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Climate Change Impact on Pastures and Livestock Systems in Kyrgyzstan

Summary report

IFAD
Enabling poor rural people to overcome poverty

fic
fundación para la investigación del clima

IEH
Instituto de Estudios del Hambre

SUMMARY REPORT

1. INTRODUCTION

The Kyrgyz government with the support of IFAD is currently designing a new livestock umbrella programme, aiming at helping the country to face not only today´s problems and constrains in the livestock sector but also future challenges.

IFAD acknowledges climate change as one of the factors negatively affecting rural livelihoods and as one of the challenges that needs to be addressed. Negative climate change impacts are more severely felt by poor people, especially smallholder farmers and herders, who rely heavily on the natural resource base for their livelihoods. This programme will focus on reducing vulnerability of poor rural households headed by women, which are among the most vulnerable and marginalized. One of the main issues to be addressed is to define adaptation strategies to future climate conditions.

Climate model simulations are essential elements of any adaptation strategy, as they allow better planning through the anticipation of future impacts. The impacts of the increased climate variability and frequency of extreme weather events on livestock and pasture systems is unknown in most regions of the world, making the recommendation of viable, practical adaptation paths even harder.

The Climate Research Foundation (Fundación para la Investigación del Clima, FIC) and the Institute for Hunger Studies (Instituto de Estudios del Hambre, IEH) have signed a letter of agreement with IFAD to detect and analyse the expected impacts of climate change in livestock and pasture systems in Kyrgyzstan, making preliminary recommendations on how to better adapt these systems to climate risks, while contributing to increase resilience among the project beneficiaries. The methodological process applied is based on the three stages necessary to address climate change adaptation:

i. Description of potential future climate conditions;
ii. Assessment of future climate impacts on pastures and livestock;
iii. Recommendations on how to reduce climate risks for Kyrgyzstan's livestock sector and increase the resilience of small-scale herders in Kyrgyzstan's rural and mountain communities.

2. DESCRIPTION OF FUTURE CLIMATE CONDITIONS

The description of future climate conditions is based on the generation of climate change scenarios. A scenario is an internally coherent, consistent and plausible description of a possible future state of a set of variables. In this case, the scenarios are generated based on future projections for temperature and precipitation.

The methodology used to produce future climate scenarios followed these phases: i) model selection[1]; ii) gathering historical observations from available monitoring stations; iii) adaptation and application of a statistical downscaling methodology (FICLIMA)[2]; iv) verification process[3]; v) validation process[4]; vi) generation of future scenarios.

[1] Six Climate Models –CM-, internationally recognized and used by the IPCC in its Fifth Assessment Report, were applied. The different ways that humanity may develop in the future regarding greenhouse gas concentration trajectories were represented by Representative Concentration Pathways, RCPs, also used in the forthcoming IPCC5.

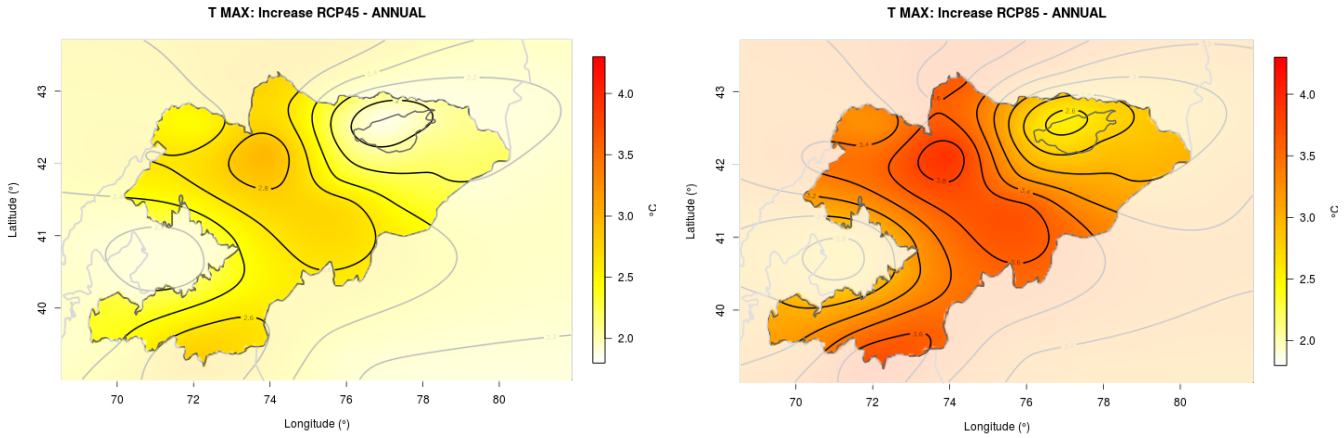
[2] Downscaling methodologies adapt the low resolution information to project local-scale surface effects (rainfall, temperature), used to generate local climate scenarios required to develop local adaptation strategies. The downscaling methodology named 'FICLIMA' (developed by FIC) was adapted to Kyrgyzstan climate conditions and then applied to produce local scenarios.

[3] Comparing the simulated series to the real recorded data series, in order to evaluate the methodology's potential to "translate" low-resolution atmospheric information into rainfall and temperature on a local scale.

[4] Aimed to assess whether the Climate Models reliably represent the current climate.

The expected changes for mid-century were defined for each monitoring station using up to four concentration pathways[5] and the average of the projections of the Climate Models that passed the validation process are presented.

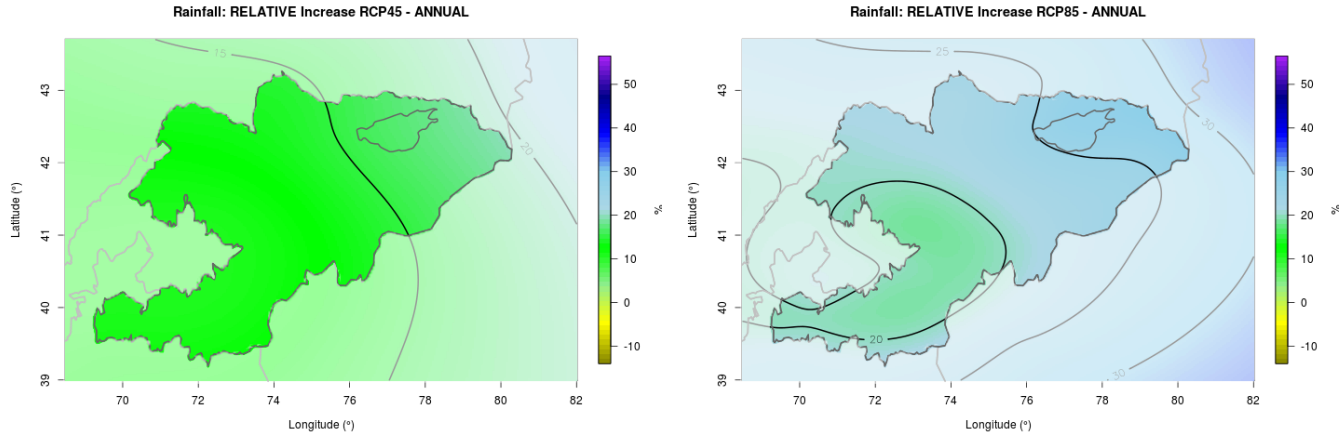
Results show that maximum temperatures are expected to suffer a clear increase all over the century. By mid century, under RCP45 increases would reach between 2ºC (in the east) and 2,8ºC (in the north). Under RCP85 temperature would rise between 2,6ºC (east) and 3,8ºC (north). Minimum temperature is also expected to increase, but less than maximum temperature (between 0,5º and 1ºC less).



Expected increases (ºC) in the mean annual maximum temperature (difference between average simulated for 2040-2070 and for the control run, 1970-2000) for RCP45 and RCP85. The map is obtained by simple interpolation of the values in the stations, and due to the small number of stations, interpolations should be managed with caution

Regarding seasonal changes, the results of the intermediate RCP45 show that increases could be between 2ºC (east) and 3ºC (north) in winter and autumn; between 2ºC (Fergana Valley) and 2,7ºC (west and north) in summer, and between 1,7ºC (east) and 2,6ºC (north) in spring.

Projections about precipitations should be viewed with caution due to poorer verification and validation results. By mid-century, the increase in accumulated rainfall could be between 12% (west) and 18% (northeast) under RCP45. For RCP85 the relative change could be between 20% (west) and 28% (north).



Expected changes (%) in the mean annual precipitation (difference between average simulated for 2030-2080 and for the control run, 1950-2000) for RCP45 and RCP85. The map is obtained by simple interpolation of the values in the stations, and due to the small number of stations, interpolations should be managed with caution

[5] RCP85, RCP45 and RCP26 (being RCP85 the highest trajectory of greenhouse gas concentration and RCP26 the lowest).

Seasonal results for RCP45 suggest that summer rainfall will not significantly change. For spring, scenarios show increases in precipitation from 8% (west) to 20% (north-east). In autumn, changes between 16% (central areas of the country) and 20% (east and west, a bit more at the Fergana Range) are foreseen. Winter increases will vary from 18% (west) to 26% (north-east).

3. ASSESSMENT OF FUTURE CLIMATE IMPACTS ON PASTURES AND LIVESTOCK

This assessment started by gathering information related to the main features of pastures and livestock in Kyrgyzstan, climate impact on these sectors, people's perception of climate change effects in Kyrgyzstan, and studies and researches of the impact of future climate on pastures and livestock in the region.

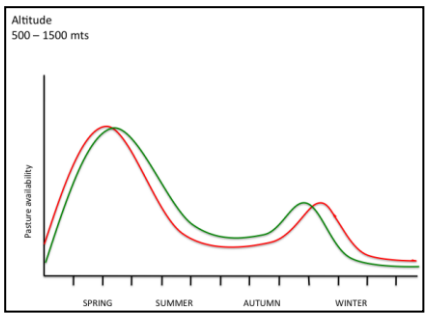
The following step was the identification of critical aspects of the climate that may eventually have a significant impact on the development and/or production, quantity or quality, of pastures and livestock.

The definition of critical elements and the future climate scenarios generated were the basis for analysing the potential future climate impacts on livestock and pasture systems.
For the analysis it was necessary to build a set of indexes based on climate information (rainfall and temperature) to measure how every critical climate element affects pastures and livestock systems.

Once verified, these indexes were applied to the generated scenarios, making it possible to determine the temporary evolution of indexes and their implications on livestock and pasture systems. This method of translating rainfall and temperature into information useful for the analysis of livestock and pastures systems is necessary in order to evaluate the impact of future climate on them and make recommendations for minimizing unwanted impacts. In order to give a clear picture of this impact, only results of RCP45 were shown, as the values obtained with this pathway are usually located between the two extreme values represented by RCP26 and RCP85. The results have been organized by altitude and climatic season. Recommendations were discussed with local experts and IFAD staff in order to assess their feasibility and suitability.

ALTITUDE: between 500-1500 masl.

--- Present pasture availability
--- Future pasture availability



Spring

- The duration of the **optimal growing period** for pastures will increase in about 10 days, and will last for about 3 months. This period will start 20 days earlier and will finish about 10 days earlier[6], with slight differences depending on the areas. Nevertheless, this increase does not necessarily imply a longer productive period because pastures will need more days to accumulate the required temperature for their development, as the first days of the growing season in the future will be slightly colder.

[6] It will start around 22 days earlier in most areas in the west of the country, and 15 days in the east. In the Fergana Valley, pastures will start growing by mid March while in the northern oblasts (Talas and Chui), they will emerge in the first two weeks of April. The end of this period will vary from 7 days in southern Bakten to 14 days in western Jalal Abad.

- **Accumulated precipitation**[7] is likely to increase between 8% and 15%[8], which is a lesser growth than the average of the country. However general data suggest that the number of rainy days would remain the same, so spring rainfalls at this altitude would be more intense. Areas **more susceptible to river flooding and water logging**, such as the north of Chuy Oblast and the Fergana Valley, might be more negatively affected by this increase in rainfall.
- No changes in **water balance** are foreseen as a result of increases in accumulated rainfall and temperatures (about 2.3ºC in maximum temperatures in most of the country). As a result, water availability for natural pastures and rain fed fodder crops would remain constant in the future.
- **Cold rainfall** will be less frequent due to the general increase in average temperatures and damages caused in first stages of emergence of pastures will be reduced.
- Milder springs will favour the development of legumes that will improve pastures quality and biodiversity.

Summer

- **Summer maximum temperatures** will rise by more than 2,5ºC, especially in August[9], while **rainfall regimes** will not significantly change, even will be reduced during the century.
- As a result, **water deficits and droughts** could be more frequent, having negative impact on pastures. Water deficits are likely to last until mid autumn. Droughts might reduce the number of harvests in rain fed perennial pastures and fodder crops affecting annual yields of legumes as lucerne and sainfoin, which are basic for livestock feeding in medium and lower altitudes. In arable lands, the water need of fodder crops will be higher and more efficient systems would need to be implemented.
- Livestock will suffer more frequent **heat stress** due to the increase in maximum temperatures (above 26ºC). At low altitudes (for example, Fergana Valley), episodes of heat stress will last almost the whole summer. At mid altitudes (for example, Chuy) the period of heat stress will increase from 1 to 2 months. Livestock that remains during summer in winter pastures at these altitudes will be heavily affected (for example milking cows). At higher altitudes (Talas) sheared sheep will suffer less cold stress days.

Autumn

- The **duration of the recovery period**, time between the first rainfalls after the summer and the beginning of the cold period[10], will increase from 42 to 52 days as a result of the delay in the beginning of winter[11]. This period is key for pastures to recover from harsh summer climate conditions. Rain fed pastures will benefit from the increase of the recovery period, and, although the accumulated rainfall required for their development will still take place late in autumn and increasing summer water deficits will require more rainfall to allow pastures recovery, perennial pastures and rain fed fodder crops (sainfoin, dactylis and lucerne) might have enough time to yield before the arrival of the cold period. On the other hand, irrigated fodder crops, with an adequate use of technology, will benefit more from this longer recovery period and might increase the number of harvests. **First snows will probably fall later (**approximately 5 days) so livestock will have more time for grazing.
- **Temperature** will rise by around 2,5ºC and **rainfall** is likely to increase about 20%[12]. Although it seems a great increase, it does not represent much because accumulated precipitation in autumn is relatively low (approximately 100mm).
- The **water balance** will not probably change; water deficits are likely to be more frequent at the beginning of autumn as it will take longer for pastures to reach a sufficient level of humidity after the harsh summer conditions.

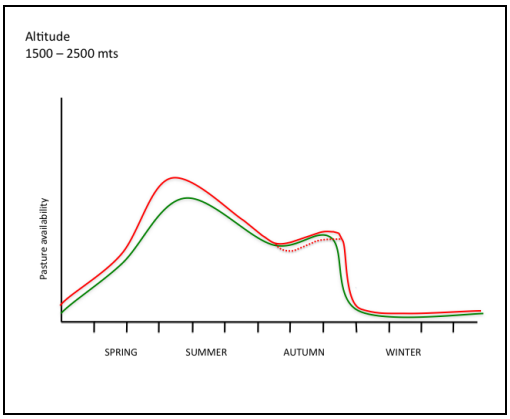
[7] All the conclusions regarding precipitation need to be handled with caution, because the precipitation simulations have much more uncertainties than the temperature ones, due to much poorer verification and validation results
[8] From 8-12% in the Fergana Valley to 13-15% in Western Chui and Talas Oblasts
[9] In locations such as Bishkek, temperatures will increase more than 2,8ºC whereas the Fergana Valley will suffer lower increases (about 1,9ºC).
[10] The recovery period determines the availability of pastures for grazing and the strength of perennial pastures for next spring.
[11] According to the future climate scenarios the first rains in autumn would not come earlier, therefore, the increase of the recovery period is due to the delay in the beginning of winter.
[12] It will increase more than 22% in the Fergana Valley whereas it seems that the increases will hardly reach 15% in Naryn

Winter

- **Cold periods** will be almost one month shorter (especially in the Fergana Valley and to a less degree in northern Chuy), as the growing season will start 20 days earlier and the autumn will end 10 days later. They will also be milder, because minimum temperatures will increase by 1,3º (north of Talas) to 2ºC (especially around the Fergana Valley), and maximum temperatures will rise around 1,5ºC. As a consequence, livestock will suffer around 10 less cold stress days.
- Available data suggest that **water balance** will not change, although the accumulated rainfall will probably increase around 20%[13] over absolute figures of 100mm.
- These better conditions will make pastures available for grazing during longer periods. However, it will negatively influence fodder crops as lucerne that will face shorter latent periods in winter.

ALTITUDE: 1500 – 2500 masl.

----- Present pasture availability
----- Future pasture availability
- - -Future pasture availability (water deficit areas)



Spring

- The average **duration of the optimal growing period** of pasture will increase in at least 7 days: it will start more than 10 days earlier (from mid May to beginning of May) and will end around 3 days in advance. However, the required time for its vegetative development will be slightly longer; it will need 4-5 more days to reach the Growing Degree Days[14] (average 700ºC) because the temperature during these first ten days will be lower than current temperature during this growing phase.
- **Accumulated rainfall** is expected to increase from 12% (Fergana Valley) to 17-18% (Naryn, eastern Chuy and south of Talas) and 20% (Issyk-Kul). The number of rainy days is likely to remain unchanged, therefore, the intensity of rainfall will probably be higher, and the **risks of floods and mudslides** might also be higher (depending on the slope and characteristics of soils). As a result, roads and tracks might be deteriorated hindering the access of livestock to spring pastures.
- **Temperatures** will increase between 2,3ºC (countrywide) and 1,7ºC (Issyk-Kul). However, the **water balance**[15] will probably be positive due to the increase in rainfall, and therefore, more water would be available for the pastures. **Cold rains** in spring will also be less frequent.

Summer

- It is foreseen a greater increase in **maximum temperature**, from 2,5ºC (countrywide) to nearly 3ºC, mainly in August. Nevertheless, **absolute maximum temperatures** will hardly reach 30ºC and therefore pastures will not be much affected by the heat.
- No changes in **rainfall regimes** are forecasted. Scarce available data show that the **water balance** could change from current surplus to future deficit (for example in Talas), reducing the availability of water until the beginning of autumn, so **droughts** could be more frequent and

[13] Accumulated rainfall will increase from 15% in Bakten to more than 20% at north and eastern Chuy
[14] Growing Degree Days = number of accumulated degrees necessary to reach the optimum development of the plant
[15] Water balance: balance between precipitation and evapotranspiration

intense at certain areas, reducing the availability of grazing areas and putting more pressure on pastures at these altitudes[16].

- Areas near the Fergana Range, eastern Issyk-Kul, Talas and Chuy might be affected by more episodes of **flash floods and mudslides** due to an increase in the amount of snow melting during summer.
- There will be slight increases in **heat stress** situations affecting livestock, whereas fewer cold days will cause less stress to sheared sheep.

Autumn

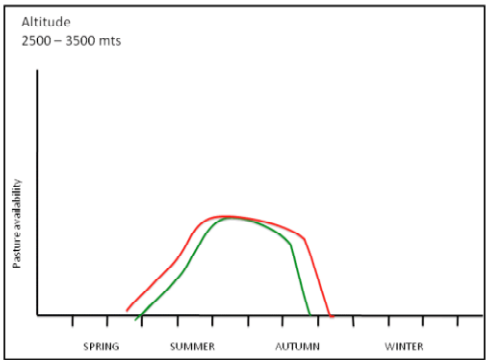
- The **beginning of winter** will be delayed in about 10 days (following the same pattern than in spring). Sufficient level of accumulated rainfall for pastures to start their recovery will be reached at the beginning of November with no important changes in relation to the present situation. **First snows** will fall approximately 7-13 days later, increasing the time for grazing at this altitude.
- **Temperatures** will increase between 2ºC (around Issyk-Kul and the Fergana Valley), 2,4ºC (most areas in the rest of the country) or even 3,2ºC (south-western Chuy), and **accumulated rainfall** will also rise from about 12% to 19%[17]. Areas with lower increases in rainfall in autumn will be more likely affected by deficits in the water balance (for example in Naryn).

Winter

- The **duration of winter** will be about 20 days shorter[18], because autumn will last 10 days more and spring will start 10 days earlier. This reduction of the cold period means that livestock could benefit earlier from spring pastures and could remain more time in autumn pastures, but at the same time it will represent more intense exploitation of these areas, as medium altitude pastures are currently more intensively grazed during spring and autumn.
- **Accumulated rainfall or snow** (depending on the altitude) will probably increase in 20% (or even more at certain areas at the east of the country) over low or medium absolute values (average of 69mm). This fact together with higher temperatures in spring and summer will result in a slight increase in hazards associated to melting snow, as was stated before.
- In relation to **cold stress** for livestock, there will be a significant reduction in the number of days below -7ºC.
- **Milder temperatures** (average increase in minimum temperatures of 0,4º in Naryn, 1,1º in eastern Issyk-Kul and 1,6º in western Issyk-Kul, and from 2ºC to 3ºC in maximum temperatures) and shorter winters will make these areas more accessible to livestock in winter, so they might remain longer periods of time or even for the whole year at these altitudes.

ALTITUDE: above 2500 masl.

--- Present pasture availability
--- Future pasture availability



[16] Data to forecast water balances are only available at a limited number of locations, and more research on water cycles in Kyrgyzstan should be made in order to reach a more detailed conclusion about this variable at country level.
[17] 12% to 15% (over 40mm) in Naryn, 17% in Northwest Kyrgyzstan and 17-19% in Eastern Issyk-Kul (in both cases over more than 100mm)
[18] A sharp decrease will take place around the Fergana Valley and lake Issyk-Kul, and a slight decrease in Naryn.

Spring

- **Relative values of rainfall** (mainly snow) are likely to increase above 15% in western Kyrgyzstan and above 20% in the east of the country. However this increase will be small in absolute figures (approximately 10-20 mm for the whole spring), with some exceptions, such as the Fergana Range, where the increase will be of more than 50 mm, reaching more than 400 mm of rainfall in spring. A thicker snow cover (due to rise in precipitation in autumn and winter) will better protect soils for pastures from degradation by strong winds or heavy rains.
- There will be significant increases in **temperatures** (around 1,3º around Issyk-Kul and Inner Tien-Shan, and 2º or more in the rest of the country). Nevertheless, this will not probably affect soils because the snow cover will protect them from high evapotranspiration and there will be more water available for summer pastures, as the snow will remain on the soil until melting.

Summer

- The beginning of the **vegetative period** of pastures currently starts in June or July, depending on the altitude, and in the future will occur approximately 13 days earlier[19].
- The summer grazing season will last longer as the beginning of the cold season will be delayed. Summer pastures will be more accessible to livestock, increasing the risk of overgrazing and deterioration of this especially sensitive environment.
- The increase of 2,4ºC in **average maximum temperatures** (over absolute low values) represents better growing conditions for pastures. This increase in temperature is not likely to cause serious droughts, given that absolute temperatures will still be relatively low, no changes in precipitation (currently more than 170mm) are foreseen and soils remain protected from evapotranspiration by snow most part of the year. Nevertheless, more detailed information about water balance is needed in order to assess the future likelihood of water deficits.
- As a result of the combination of thicker snow covers and higher temperatures during the melting period, certain hazards such as **floods** (at lower altitudes)**, mudslides or lake-flashes** will be more likely to affect vulnerable areas, especially those near the eastern shore of Lake Issyk-Kul, south and western Chuy, Talas, central Batken and the Fergana Range.

Autumn

- As a result of the temperature increase, the **beginning of the cold period** will be delayed in about 15 days, and therefore, the summer grazing period might be extended during these 15 days. The cold period will start by mid October and great part of autumn rainfalls will likely be in the form of snow. The pastures available in autumn will be the remains of summer pastures.

Winter

- "**Cold periods**" are currently longer than the winter season as they last 7-8 months at lower altitudes and up to 10 months at higher locations such as Tien Shan. In any case, foreseen increases in temperatures will shorten this period in about 3-4 weeks (or even more at south-eastern Issyk-Kul, near Tien Shan), so there will be longer summer grazing seasons.
- Snow cover will depend mainly on the snow fallen during autumn, winter and spring. **Accumulated rainfall (snow) during autumn and winter** will probably increase by 16% (19% in Eastern Issyk-Kul and South Chui), over important figures of about 150mm, or even more (380mm) at high altitudes in the Fergana Range.

VULNERABILITY AND HAZARDS

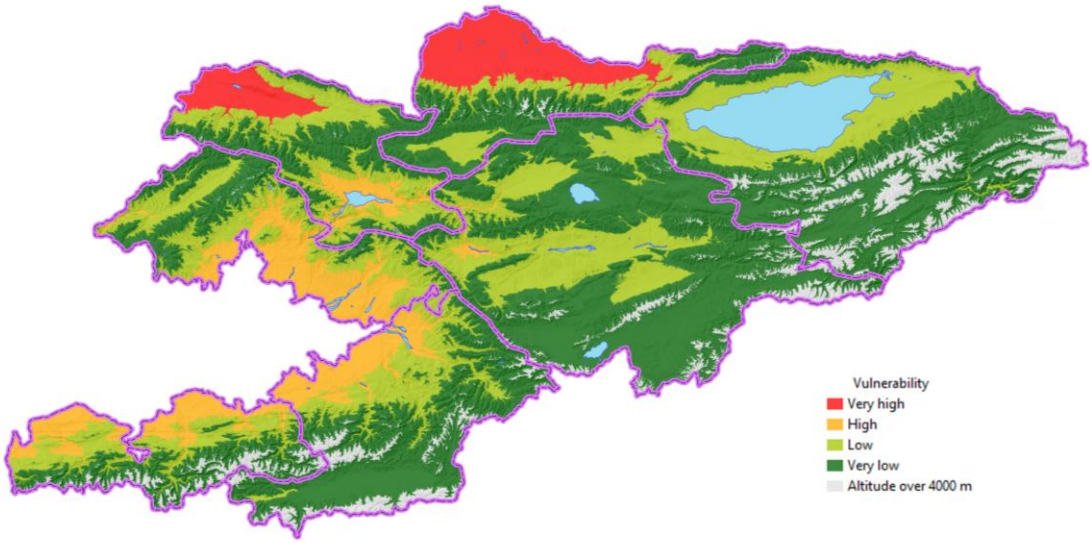
At the first level of altitude (below 1500masl) the main factor regarding vulnerability will be heat stress in summer. North of Chuy Oblast and east of Talas Oblast are considered areas of very high vulnerability, as average maximum temperatures will increase by 2,5º-3ºC, reaching more than 30ºC (pastures and livestock will face harsher conditions). The Fergana Valley is classified as a high vulnerability area, because average maximum temperatures (also reaching more than 30ºC) will increase less, from 1,5º to 2ºC. Main hazards at this level are also related to heat stress in summer.

[19] For example, this period will shift from the beginning of August to mid-July in Tien-Shan (3639masl) and from the end of June to mid June in Dolon Pass (3040masl).

Areas at middle altitude (1500-2500masl) are considered of low vulnerability because increases in maximum temperatures in summer will not reach 30ºC, so the vegetative activity will not be negatively affected, and in general livestock will not suffer heat stress. Milder winters will benefit pastures and livestock. Rainfall could increase in spring, autumn and winter, and remain stable in summer. With these changes, pastures and livestock will have better conditions, despite the increasing likelihood of water deficits in summer at certain locations (more detailed water balance studies are required). The most important hazards are river floods, mudslides and water logging in spring, and snow melting in summer.

Areas at high altitude (above 2500masl) are regarded as of very low vulnerability, because general increases in temperatures will benefit pastures and livestock, especially in summer and the likelihood of relevant droughts will probably be low even in summer. Flush floods and snow melting in summer are the main hazards at this altitude.

Levels of vulnerability to climate change



The future hazards related to climate change will be:

- River floods and water logging in spring. This hazard will affect mainly at lower altitudes. Rainfall will be more intense, affecting areas more susceptible to flooding, such as the north of Chuy Oblast and the Fergana Valley. Infrastructures would be more frequently affected, pastures less accessible and livestock could suffer more stress.

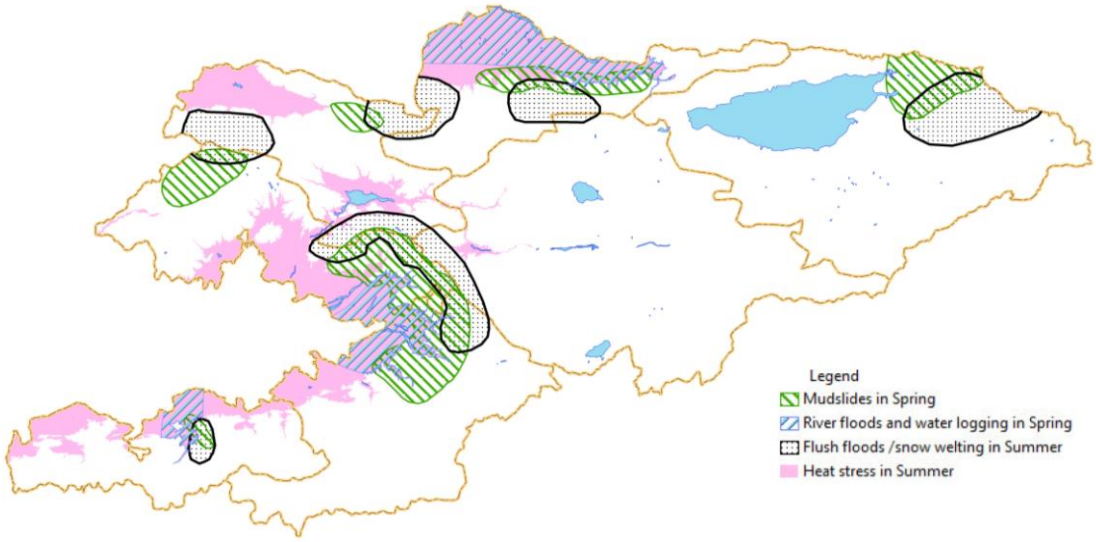
- Heat stress in summer. Livestock (and people) in north of Chuy Oblast, western Talas and the Fergana Valley will suffer more heat stress in summer, as maximum temperatures will be more frequently over 30ºC. More probable droughts will reduce the availability of water needed to face heat stress.

- Mudslides. At medium altitudes (and in a lesser degree also high altitudes) rainfall will also be more intense in spring, increasing the risk of mudslides that could affect the access of livestock to spring pastures. Areas more vulnerable are the Fergana Range, eastern Issyk-Kul, central Batken, eastern and western Talas, western Jalal-Abad and south and western Chuy.

- Flush floods and snow melting in summer are due to the increase in temperatures together with the increase in winter, spring and autumn rainfall (snow at higher altitudes). Livelihoods will be more affected by these hazards, because there will be less access to pastures, damages

in infrastructures and so forth. Higher altitudes (and in some degree also medium) are more susceptible to this hazard, in the Fergana Range, western and eastern Talas, south and western Chuy, central Batken and eastern Issyk-Kul.

Main changes in hazards due to climate change



4. RECCOMENDATIONS

Addressing variability and more frequent extreme events

- Setting up an Early Warning System (EWS) to provide timely information about hazards and weather effects on livestock and pastures. The EWS should be based on powerful weather forecasts for at least the next ten days, and should ensure that all the information reaches end users on time, and that it is usable and useful for them.
- Development of preventive actions to face more frequent climatic hazards (infrastructures, shelters for livestock, drainage, wind protection, silvo-pastoral protection of soils, etc.)

Addressing heat stress and droughts in low and middle altitude pastures

- Improvement of livestock water supply systems and water points in the most vulnerable areas
- Improvement of thermal insulation in stabling facilities for livestock using local experience and inputs (shadow trees, straw, ventilation, etc.)
- Promotion of silvo-pastoral systems for improving humidity of soils and shadow for livestock in summer
- Improvement of vegetation cover / pasture productivity with native species / varieties tolerant to climate constraints (drought, heat stress, shorter latent periods, intense rains...)
- Support of fodder production in irrigated lands and haymaking in rain fed areas through seed production, storage systems, market promotion, irrigation improvement...

Promoting access to and protection of spring, summer and autumn pastures

- Improvement and maintenance of infrastructures (roads, bridges, water points, shelters...) and access to services (energy, drinking water, etc.) to facilitate usage of spring/autumn and summer pastures and benefit from longer grazing seasons.

- Promote river basin approaches and practices for the protection, conservation and management of land and water resources (water springs, soil protection in the upper areas of watersheds, restoration of pastures, etc.).

Capacity enhancement and research[20]

- Research:
  - Climate change impacts on pastures eco-systems and productivity (hydrology, soil conditions...) at local scale.
  - Practices that enhance adaptive capacities of pastoral communities.
  - Selection of varieties tolerant to climate constraints.
  - Creation of a grant system for researchers on CC adaptation.
- Capacity Enhancement:
  - Raising awareness and training for integrating climate change into livestock and pastures management and policy making.
  - Training of trainers (extensionists, service providers) and pasture communities on climate change adaptation and resilience practices.
  - Training of researchers (Livestock and Pasture Research Institute, universities…) on climate change adaptation. Promote the academic exchange of researchers with foreign universities and research centres.

[20] The following subjects of research and capacity enhancement are just illustrative examples.