

Food security in mountains of Central Asia: down to upstream challenges

Life in Kyrgyzstan Conference
11-12th of September 2023

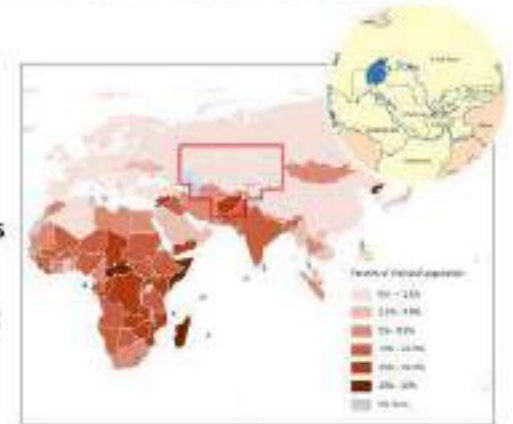
Dr. Arnaud Calserman

Senior Research Fellow and Assistant Director of Mountain Societies Research Institute (MSRI)



Food security at the center of our research

- Significant inequalities between Central Asian countries
- Mountainous regions
- CA has the environmental capacities to improve its food security: water
- No unique answer to food insecurity
- Holistic approach is required
- Threats are multiple: new and continuous challenges



Various stressors impacts on food security



Food security and Water security

Downstream: irrigation efficiency



- Irrigation efficiency: only 30%
- Despite significant water resources
- Around 70% of the water is lost: leakage, poor maintenance of canals
- A water infrastructure and management issue

Food security and Water security

Downstream: irrigation efficiency



- Water diversion on small streams
- A water infrastructure and management issue



(Un)sustainable agricultural practices

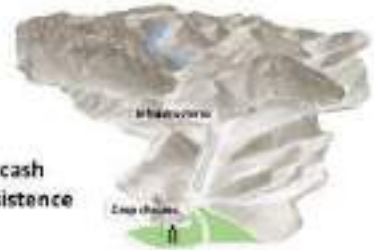
Downstream: crop choices

- Wheat, maize, rice fruits/vegetables and cotton in *lowlands*: **cash**
- Potatoes, wheat, alfalfa (some vegetables) in *highlands*: **subsistence**



- **Cotton**: up to 7000 m³/t in Turkmenistan, 3000 in Kyrgyzstan, Kazakhstan and Tajikistan
- **Wheat**: from 2000-4000 m³ currently in Tajikistan and Uzbekistan, to 770 m³ in Kazakhstan and Kyrgyzstan

(Moshiri et al. 2008)



(Un)sustainable agricultural practices

Downstream: crop choices

- Wheat, maize, rice fruits/vegetables and cotton in *lowlands*: **cash**
- Potatoes, wheat, alfalfa (some vegetables) in *highlands*: **subsistence**
 - *Between sustainability and vulnerability*



(Un)sustainable agricultural practices

Downstream: crop choices

- Wheat variety trials and crop choices recommendations



- Lack of space and low yields
- Need for more productive/disease-resistant varieties
- Trials in South Central Asia: wheat from Tajikistan, China and Pakistan
- Local varieties: more grains, spikes, spikelet and tillers
- Longer straw: as cattle fodder

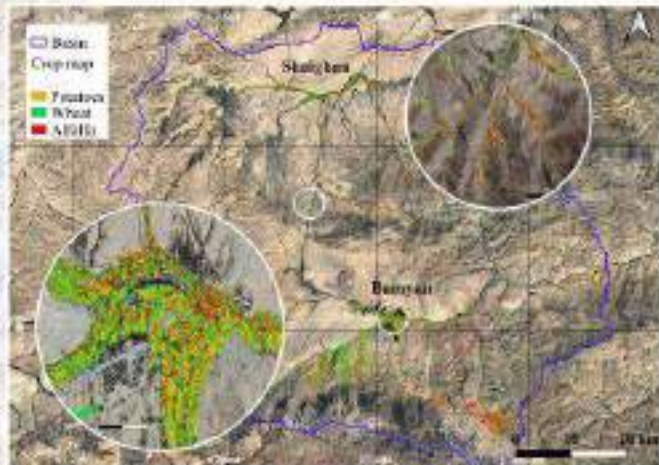
- However, Chinese and Pakistan varieties spike and grains are heavier
- Earlier maturation, particularly valuable at a time of climate change (harvest before September)

- Crossbreed of local and foreign varieties recommended



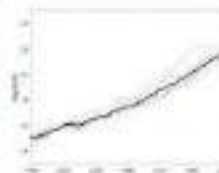
(Un)sustainable agricultural practices Downstream: crop choices

- Wheat variety trials and crop choices recommendations

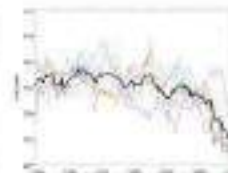


- Traditional choices of northern Afghanistan (Bamyan): potatoes, wheat and alfalfa
- Crop choices might evolve in the future:
 - Groundnut, maize, beans, cowpea, sorghum, millet, eggplants...

(a) CORDEX-CORE RCP6.0 Mean Annual Temperature



(b) CORDEX-CORE RCP6.0 Total Annual Precipitation



Vulnerability Assessment Report, 2023

(Un)sustainable agricultural practices Food security to its limits



- Few green houses, a partial solution to food production in mountains
- Winter vegetables at 3600 m above sea level
- Hot spring

(Un)sustainable agricultural practices

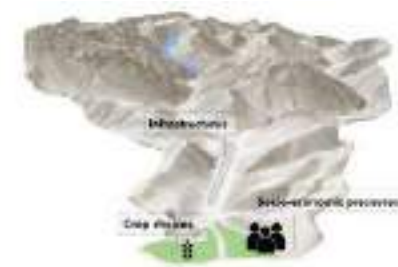
Food security to its limits



- Forage production at 4200 m a.s.l
- Very low precipitation (50 mm/year)
- Very arid conditions
- No other crops

Food security and migration

Downstream: households' poverty



- Monetary poverty (less than 2.15 USD/day)
- Remittance dependency
- Lack of labor
- Impact on the **production**

> From limited food accessibility to reduced production

Food production threat on food security

Upstream: rangelands degradation

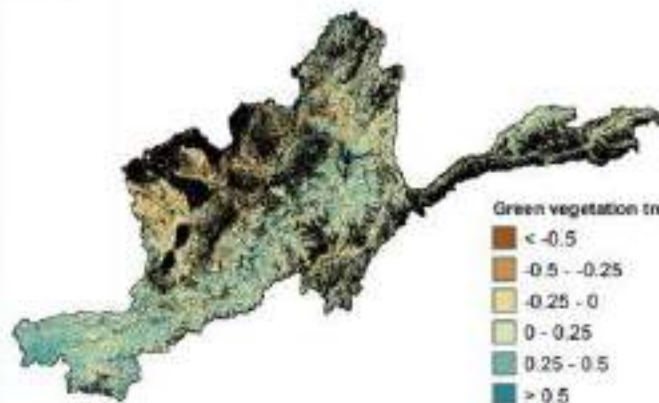
- Food security in Central Asia largely depends on livestock
- Rangelands = 65% of CA surface
- Cost of the degradation 4.6 MS/year (Mirzabaev et al., 2015)



Food production threat on food security

Upstream: rangelands degradation

- Food security in Central Asia largely depends on livestock
- Multiple studies on rangelands degradation/regeneration



Vulnerability Assessment Report, 2021

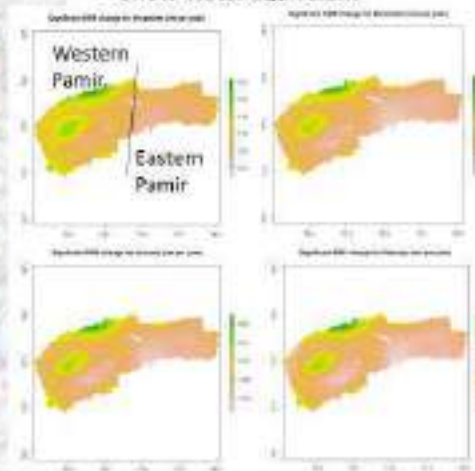


- For example, rangelands in Amu Darya basin in Afghanistan experience a degradation on 15.5% of its surface since 2000
- Declining precipitations (liquid/solid)
- High livestock density
- Recovery when rest is given to the lands
- Possible improvement with management

Food security vs Climate change

Upstream: cryosphere changes

• Snow Water Equivalent



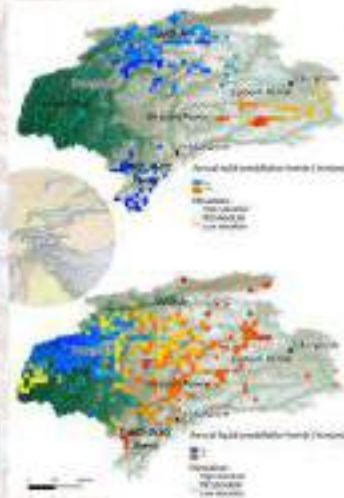
- Snow appear to become **drier** in the **Eastern Pamir**, while in the **Western Pamir** it is becoming **moister**
- **Drier?**
 - Earlier melt, moving the peak season of runoff to earlier spring
 - Currently, it is feasible to **harvest crops twice during the growing season** as there is **snowmelt contributions to streams flow from spring into summer**
 - Earlier snowmelt requires **longer irrigation-period**
 - **Moister?**
 - Due to **higher solid precipitation**.
 - **Positive and negative** impacts
 - **More water** for agriculture and hydropower
 - **Concentrated melt: flood risk**
 - **Avalanches** (heavy/wet snow)



Food security vs Climate change

Upstream: cryosphere changes

• Total precipitation trends



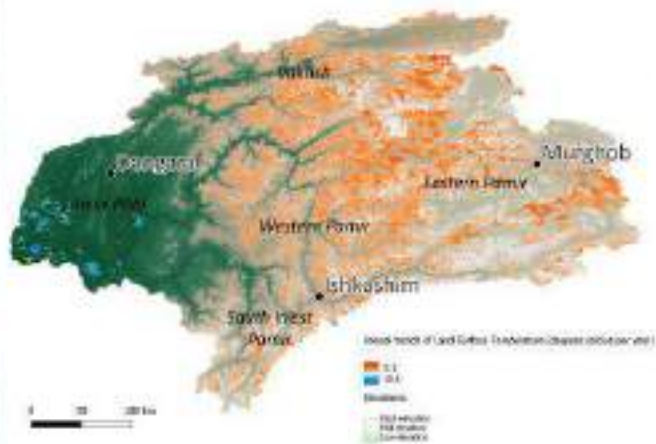
- Complex patterns: no uniform precipitation decrease
- An increase of snowfall in March (+2.55 mm/y) in high elevation
- However, decreasing total precipitation annually in Eastern Pamir
- And increases in Vakhsh and Dangara, but not at the station
- Long term monitoring (observations)



Food security vs Climate change

Upstream: cryosphere changes

Temperature trends

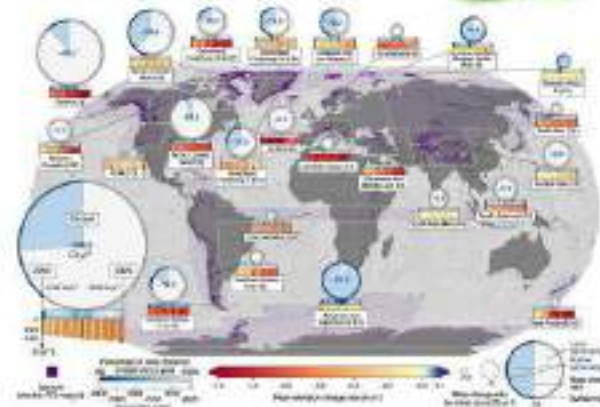


- Long-term water supplies vulnerability
- Overall, increasing Growth Length Season by 10 days due to increasing temperature and heat waves (evapotranspiration and water needs) (Liu et al., 2020)

Food security vs Climate change

Upstream: cryosphere changes

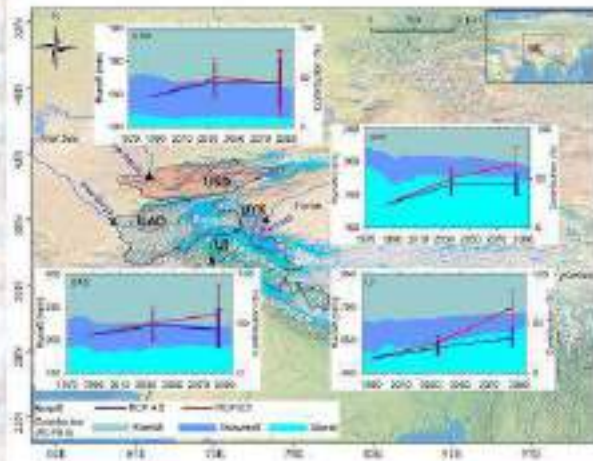
- Glaciers dynamics
- Healthy in Pamir
- Declining (volume) in Tien Shan



Food security vs Climate change

Upstream: cryosphere changes

Runoff dynamics



Mean annual runoff:

- Early 21st: increasing
- Mid 21st: stabilizes
- Late 21st: increase in Amu Darya, decrease in Syr Darya with water shortages
- In both basins: peak of the runoff one month earlier (fast snow melt in spring and less rain in summer)
- Longer irrigation period
- But more water in some cases (storage)

Reasons:

- Increasing role of rainfall (pluvial regime)
- Continuous melting of ice

Croplands and cattle at risk

Avalanche, landslide, debris flow

- Systematic and severe consequences on food security
- *Roads blockage, livestock and harvest destructions*



Croplands and cattle at risk Avalanche, landslide, debris flow

- More specifically on snow avalanches



- **Thousands of cubic meters** in only few seconds
- **Wet snow**: very destructive
- **6% of the road network** in north Afghanistan is blocked every year, every kilometer by two avalanches (Calserman et al., 2022)
- **8%** in south Tajikistan (MSRI, 2023)
- **Food-Energy-Medicines** supplies
- 1972-present: **1900 livestock killed** in 24 events (recorded only) (Acharya et al., 2023)
- *Very dynamic spatial and temporal pattern: forecast and EWS are possible*



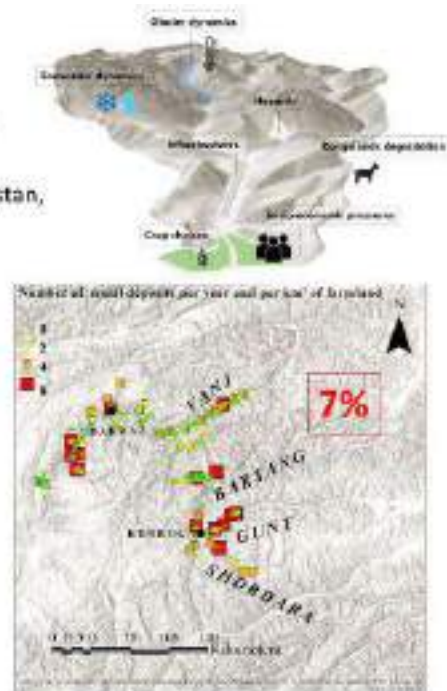
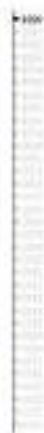
Croplands and cattle at risk Avalanche, landslide, debris flow

- More specifically on snow avalanches



Croplands and cattle at risk Avalanche, landslide, debris flow

- Snow Avalanches Frequency Estimation (SAFE): Afghanistan, Tajikistan, Tien Shan and Himalayas



Down to upstream: interlinked challenges



No one-size-fits-all strategy



"We have lands, potatoes, wheat and animals, we just don't have job"

- Accessibility and productivity:
 - Access to decent food is limited by a **poor power of purchasing** (monetary poverty, unemployment, low salaries...)
 - **Landlocked societies** very vulnerable with limited productivity (climate, available lands, hazards): an inherent issue to food security in Central Asia
 - Production can be improved: infrastructures (irrigation and roads) and crop choices
- Long term strategy:
 - Climate change is not the issue, it is a **consequence of a global scale challenge** (climate inertia)
 - **Shift from snow to rain**: the biggest challenge
 - Possible adaptations: crop calendars and irrigation efficiency

Recommendations (in a possible world):

- Improve the irrigation network
- Diversify the crop choices
- Choose alternative solutions such as greenhouses using hot spring water
- Securing lands and roads

Next steps for (interdisciplinary) research

- Diet, nutrition and self-sufficiency at household level
- Where (when) the water will come from: at granular scale
- Crops and cereals varieties trials in reasonable locations
- Development of food processing industry



Thank you