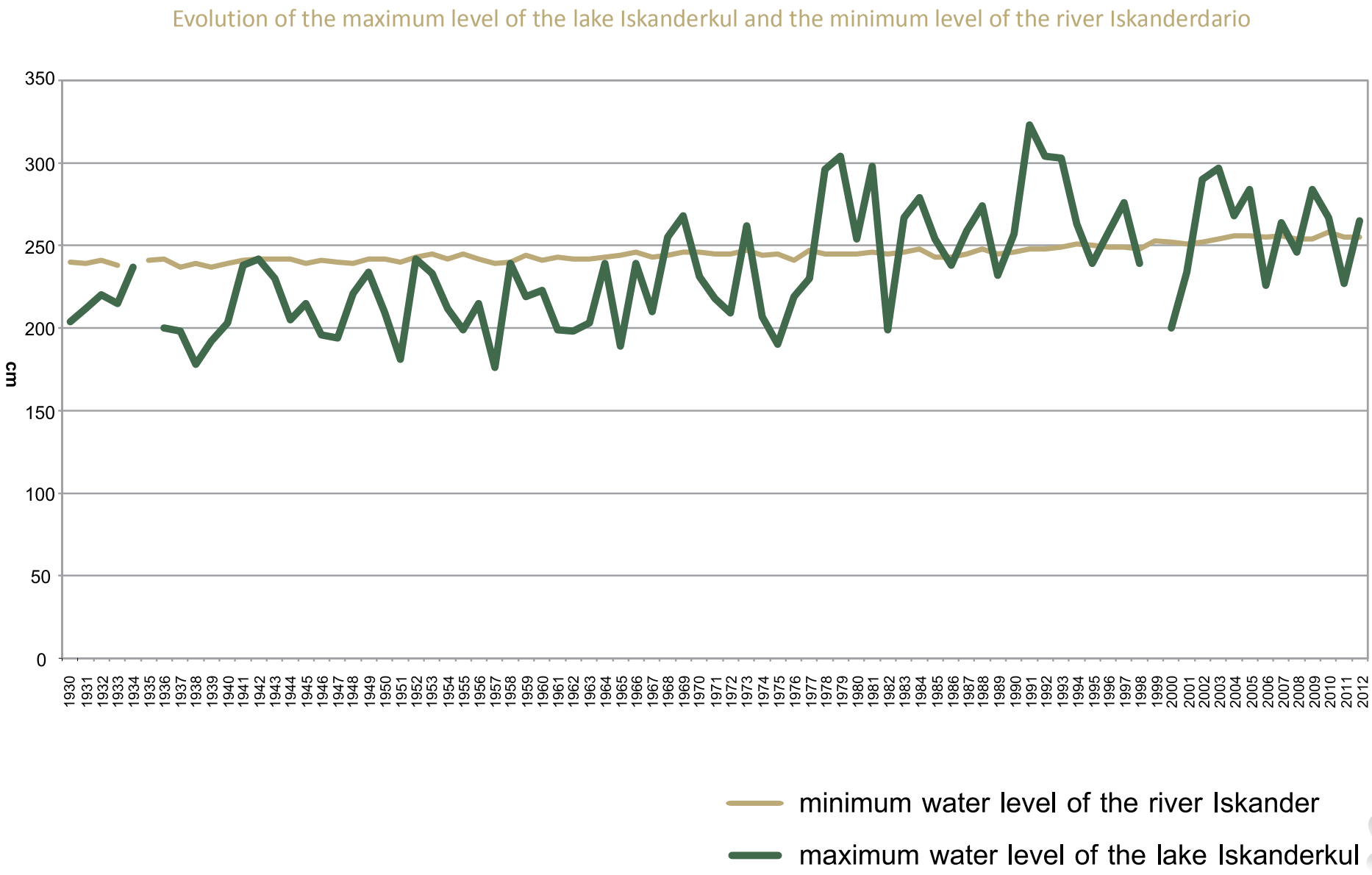


FIGURE 26 EVOLUTION OF THE MAXIMUM LEVEL OF THE LAKE ISKANDERKUL AND THE MINIMUM LEVEL OF THE RIVER ISKANDERDARIOL

8.4 Comparison of climate records and people's perceptions

Temperatures: warming up

- Winters are warmer: yes,
- Spring is warmer: yes,
- Summers are warmer: no,
- There is no mention of autumn: there is no change.

Precipitations: overall decrease of precipitations, less snow

- Decrease of rainfall: no,
- Softer rain, but some people say stronger rains: no possible to verify through data,
- Irregularity of the precipitations: "it used to rain in March, now it rains in April": spring has the most variability in terms of precipitations.
- Less snow since the 70s, less snow since the 50s, since the 60s: no such significant trend.

Extreme events:

- *Dry years:*

1976 was a dry year with only 197mm, which is below the 300mm average in the area, as well as for 1983 with 259mm, and 1986 with 185mm. But 1987 with 403mm, 1992 with 335mm and 1994 with 311mm were not particularly dry.

- *Very hot years*

1985, 2013, 2014

	jan	feb	mar	apr	may	june	july	aug	sept	oct	nov	dec	mean annual
1985	-3,9	-1,7	0,1	8,1	10,5	15,6	19,9	16,8	14,3	7,5	1,4	-2,3	7,2
2013	-5,1	-3,3	3,8	6,4	11,5	15,7	18,3	17,3	15,7	9,3	2,3	-2,9	7,4
mean 1930-2013	-5,13	-3,8	0,87	7,16	11,4	14,86	17,9	17,69	13,63	7,48	1,7	-2,89	6,74

FIGURE 27 PERCEPTIONS OF VERY HOT YEARS VERSUS SCIENTIFIC DATA

- *Very cold years*

2008-2009: yes, the months of January and February were a lot colder that the usual mean.
2009-2010: not really

	jan	feb	mar	april	may	june	luly	aug	sept	oct	nov	dec
mean extreme minimum	-16,0	-16,9	-12,3	-4,1	1,0	4,0	6,6	6,1	2,0	-3,3	-9,3	-14,7
2008	-22,8	-21,9	-6,2	-0,5	2,5	5,9	6,9	5,6	2,7	-1,9	-	-12,5
2009	-15,0	-12,5	-7,5	-4,2	1,0	2,9	3,3	6,5	1,5	-4,5	-12,0	-15,5

FIGURE 28 PERCEPTIONS OF VERY COLD YEAR VERSUS SCIENTIFIC DATA

- *Very wet year*

1974 was a very wet year: yes, precipitations were above 400mm

Conclusion on perceptions versus data:

- Mind plays tricks
- Winter and spring are getting warmer: right perception
- No evident change on precipitations although there is a general complain of lack of water
- It raises the question of the impact of increase of temperatures on the water regime

Conclusion on exposure to climate change

- **Climate change is proven to happen in the Iskanderkul valley**
- **It mostly impacts the temperatures: the decade 2000-2009 was +0,7°C warmer than the average since 1930, the months that have been warming up are the winter and spring months**
- **The regime of precipitations doesn't seem affected**
- **This has an impact on the hydrology of the area: glacier melting, increase of the maximum level of Iskanderkul, increase of the minimum level of Iskanderdario**
- **There has been no significant increase of natural disasters in relation to climate change**

9 SENSITIVIY TO CLIMATE VARIABILITY AND CHANGE

Sensitivity to climate change has been explored with different angles: first, by looking at the geographical sensitivity of villages according to their location, then the sensitivity of the income of the population combined with their general remarks on how their activities have been impacted. Finally, a general look at the ecosystem of the area describes how it is sensitive to climate change, in link with the human pressure that it is bearing.

9.1 Villages sensitivity to climate change

On the long-term, the villages on the slopes facing south (Narvad, Dijik, Shordam and Xaironbed) will be the first to see a decrease of the availability of water (both of springs and streams for irrigation).
Then all villages dependent on spring water will be confronted to a significant decrease of their water supply.
Villages along the main rivers (Sarytag, Tuda, Nurabad, Shordam, Rui Ob, Xaironed, Kanapo) will still be able to access water by pumping in the main river if they can afford to invest in new equipments (pumps, pipes) and have access to electricity.

9.2 Income sensitivity to climate change

A in-depth decomposition of the income allows to specify how much the population is sensitive to climate change.
The data is issued from the baseline survey report in spring 2011, it doesn't take into consideration what is produced for home consumption, so doesn't give a financial value to the production from gardens and orchards, which are nevertheless substantial for food security.

- **Structure of the income**

The income of the population of the jamoat Fon Dario is for 80% of the population below 12,000 TJS/year.

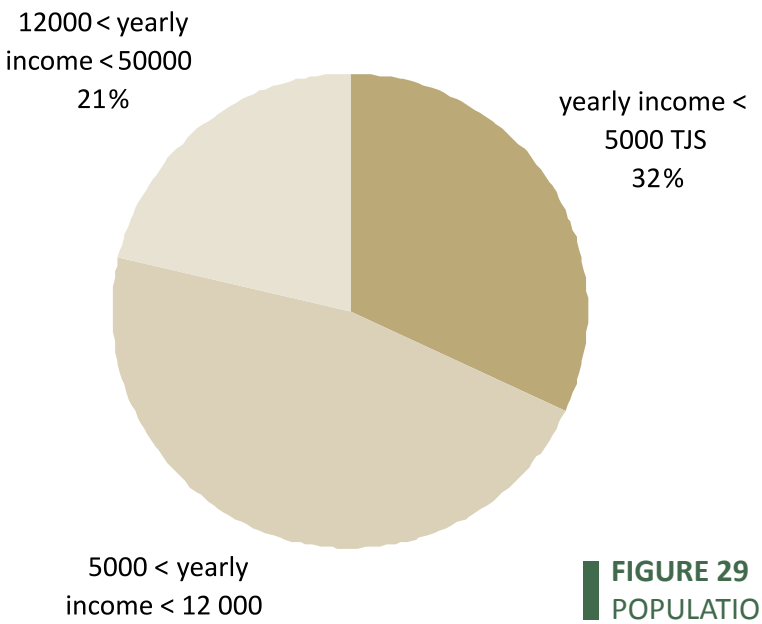


FIGURE 29 LEVELS OF INCOME OF THE POPULATION OF FON DARIO JAMOAT

The population can be divided into three categories: low income households (below 5,000 TJS), middle income households (from 5,000 to 12,000 TJS/year) which gathers the 2nd and 3rd quartiles, and high income households (last quartile, above 12,000 TJS/year).
Within the community, the difference of wealth will create disparities. A household with more financial means will be less sensitive to the question of water scarcity.

Within each category (low, middle, high incomes), incomes can be structured differently.
Income is diversified, there are at least two main sources of income, some household managing to diversify up to three sources of income.

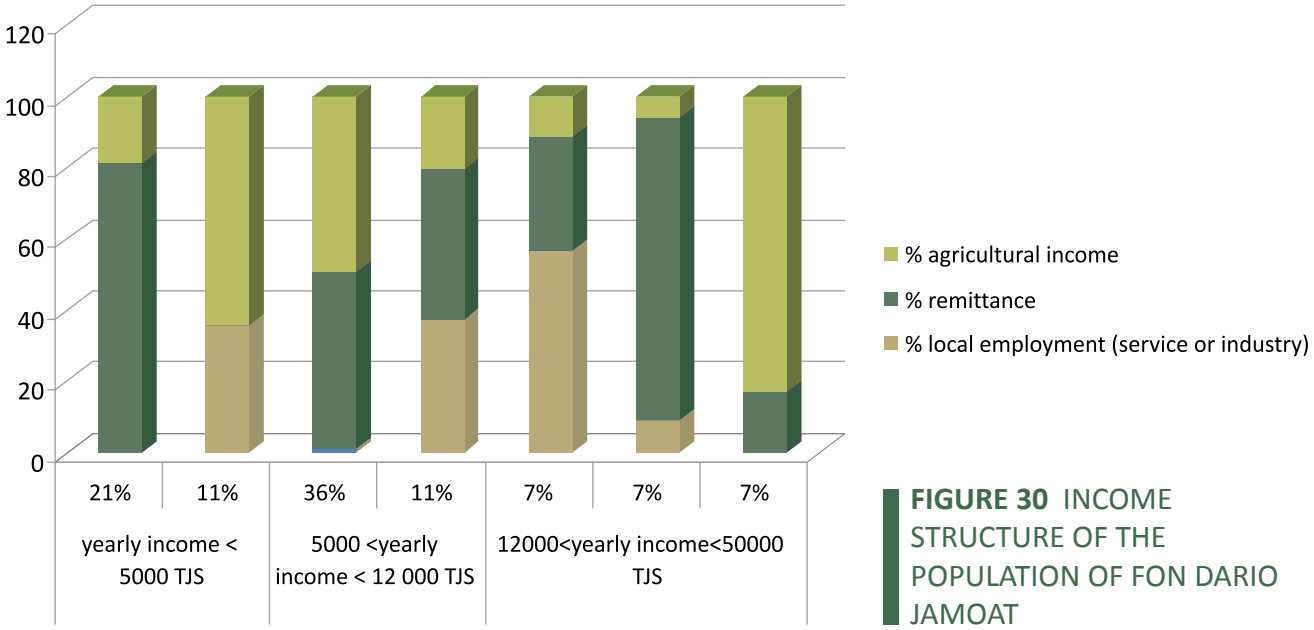


FIGURE 30 INCOME STRUCTURE OF THE POPULATION OF FON DARIO JAMOAT

Remittances represents at least 15% of the income for 90 % of the households.
For those who don't depend on remittances, from the low income households, they rely for **at least 60% on agriculture.**
Agriculture is part of all income structure, with a minimum of 10%; it can be understood as **a safety net.**
Agriculture income comes first from selling **livestock**, then selling potatoes and finally from fruits and vegetables.

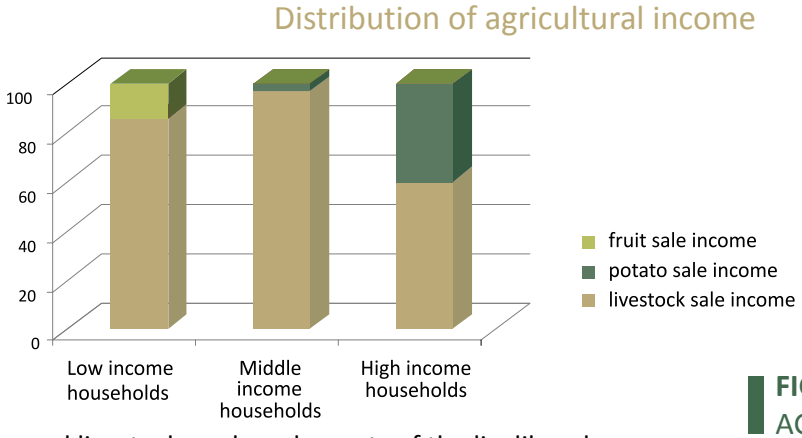


FIGURE 31 DISTRIBUTION OF AGRICULTURAL INCOME

Remittances and livestock are key elements of the livelihoods.

9.3 Sensitivity of the incomes to climate change

During the focus groups, 4 main points were identified as key for the livelihoods, by order of importance: migration, water, livestock and, gardens and orchards.
It matches with the conclusion on the analysis of the income structure, which shows that remittances first sustain the livelihoods, followed by agricultural activities.
The water question will be integrated crosswise in the agricultural activities.

- **Migration**

The link between climate change and migration has been made by understanding environmental degradation as a push factor towards migration[18].
Nevertheless, in her report, Olimova acknowledges that "push factors for migration are complex" and in the case of the studied area, it seems that the demographic growth and the lack of employment possibilities are the main factors that will explain the external labor migration.
Climate change has not brought major shifts in this trend, but remittance, an on-going phenomenon for the last 15 years, is not without risks either, as it is dependent on factors that the migrant cannot control (global economic crisis[19], decreasing oil prices, recession in Russia…).

- **Livestock**

Livestock represents 80% of the agricultural income of the low-income households.

Quality of livestock products
Interviewed people don't see a difference in the quality and quantity of meat, but acknowledge the difference in milk production: "This year, in 2014, there is less grass, so less milk"

Disease on livestock
Diseases on livestock (anthrax, foot and mouth disease, brucellosis) have increased since the end of the USSR, probably because of the absence of vaccinations which were paid by the state during the soviet time. Villagers have a difficult time covering the veterinarian's costs (5TJS/ cow).

Quality of the pastures

- Pastures around the villages:

Pastures and general vegetation cover around the villages are very degraded due to the large number of animals grazing.

- High mountain pastures:

Villagers see clearly a difference in the pastures quality; the vegetation size will decrease if there is no rain. They don't make the connection with a large number of animals.
Shepherds in the mountains confirm that the grasses varieties and quantities remain the same, but that the size decreases.
"less grass"
There is in 2014 around 8000 heads of livestock in the valley. This seems, in regards to the erosion of the mountains around, far too much for the carrying capacity of the environment.

Fodder production: cereals
According to the population, fodder production, which is traditionally grown in the fields around the villages has been impacted because of the lack of irrigation water.
Some farmers complain that they lack water every year, but that it is linked with the origin of water that is very far away from the fields (Tuda and Rui Ob). Farmers also say that more water is infiltrating in the channels, reducing the quantity of water available, which would decrease the final volume of water available.

18 *Olimova Saodat, Olimov Muzaffar Environmental Degradation, Migration, Internal Displacement, and Rural Vulnerabilities in Tajikistan,*

19 *Danzer Alexander M., Ivaschenko Oleksiy, Migration patterns in a remittances dependent economy: Evidence from Tajikistan during the global financial crisis*

In Saratog, farmers complain that the wheat harvests are not as good as what they used to be, without knowing what the main factor is.

"the land has become dried and hard to work"

Irrigation requires in some cases long channels to bring water from a faraway stream to the fields.

A important task is the cleaning and maintenance of these channels. The lack of labor force is also a explanation for the general complain of lack of water for irrigation: some channels are not maintained anymore and water cannot access the fields, leading to loss of agricultural land (8 ha Tuda, 5 to 6 ha in Narvad).
The cleaning of the water channels is usually done in spring, when the agricultural season is starting again, which matches with the departure of men to migration.

Those fields were abandoned 10 to 15 years ago when started at the same time both the hottest decade since 1930 and the men drain to Russia.

In this case, it is a consequence of the lack of labor force coupled probably with a decrease in the water debit of the streams fed by snowmelt that led to the loss of fodder fields.

- **Vegetables and orchards**

Impacts of climate change over vegetables and fruit harvests are not clear. Different factors might influence the quality of harvests.

On orchards

Some farmers report lacking water to irrigate their orchards and that apricots are not getting ripe as usual because of cloudy summers.
People link the hot weather and the lack of rain with the apparition of diseases on their crops (more worms on the fruit trees); according to them there were less disease 20 years ago.
Because of the heat, the land becomes dry and hard to work (lack of labor force and lack of machinery).

Change on vegetable yields

When asked if the harvests (vegetables and fruits) have been changing these last years, answers are diverse.

Some villagers complain about getting smaller harvests, most people don't. They acknowledge that the harvests will depend on the skills of the farmers.
Women reported that the changing weather could not provide good conditions for potatoes sowing, which matches with the conclusion given by Bobojonova [20] according to whom "producers in arid regions may suffer from losses under climate change scenarios".

On the other hand, a warmer climate might give new opportunities: it was reported that eggplants and belt peppers were giving better harvests now than in the past, and women started to sow earlier (Saratog, Chordam, Makshevat, Dijik) because the land is warming up faster in spring.

One aspect that needs to be taken account is that climate can impact the food security of the population, without directly impacting the revenue of the household.
Gardens and orchards participate most of all to the diversity of the diet of the population.

9.4 Gradation of sensitivity to climate change according to the income origin

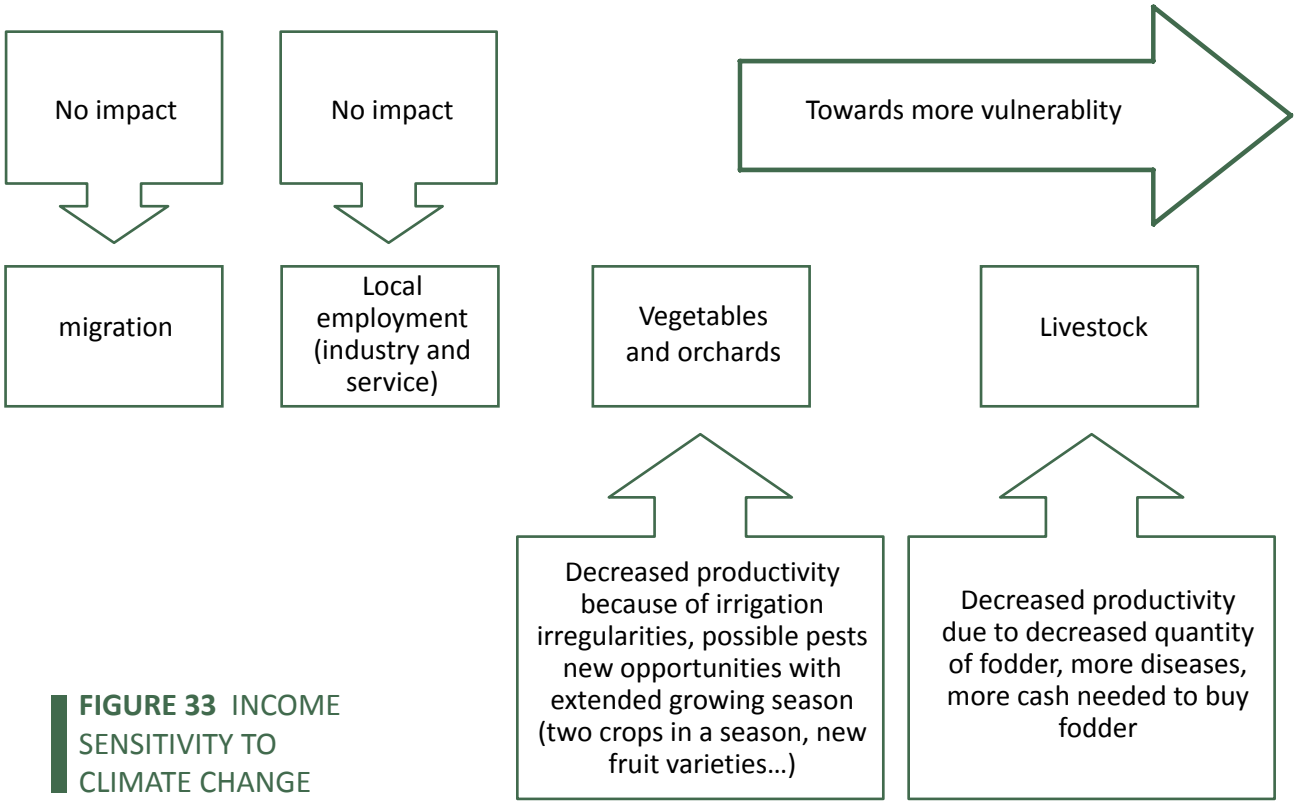


FIGURE 33 INCOME SENSITIVITY TO CLIMATE CHANGE

Climate change impacts mostly the agricultural income and the food security of the population of Iskanderdario.
The most sensitive households to climate change are the lowest income households who rely on the sale of livestock, apples and apricots to complement their income and the dekhan farmers whose income is guaranteed by the sale of potatoes.
The diversification of the diet with the provision of vegetables and fruits for all households is also sensitive to the changes of climate.

20 *Bobojonova Ihtiyor, Aw-Hassan Aden, Impacts of climate change on farm income security in Central Asia: An integrated modeling approach,*

9.5 Ecosystem sensitivity to climate change in link with livelihoods

The observed increase of temperature has a major impact on the hydrology of the area, which, in return has a direct impact on the biodiversity. It would need a full assessment by itself.
Here we will focus on the noticed modifications of the ecosystem that have an impact on the livelihood of the population.

- **Decreasing water supply with strong demographic pressure**

Springs are said to dry out earlier than in the past, or are reported to have a variation in their water debit.
Women spoke about the increasing waiting time to fill their water recipients.
Water is a key question that was raised spontaneously by all the population; it concerns both the durability of the livelihood (drinking water) and the sustainability of agriculture.
Women report arguments over water when there is no good cooperation or leader amongst the population to organize the water turn.

- **Disappearance of medicinal herbs**

Not all villagers have the same knowledge on medicinal plants. Women often confess not knowing so well the herbs of the mountains, children and teenagers are in charge of picking them up. Herbs are used to flavor the dishes and fill a medicinal purpose at the same time.
Several herbs ('zeera' or wild cumin, 'roba' and 'alfafi zulf') don't grow anymore during the hot and dry years.
Endemic species are abundant in the area of Iskanderkul, but are suffering from human pressure as botanists describe it :"The most important threats […]are intensive grazing and erosion of soils, as well as denudation. Most vulnerable types of vegetation to the human impact are forest and scrub communities"[21].

- **Pressure on forests**

Juniper forests are the main forests in the area.
During the interview with the forest department manager, it was said that the size of junipers has been decreasing, although the varieties of trees (the type of the forest) haven't changed within time. The main reason given was human collecting which does not allow the trees to grow old.
The forest used to be more dense as well: elders from Saratog village remembered to have to mark the trees on their way not to get lost.
Elders also report that the number of trees on the household plots has increased, as it is sometimes aimed at construction work.
Women, on their side, notice an increase of the time spent and the distance to collect wood.
From these observations, it is difficult to determine the exact impact and share of responsibility between climate change and human pressure on the forest modifications.

Interviews showed that the population switched from the use of wood to coal in the 1960s, with the improvement of the road and the opening of coal mines in Ayni district.
Nevertheless, wood remains a major source of fuel: it is a starter for coal fires, is indispensable for bread cooking and outside cooking. One household uses up to 1,2 ton of wood and 1,25 tons of bushes every year[22].
Wood and bushes are first collected around the villages. But the remaining forest is mostly situated in the mountains around Iskanderkul and villages now collect their wood there as there is nothing left around the villages.
There is thus a strong human pressure on the juniper forest.

21 *Nowak Arkadiusz and Nobis Marcin, Tentative list of endemic vascular plants of the Zeravshan Mts in Tajikistan: distribution, habitat preferences and conservation status of species,*

22 *SEADEP, GERES, 2012*

The behavior of the juniper to the increase of temperature might be similar to the one of the dwarf juniper[23], with moisture becoming a limiting factor to growth. The exact reaction of juniper forest to climate change would need to be better studied.

- **Villages situated on the south facing slopes are more sensitive to climate change in terms of water supply,**
- **The livestock sector, which represents a safety net for the population, is sensitive to climate change in terms of fodder production and water availability,**
- **Food security is also at risk,**
- **Households which rely both on remittance and agriculture, which makes 64% of the total population, can be considered sensitive, as both sources of income can vary out of the households'predictability zone**
- **The ecosystem of the valley is sensitive to climate change: there are signs of modified hydrology and vegetation, to which the increasing population adds more stress.**

23 Opała Magdalena, Niedźwiedź Tadeusz, Rahmonov Oimahmad, Dendrochronological potential of Ephedra equisetina from Zaravshan Mountains (Tajikistan) in climate change studies.

10 ADAPTIVE CAPACITY TO CLIMATE CHANGE

The population of the jamoat and the institutions have mixed knowledge of the impacts of climate change on their lives and demonstrate a capacity to adapt to the most immediate challenges of climate change without envisioning the long term impacts.

10.1 Knowledge of climate change amongst stakeholders

Awareness of climate change decreases when going from top - the government, to down- the local population.

At the national level, climate change is tackled by the government.
Actions on climate change are mostly implemented by PPCR, the Pilot Programme for Climate Resilience, a multi-donor project, which started in 2009 in 11 countries and aims at building resilience to climate change in Tajikistan through integrating climate change in the legal framework, building capacities of professionals and offering solutions for adaptation.
PPCR is the main actor on climate change through ministries.

The capacity assessment carried out at the beginning of the PPCR project showed that climate change was not included into the laws relating to agriculture, water, energy… and that the capacities of district and local officials were diverse.
Tajikistan participates every year in the United Nation conferences on climate change and makes a declaration with the group of landlocked countries.

At the jamoat level, a meeting with the head of jamoat of Fon Dario (30/07/2014) showed that climate change effects are understood. Even though the causes are maybe not so well identified, the local consequences are well known: the head of the jamoat points out that the biggest problem is the lack of water. This year for example, springs gave very little water or were dried out. He reports that the population of the jamoat doesn't pay attention to climate change as they rely on the religious belief that "god knows better".
No climatic projections and modelisations are available locally although the jamoat possesses a national meteorological station on its own territory.
The jamoat also attended a training for 10 days on disasters risk reduction organized by the regional disaster committee and the Red Crescent Society of Tajikistan (RCST) is implementing a project in 2 villages of Iskanderkul valley (Makshevat, Dijik) to answer to the risk of natural disasters.
RCST is providing trainings for groups of 15 persons to answer to natural disasters (first aid) and within this training, has been providing information on climate change as well to the volunteers' team.
But there is no mechanism existing for early warning on natural disasters as the jamoat level.
ASDP Nau and GERES trained the local authorities on natural resource management in 2012 and 2013 and included in the local development plan the priorities for sustainable management of natural resources.
The head of the jamoat is aware of coping strategies: more vegetable growing in the household gardens, saving water, providing more information (at the jamoat level and at the population level), encouraging the supply of electricity to avoid deforestation.
Nevertheless climate change is not included yet in the local development plan and the biggest constraint is the lack of financial resources to implement actions, salaries of civil workers at the jamoat and district levels are already hardly paid.

At the level of the villages, local committees (mahalla committees) work voluntarily for the benefit of their fellows. They are chosen by the population when their members decide to leave and show various knowledge on climate change depending on their background.

Amongst the population, people have heard of the concept of climate change without being sure of what it means.
The causes of the change are not well understood: one person said that it is the salt of the dried Aral Sea which is coming on the glaciers to melt them. There is a broad understanding that the industrialization pollutes and impacts on nature, but the mechanisms are not clear.

Within different groups, people might have a different understanding of climate change questions. Women in general have a lower understanding of the concept of climate change although they are the one who deal daily with the impacts of climate change, as they are responsible of the household when the men are in migration.

10.2 Existing adaptive strategies

The population shows amongst itself a very different capacity level to adapt to climate change. It has started to adapt to the most urgent question: the access to water. On agriculture, farmers have been reacting more or less to the changes, while the changes on the ecosystem are out of their reach.
For all the population, migration has been an adaptive strategy to the collapse of the USSR. In the context of climate change the remittance can help alleviate climatic accidents.

- **Strategies related to the lack of water**

Buying equipment (waterpump and pipes) individually
Some households who don't benefit from a good supply of irrigation water have bought a waterpump and pipes to pump the main river water.
The investment can be as high as 2800 somonis for the materials and 800 somonis for electricy per year.
This technique is possible to implement for households who live close to the main river.

Organizing water supply collectively
Some men have been organizing together the collection of money from several households to install pipes from a higher up spring.

Stealing water from the neighbours
Some people get up at night to direct the water flowing to their neighbors' land into their own plot.

- **Strategies related to agriculture**

Livestock
The lack of fodder for feeding the livestock in the winter time has already forced the population into buying straw bales (15 TJS/bale). The cost of the imported fodder from the south of Tajikistan prevents it from being a very sustainable solution.
There are talks about diminishing the number of heads of livestock, but nothing is acted.
Pastures rotation is not implemented.

Gardening
Different groups show a very different adaptive capacity. Some women already started to plant earlier, while other report that they haven't changed their practices and rely on the tradition:
«we are used to celebrate Navruz with planting»
Women stated that in case they would lose their crops due to the lack of water, they could always buy what was needed (potatoes and other vegetables) from the bazaar that is situated at a maximum of 30 km from their villages.

Putting all the land in use and all the labor force at work
In 1997-1998, the population of Saratog realized that they would not be able to feed their whole population.

The women reported that all men went to work in the fields and put into culture all the available land. They were finally able to meet their needs. But this only happened one year, then all the men went to migration. This would only be possible in Saratog village where land is plenty.

Canning started at the end of the Soviet Union to make reserves of vegetables for the winter time. Skills are also various from individual to individual.

Social nets are still very strong: in case a family does not have money, they can borrow from their relatives, from their neighbours or ask for a credit at the shop.

Reduction of needs
Some households reported having reduced their consumption in case of lack of financial means.

- **Strategy related to ecosystem**

There has been no strategy implemented to cope with the retention of water in the watershed, nor to grow replacement medicinal herbs.
As for forest management, the forest department in Ayni is proceeding to replanting every year (300 saplings), but confess a difficulty in replanting juniper, as saplings are difficult to grow and they lack the means (financial, knowledge) to properly manage the forests.
They are thus replanting "Tuia" which is modifying the original ecosystem.

CONCLUSION: Coping and adaptation mechanisms implemented by the communities

Observed climate changes	Experienced impacts on livelihood systems	Coping and adaptation	Potential future risks
Higher temperatures linked with decreased water availability	Drying up of springs; less flow in springs and streams	Buying waterpumps and pipes	Growing food and livelihood insecurity Scarcity of water for drinking and agriculture; increase in health problems; increased workload for women and children; children staying away from school
	Loss of land	Less land area under cultivation; buying food	Growing food insecurity
	Decreased quality of pastures, lack of fodder	Buying fodder	Dependence on cash income; food insecurity
	Increased pests	No coping strategy	Crop failure Reliance on cash income
	early vegetative period	Early sowing in some villages	Crop failure

11 RECOMMENDATIONS FOR ADAPTATION PROCESSES TO CLIMATE CHANGE

11.1 First priority

Governmental level

- Engage the local authorities in the design of the national adaptation plan:
  "Engaging all relevant stakeholders, including the most vulnerable communities and populations, in national and local level planning can help to ensure that investment is directed to the most vulnerable populations"[24]
- Increase information on climate change with proposing solutions
- Provide mechanisms to allocate funding for most immediate needs on adaptation to climate change (water supply, ecosystem management)
- Provide beneficial environment for developing local businesses
- Coordinate scientific data collection at the national level to feed a database of local impacts of climate change

Jamoat level

- Implement measures of water management:
  - Create water users association
  - Implement monitoring of springs and glaciers to feed data analysis at the national level,
- Support protection of forest, cover with long growth species development of new policy for preservation of juniper forests, promote the development of tree nurseries
- Regulate livestock
  - Pastures management plan coordination
  - Promote family planning
- Promote women's involvement in community matters

Mahalla committee level

- Engage in self-governance process
- Implementation of pasture management plans
  - Create pasture management committees
  - Coordinate the rotation
- Implementation of water management plans
  - Create plan of use of water resources (map, repartition…)
  - Create water reservoirs

Household level

- Modify agricultural practices in the household plot and the field: mulch, compost, agroforesty
- Adapt sowing periods
- Improve knowledge on pests
- Minimize dependency on livestock (bank accounts)
- Increase gardening practices as a safety net (vegetables and fruits)
- Plant trees in the household plot, fields around the villages and pastures
- implement energy efficient techniques and renewable energies for the household needs

24 CARE, Understanding Vulnerability to Climate Change, Insights from Application of CARE's Climate Vulnerability and Capacity Analysis (CVCA) Methodology

11.2 Second priorities

- explore the possibility to apply the land reform to empower farmers on using their land
- explore the possibility of GLOF[25] from lakes created by the melting of the glaciers

25 *César A. Portocarrero Rodríguez, The glacial lake handbook reducing risk from dangerous glacial lakes in the Cordillera Blanca*

12 CONCLUSION

Climate change adds uncertainties to a remittance-based economy by impacting the safety net that represents the agriculture sector (livestock and gardening). More than half of the households are considered vulnerable to climate change.

The income provided by the sale of livestock, and the food security of the household could be the most impacted. Furthermore, women, who take care of livestock and gardening, are the ones who have to take appropriate decisions to adapt to climate change, but lack the necessary information, means, and empowerment.

Climate change also contributes to modify the ecosystem (hydrology, vegetation) on which the population growth is already putting strong pressure.

The population has been adapting to climate change for their most immediate needs but should be supported with informational, organizational and financial means, to alleviate the impacts of the climate variability and changes. A special emphasis should be made on the hydrological changes that this watershed will experience and the need to prepare for, in a medium to long-term perspective, water scarcity.

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16 ANNEXES

16.1 Detailed data for ombrothermic graph

	mean T°C	precipitations (mm)
Jan	-5	16
Feb	-4	24
March	1	47
April	7	59
May	11	46
June	15	23
July	18	14
August	18	8
Sept	14	7
Oct	7	19
Nov	2	21
Dec	-3	21

16.2 Interview guidelines: Detailed questionnaires for each group

1.1.5 Focus group discussions with elderly people

- **TOOL: Community time line**

Put on a historic line that runs over the last 60 years the main events that the community was confronted to:
- climatic phenomena (very heavy snowfalls, droughts, floods),
- natural hazards and their effects (rockfalls, avalanches),
- major outmigration,
- changes in livelihood activities (e.g., new livelihood strategies),
- changes in land use (crops, forest cover, houses etc.) and in land tenure,
- pests,
- diseases,
- conflict,
- changes in administration and organization,
- major political events,
- show some old pictures of iskander kul to discuss about the changes.

Milestones:
- Year the road was built,
- Year electricity was installed and when it was cut off,
- Years when switch was made from wood to coal heating,
- Tree cover past/present.

Complementary questions over activities profile:

- What changes have occurred over the last 60 years in terms of activities and workload?
- Are there new activities now performed by men/by women? Which ones? Why?
- Has the community changed their livelihood strategies in the last 60 years?
- If yes, which new livelihood options have been adopted, which ones have been abandoned?

- What is the impact of these changed livelihood options on women's and men's workload?
- Are there any different or new activities you are carrying out now?
- Are there activities that used to be performed by men and are now performed by women, or vice versa?
- What caused these changes?

Complementary questions over use of resources :

- Has the seasonal availability and abundance of any resources you are dependent on changed? Which ones? In what way? How does this influence your activities and your wellbeing?

- Are there any new resources that have appeared and that you have started to use (e.g., plants, animals, materials for energy production, and so forth)? Which ones? For what purposes?

- Why did you start using these new resources?

Complementary questions about the perception of change:

- Have you experienced any major hazards over the past 10/20 years (e.g., floods, droughts, landslides, avalanches)?
  – If yes, what kind? When did they occur?
  – How did they affect you and your family?
  – Have these hazards become more frequent or more intense over the past years?
- Have you noticed any changes in the size of glaciers? If yes in what way?
  (only ask this question if there are glaciers in proximity to the study site)
- Have you noticed any difference in temperature over the past 50 years?
  – If yes, in which way did the temperature change?
  – What do you think is the reason for this change?
- In your perception, has the availability of water from rain, snowfall, and water in water bodies (lakes, streams, springs and so on) changed over the past 10/20 years?
  – How has it changed (e.g., less or more rainfall, snowfall, glaciers are melting, lower water levels in rivers, lakes)?
  – What do you think are the reasons for these changes?
  – Does this have any influence on your daily activities/your workload?

- What are the main difficulties women and men are facing in their daily lives at present (with regard to the changes identified above)?

1.1.6 Focus group discussions with women groups

- *seasonal calendar*

rainfall, snow, hailstorm, dry period, flood, landslide, avalanche, livestock disease or pests, crop disease or pests, food shortage, human disease…are put in a table with the different months and their intensity.

Once the seasonal calendar (usually the last 12 months) is established, then the facilitator asks the participants whether they have experienced any changes in the listed major climatic and environmental periods and hazards over the past 10 to 20 years (depending on the age of the participants).

- *Livelihood seasonal calendar*

The main tasks during the year are written on a calendar

Livelihood activity	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July
Home garden												

Orchards												
fields												
forestry												
Animal husbandry												
Tourism												
migration												

Agriculture:

home garden : potato, vegetables
Orchards: fruits, tree planting
Field: wheat, barley
Water channels maintenance

Forestry

Collecting wood
Medicinal herbs

Animal husbandry

Animals in the pastures near the village
Animals in the high pastures
Production of dairy products
Meat
Lambing/calving/kidding period

Tourism

Tourists visiting the area

Building houses

Time for construction

Migration

Migration time to Russia
Housekeeping
Jammaking
Cans making

Once completed, it is merged with the seasonal calendar to show if the current calendar of livelihoods is in contradiction with the calendar of season (lack of rain for such activity…) and how to adapt to it.

Complementary questions:

• Which decisions within the household related to the management of small livestock/big livestock are taken by women, which by men, and which by men and women together?

• Which decisions within the household related to the management of crops are taken by women, which by men, and which by men and women together?

• Do you have access to off-farm income and loans? How do you use the income and loans?

• Which decisions within the household related to the use of income and loans are taken by women, which by men, and which by women and men together?

Perception of changes

• In your perception, has the availability of water from rain, snowfall, and water in water bodies (lakes, streams, springs and so on) changed over the past 10/20 years?

– How has it changed (e.g., less or more rainfall, snowfall, glaciers are melting, lower water levels in rivers, lakes)?

– What do you think are the reasons for these changes?

– Does this have any influence on your daily activities/your workload?

• Have you noticed that some species (plants, animals) are appearing earlier or later in the season or in places where they did not appear before?

• Have any species (plants, animals) disappeared or become less/more abundant? If yes, which ones?

• Have you observed any new diseases affecting your livestock and crops over the past 10/20 years? Which ones? When did they occur for the first time? Do they occur every year? Why do you think they occur?

• Have you observed any new pests affecting your livestock and crops? Which ones? When did you notice them for the first time? Do they occur every year? Why do you think they are occurring?

• Have you observed any new health problems that have affected you and your family? Which ones? Are there any health problems which have diminished or disappeard? Which ones and why do you think they have diminished or disappeard?

• Are there any positive changes you can think of that make things easier (e.g., prolonged cropping season, warmer winters with lower energy consumption, warmer streams for washing, hygiene, modern technologies, remittances, health posts? and so forth)?

Capacity analysis: Coping and adaptation mechanisms

• What do you do when there is too little rain/water or there is an unusually long dry period?

– What do you do with your crops (e.g., do you change varieties, timing of sowing/planting or harvesting, irrigate the land)?

– What do you do with your animals?

– What do you do in your household/in the community? Who is dealing with this problem (you, your husband/wife, other family members, or the community as a whole)?

– Are these strategies still useful today? Or what, in your view, needs to be done? Who could help you?

• What exactly do you do when there is a landslide?

• Have you introduced any new crops or given up planting some crops?

– If yes, which ones and why?

• What do you do when your crops are affected by pests/diseases?

– Do you have any remedies for this? Are these remedies still useful?

– Who is dealing with this problem (you, your husband/wife, or the community as a whole)? Can you get any support from the community, from outside (e.g., extension services)? What kind of support would you need?

• What do you do when your livestock are sick?

– Ask same questions as with pests.

• What do you do when members of your family get sick?

– Do you have any traditional remedies?

– Can you go and see a doctor/ health worker?

– Who is taking care of those who are sick? Do you get assistance (also in monetary terms) from other members of the community or from outsiders?

• What do you do if there is a prolonged period of food shortage?

Needs assessment

- What would help you most to improve your life?

1.1.7 Question guide for the jamoat and institutions

Resilient Livelihoods

- Are scaled-down climate projections available?
- Do local institutions have access to information on current and future climate risks?
- Do local plans or policies support climate-resilient livelihoods?
- Do local government and NGO extension workers understand climate risks and promote adaptation strategies?

Disaster Risk Reduction

- What are the most important climate-related hazards the region and/or ecological zone faces? Non-climate related?
- How are hazards likely to change over time as a result of climate change?
- Do local institutions have access to disaster risk information?
- Are local disaster risk management plans being implemented?
- Are functional early warning systems in place at the local level?
- Which other institutions are engaged disaster risk management at local level?

Capacity Development

- Do local institutions have capacity to plan and implement adaptation activities?
- Are resources allocated for implementation of adaptation-related policies? What is the budget?
- What new capacities may be needed to address changing circumstances ?

Control over resources

Are there any traditional institutional arrangements within the community for the management of, and control over, productive resources? How do women and men participate in these traditional institutions? How are decisions taken within these institutions.

1.1.8 Question guide for the local forest agency

- for how long have you been working in the area?
- Have you seen a change in the climate over the last 20 years?
- Have you seen a change in the vegetation? in the quantity of trees? in the type of vegetation? In the quality of the vegetation?
- Did you see a shift in the grown species? (growing at higher elevations...?)
- What is the procedure for local inhabitants to come and collect wood?
- How well is it working?
- Do you think an increase of temperature had had an impact on the tree cover/ the vegetation?

1.1.9 Question guide for the district forest agency

- Have you seen a change in the vegetation? in the quantity of trees? in the type of vegetation? In the quality of the vegetation?
- What is the procedure for local inhabitants to come and collect wood?
- How well is it working?
- Do you think an increase of temperature had had an impact on the tree cover/ the vegetation?

- Are you proceeding to reforestation measures?
- Are you aware of climate change?
- Are you in touch with academics about the best way to reforest? Are you supported by some research agency about which species to plant?
- Would you be interested in learning more about climate change?
- Do you proceed to annual census of the fauna?
- Have you seen changes in the ecosystems over the last 20 years?

1.1.10 Question guide to shepherds

- for how long have you come to these pastures?
- How big is your flock?
- Did you change the size of your flock over the last 10 years?
- Have you noticed any environmental change in your pastures (water, vegetation, fauna)?
- Do you think you will need to modify your pasture system to adapt to water scarcity?
- How do you envision the future?
- Do you have new diseases on your flock?
- How do you treat your flock?

1.1.11 Question guide to summer pastures users

- for how long did you come to this area?
- Did you modify the numbers of animals coming to the summer pastures?
- Have you seen a change in the climate over the last 15 years?
- Have you seen a change in the pastures over the last 15 years (varieties of grasses, size of the forage, quantity)?
- Have you seen a change in the river level/ in the spring level?
- Have you seen an increase of diseases/ the apparition of new diseases?
- Have you modified your practices amonst pastures users (sharing the milk, ...)?

16.3 Calendar of focus groups and interviews

Narvad 30/07 : visit to rais of jamoat, elderly focus group, women's focus group
Makshevat 31/07: elderly focus group, women's focus group
Saratog 1/08: elderly focus group, 2/08 women's focus group
Tuda 4/08: elderly focus group,
Kanapo, 4/8
Nurobod 5/8 ladies group
Dijik 5/8 elderly and ladies group
Xaironbed, 6/08/2014 Ladies focus group
Rui Ob 6/8/14 mixed focus group
Shordam 7/08/14 ladies group and young men

16.4 Lists of participants

30.07.2014.Narvad

1 Махадёров Х
2 Набиев с
3 Камолов К
4 Бокиев Содик
5 Рахимов М
6 Ахмедов М
7 Машрапов А
8 Бехзод Х
9 Набиев К
10 Гафуров Э

30.07.2014 Narvad

1 Махадёрова Х
2 Ахмедова Х
3 Аминова Д
4 Махадёрова С
5 Норова Д
6 Бокиева Д
7 Азизова М

31.07.2014.Makshevat

1 Кодирова Максадой
2 Рахматова Эхтиром
3 Нуралиева Гулбарг
4 Файзуллоева
5 Гулназарова Отун
6 Файзуллоева Сайидо
7 Ниёзова хурсанд

31.07.2014.Махшевад Makshevat

1 Атобуллоев Иброхим
2 Шосаидов Косим
3 Нуралиев Саид
4 Файзуллоев Халим
5 Муродов Худойназар
6 Миров Фарход
7 Каримдодова Давлат
8 Бобочонов Бобочон
9 Саидшоев Амир

01.08.2014.Сараток Saratog

1 Давлатов Махмадали
2 Холов Абдулло
3 Давлатов Файзали
4 Вадудов Халим
5 Кучаков Уктам
6 Давлатов Махмуд
7 Охунова Мохира
8 Яхёев Мавлон
9 Давлатов Б

1/08/14 Saratog Summer pastures

Olova Muxarram
Kamolova Jamila
Kamolova Muazam
Saratog- shepherds' interviews
Abdushukur Peremkulov

02.08.2014.Сараток Saratog

1 Аббосова Малохат
2 Охунова Мохина
3 Рахимова Зеби
4 Боева Бунафша
5 Охунова Мохира
6 Холова Нарзиой

04.08.2014.Туда Tuda

1 Маликова Мехрубон
2 Ходиева Сулхия
3 Чалилова Ойбика
4 Хакимова Чамила

04.08.2014.Туда Tuda

1 Холов Карим
2 Чалилов Хасан
3 Сабуров Накиб
4 Рахмонов Маиз
5 Содиков Мухазар
6 Холов Абубакр
7 Рахмонов Идибой
8 Хакимов Абдурахим
9 Рахмонов Мичрон
10 Хакимов Хуршед

04.08.2014 канапо Kanapo

1 Мувадова Чонбиби
2 Саидшоева Гулхотун
3 Ниёзова Оим
4 Атобуллоева Мунира
5 Муминова Гулхироч
6 Шарифова Гулхироч
7 Муродова Мавчи
8 бокиева Шахло
9 Муродова Муниса
10 Бадалова Таборак

05.08.2014. Нуробод Nurobod

1 Бопирова Нидомат
2 Мирзоева Орзумо
3 Бозорова Махфират
4 Маликова Саврimo
5 Зиёева Хосиятхон
6 Камолова Сохирамох
7 Рачабов Сухроб
8 Чабборова Сайримох

05.08.2014. Дичик Dijik

1 Тамманнои Акбар
2 Сирочиддинова М
3 Исматова ф
4 Исматова Г

05.08.2014.Дичик Dijik

1 Аслиддинов Садриддин
2 Исматов А
3 Рахмонов Х
4 Абдуллоев М
5 Исматов И
6 Рахмонов У
7 Хасанов Э
8 Саидов Н

06.08.2014.Хайронбед Xaironbed

1 Заргунаи Чаббор
2 Саидова Оначон
3 Амондуллоева Мавзуна
4 Тошева Заррагул
5 Чабборова Ш
6 Рахмонова Б
7 Чунайдова З

06.08.2014.Руйи об Rui Ob

1 Шомирзоев Ислом
2 Шарипова Аюма
3 Дилшодаи Гоиб
4 Каримдодова Аюма
5 Мунисаи Шариф
6 Шодиева Парвина
7 Давлатов Шомирзо
8 Шомирзоев Мехвар
9 Давлатова И
10 Мирова Н
11 Шомирзоева Парвина

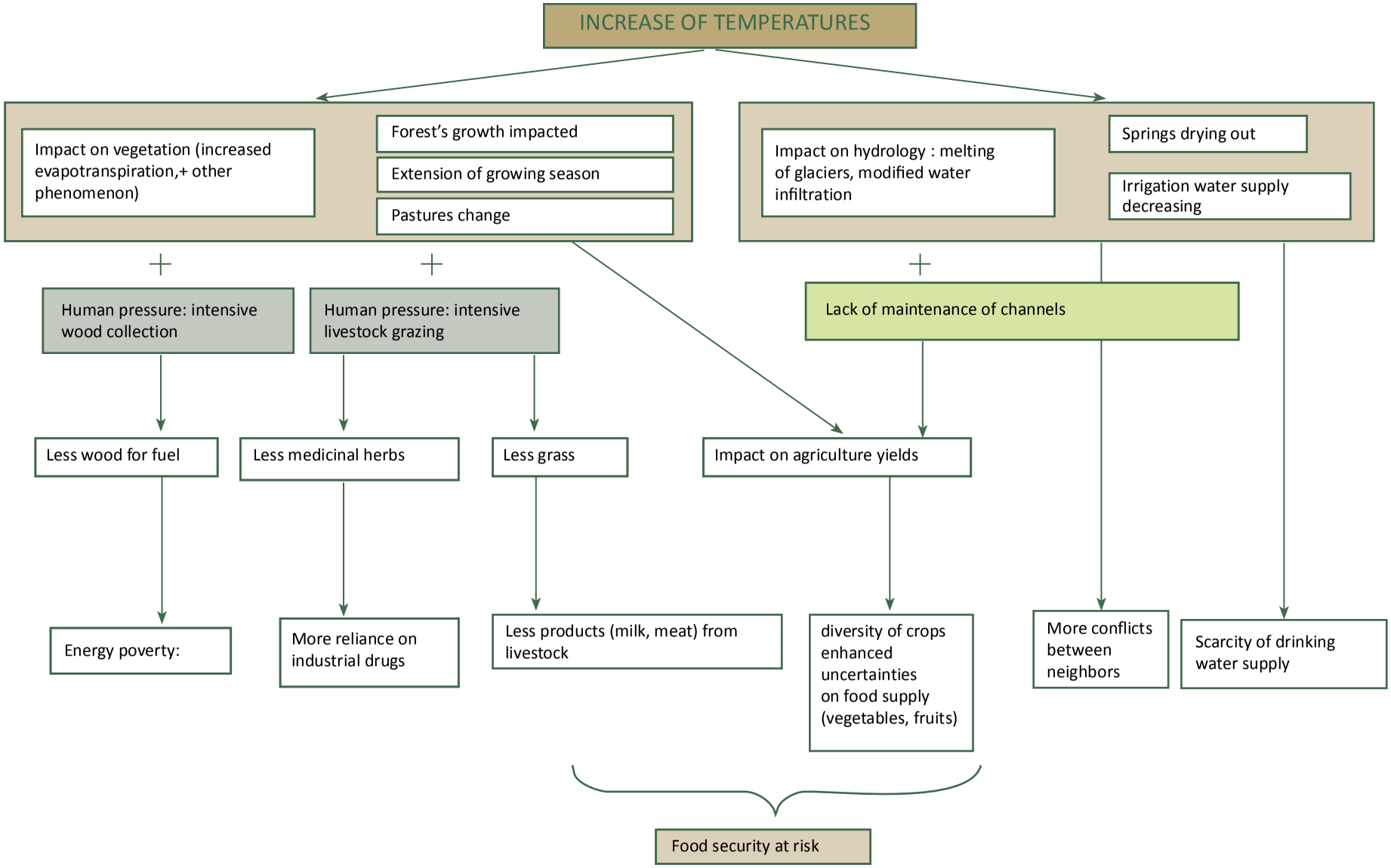
07.08.2014.Shordam

1 Боева М
2 Рачабова Д
3 Неъматуллоева М
4 Холова Соро
5 Хакимова Сарвиноз

07.08.2014.Shordam

1 Одинаев Мухиддин
2 Адхамов Адхам
3 Исматов Замир
4 Исматов Чамшед
5 Исматов Махмадали
6 Сирочиддинов Анушервон

16.5 Causal links between climate change and livelihood impacts put in light through cvra



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