

Conflict and Agricultural Resilience in Afghanistan's River Basins: A Remote Sensing Assessment of Irrigated Cropland Dynamics

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Main takeaway Conflict is associated with diverse cropland-change patterns, including expansion, localized decline, and simultaneous gains and losses across Afghanistan’s river basins and sub-basins.

1. Background

- Armed conflict can reduce cultivation through displacement, labor loss, infrastructure damage, market disruption, and changes in the political economy of cultivation.
- Crop cultivation can persist or intensify where land, water, and high-value crops are strategically and economically important.
- Afghanistan provides a river-basin-scale case for examining conflict intensity and irrigated cropland dynamics.

2. Objective / research question

- Examine changes in cropland and irrigated cropland during prolonged conflict.
- Assess the association between conflict intensity (measured by fatalities) and cropland change at basin and sub-basin levels.

3. Study area

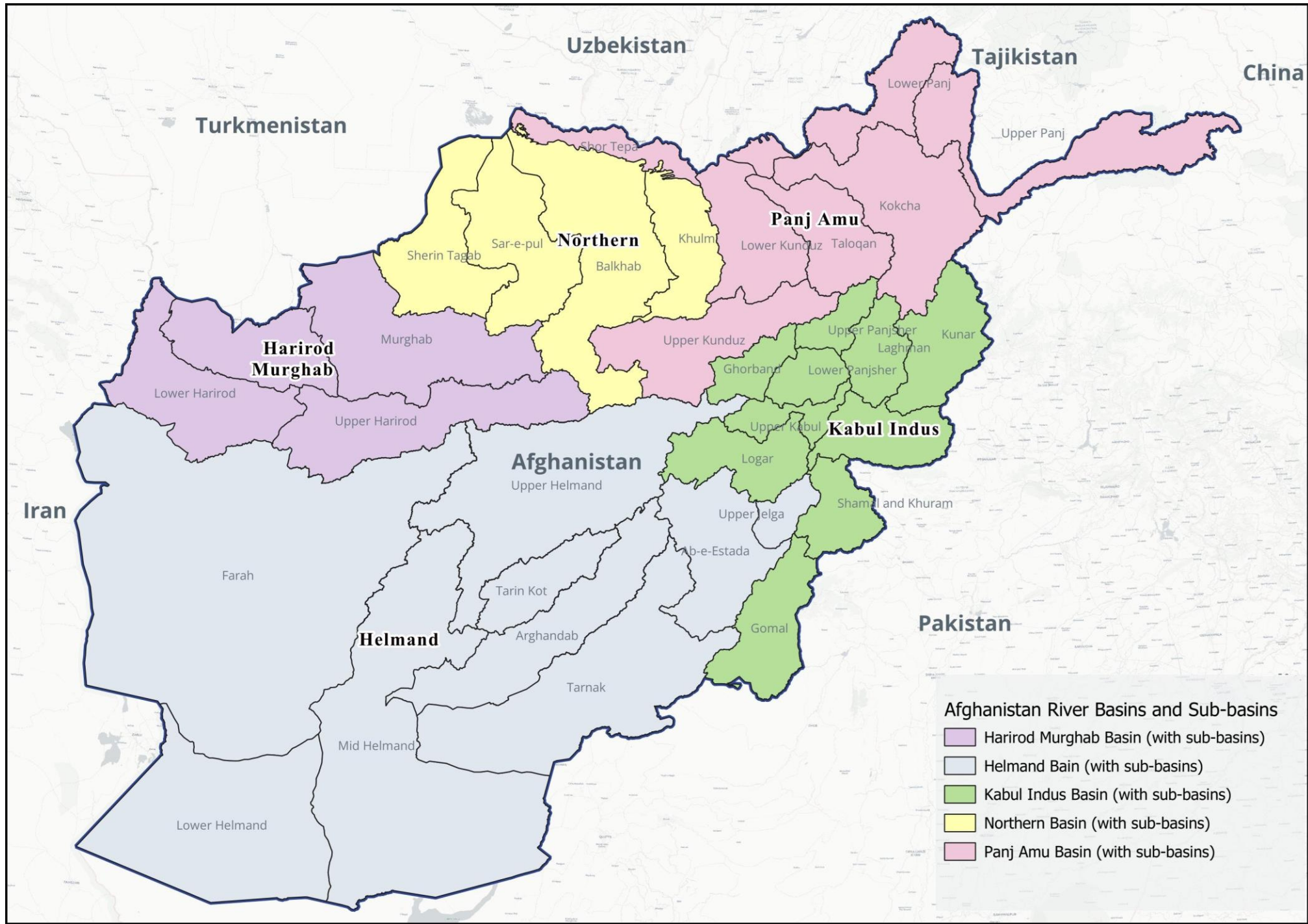


Figure 1. Map of Afghanistan's major river basins and sub-basins (Timory, 2026).

4. Data and methods

Data sources

- Uppsala Conflict Data Program (UCDP):** georeferenced conflict fatalities
- Global Land Analysis and Discovery (GLAD):** Landsat-based total cropland data (30 m); five-year intervals, 2000–2020
- U.S. Geological Survey (USGS) / Famine Early Warning Systems Network (FEWS NET) eMODIS:** irrigated area product (250 m); annual data, 2002–2024

Spatial and temporal harmonization

- Conflict events assigned to basins and sub-basins using point-in-polygon overlay
- Annual alignment of irrigated area and fatalities
- Total cropland gains and losses analyzed separately in five-year intervals

Analysis

- Basin-level Pearson correlations
- Two-way fixed-effects panel regressions
- Sub-basin analysis of cropland gains and losses

5. Key results: two scales

Basin level

Positive correlations in Helmand, Northern, and Panj Amu; weaker in Harirod Murghab and weak in Kabul Indus.

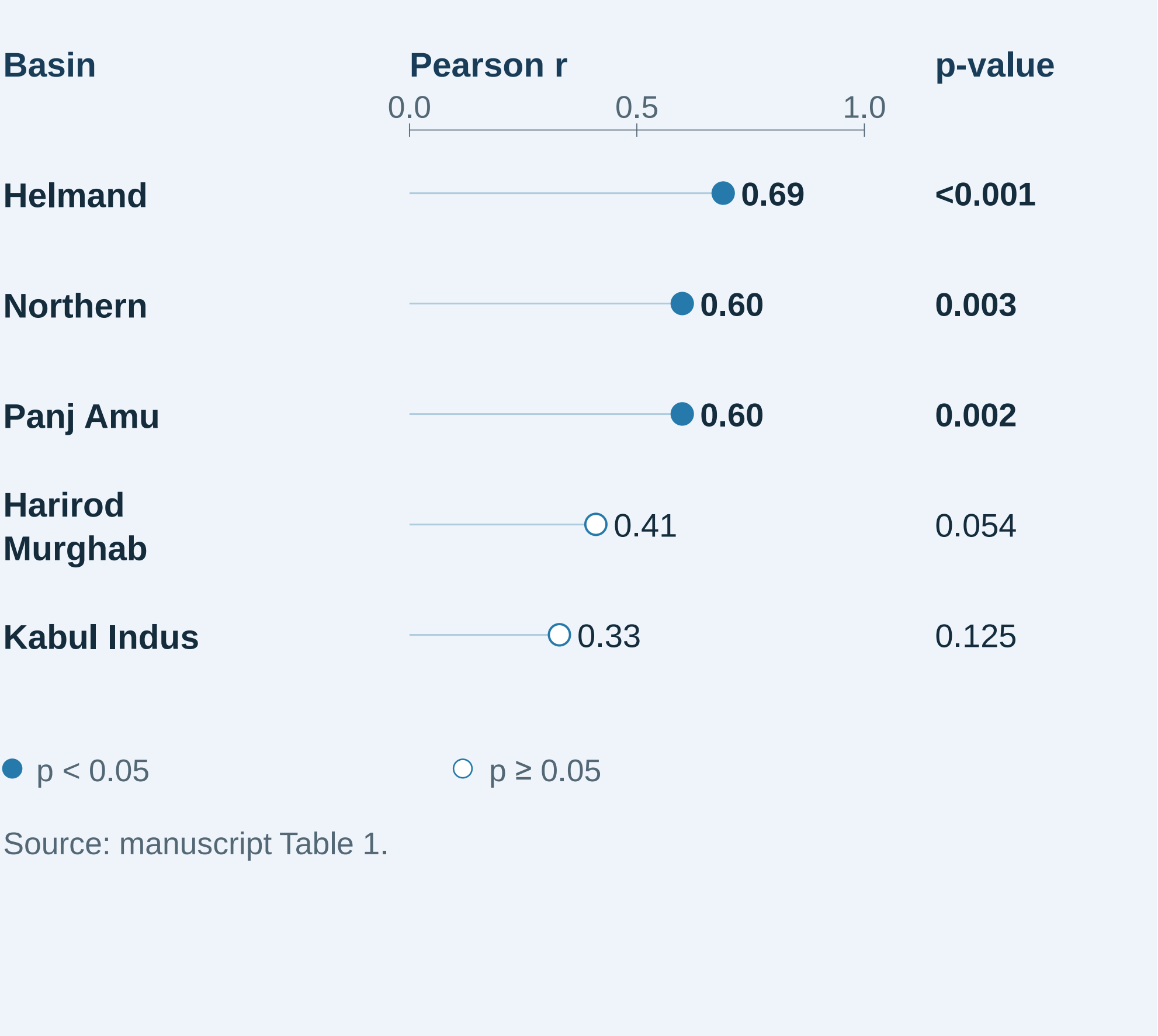
Sub-basin level

No significant contemporaneous association between fatalities and net annual irrigated cropland change after controlling for sub-basin and year effects.

Basin-level analysis shows the overall association, while sub-basin analysis reveals important local differences.

6. Basin-level association pattern

Annual irrigated cropland area and conflict fatalities
Pearson r; 2002–2024; n = 23 per basin



8. Policy Implications

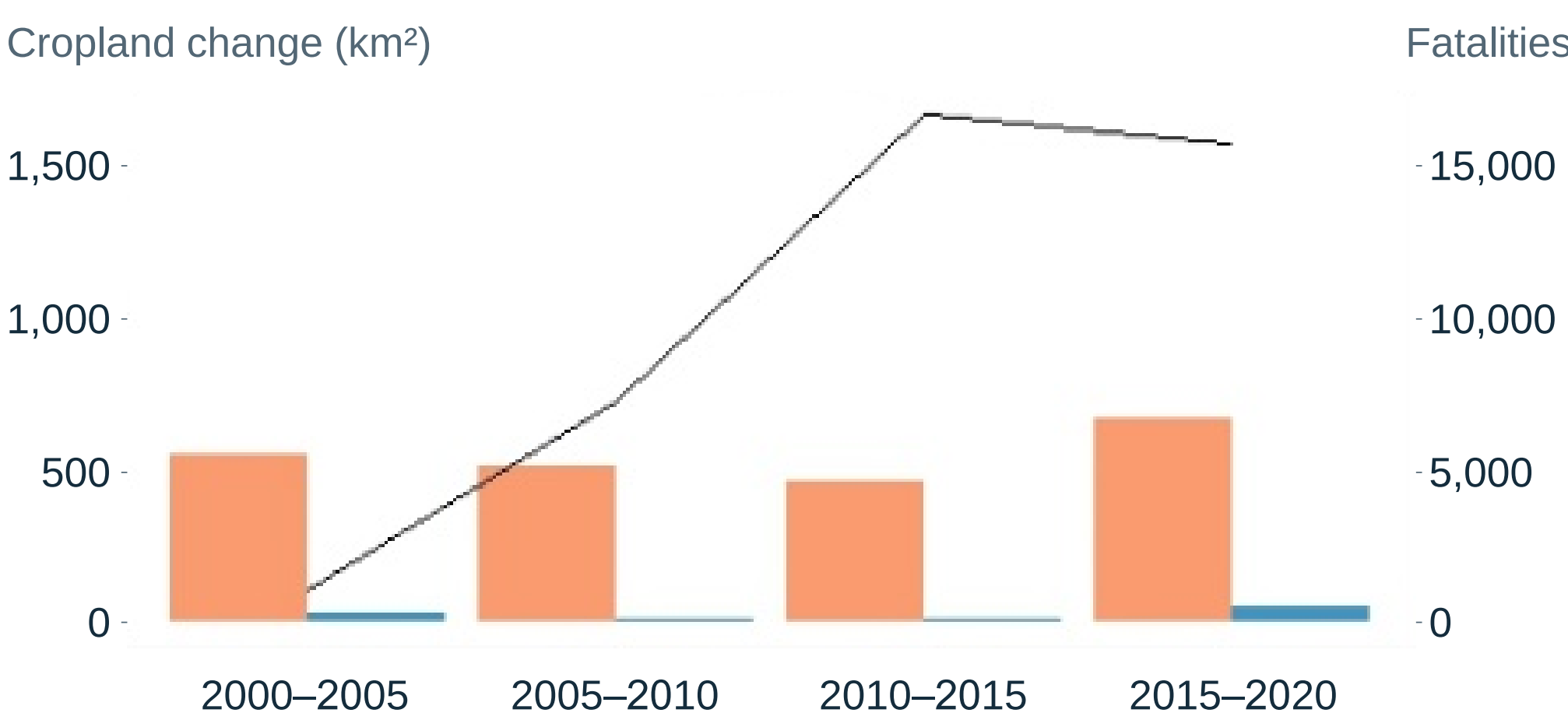
- Irrigated-cropland stability or expansion should not be treated as sufficient evidence of agricultural recovery or resilience.
- In irrigation-intensive basins, especially Helmand, policy should focus on groundwater sustainability and water management rather than expanding cultivated area
- Cropland monitoring should also include conflict, groundwater, crop composition, and governance information at the sub-basin level.
- Uniform national strategies may not be appropriate; policy responses should be tailored to sub-basin conditions.

7. Sub-basin heterogeneity

Selected sub-basins across all five river basins • Total cropland change, 2000–2020

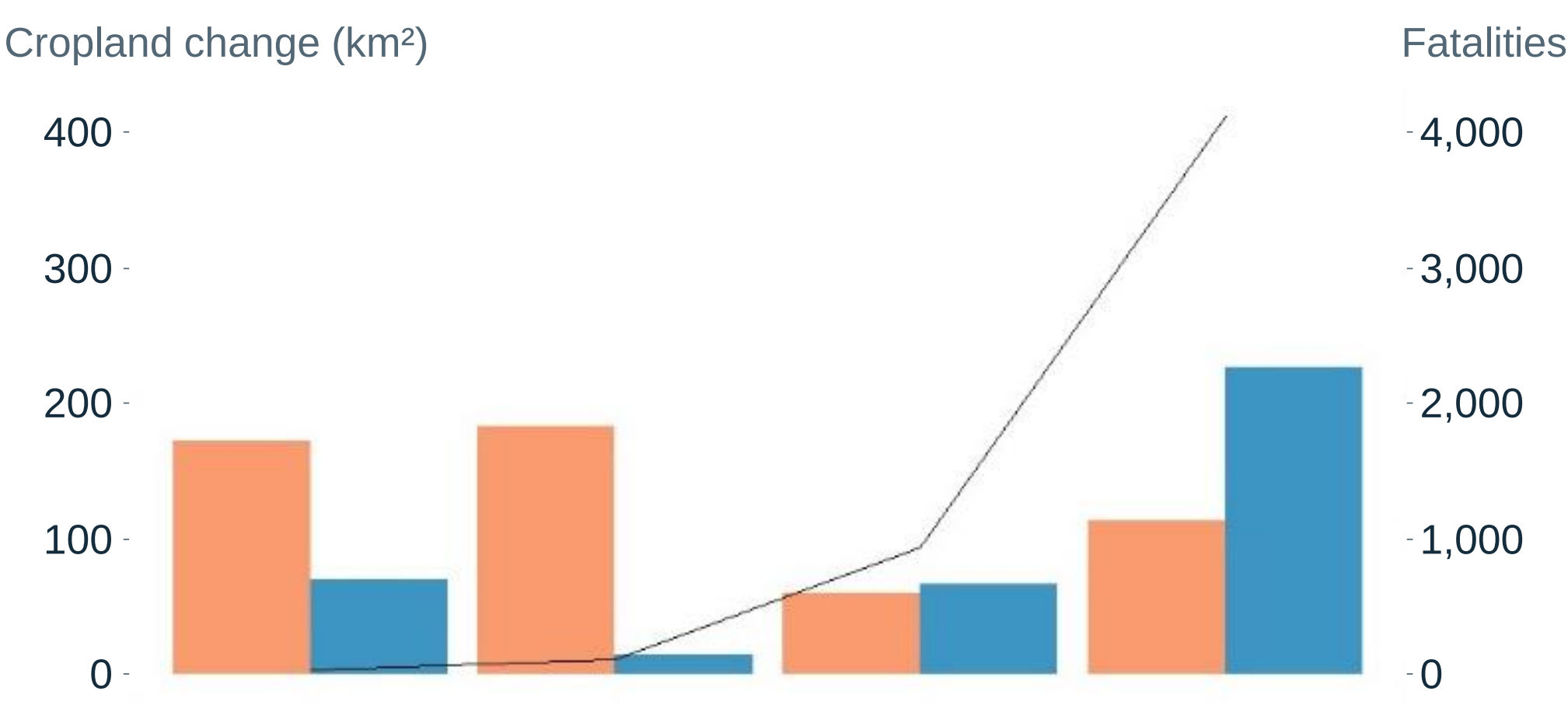
Vertical-axis scales differ across panels.

Mid Helmand (Helmand basin)



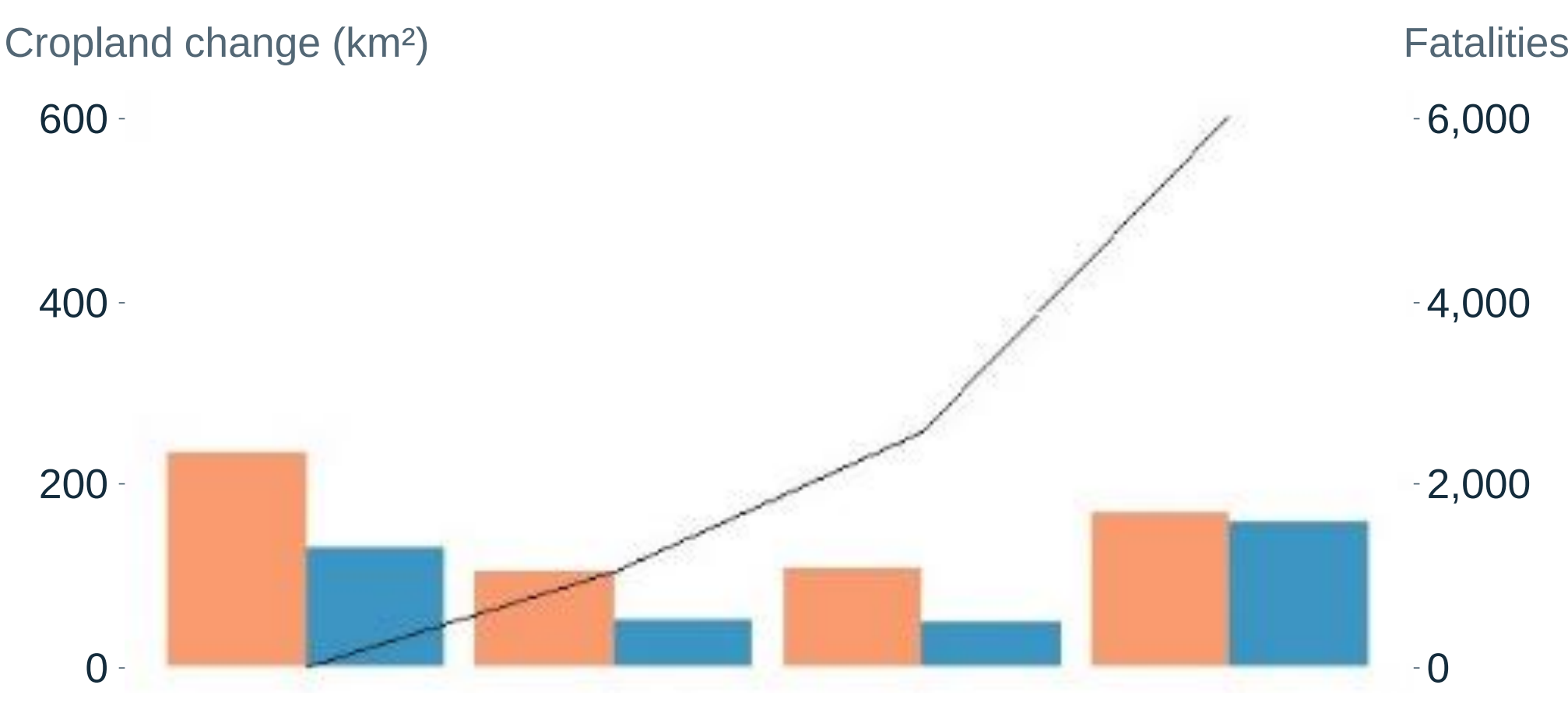
Expansion

Sherin Tagab (Northern basin)



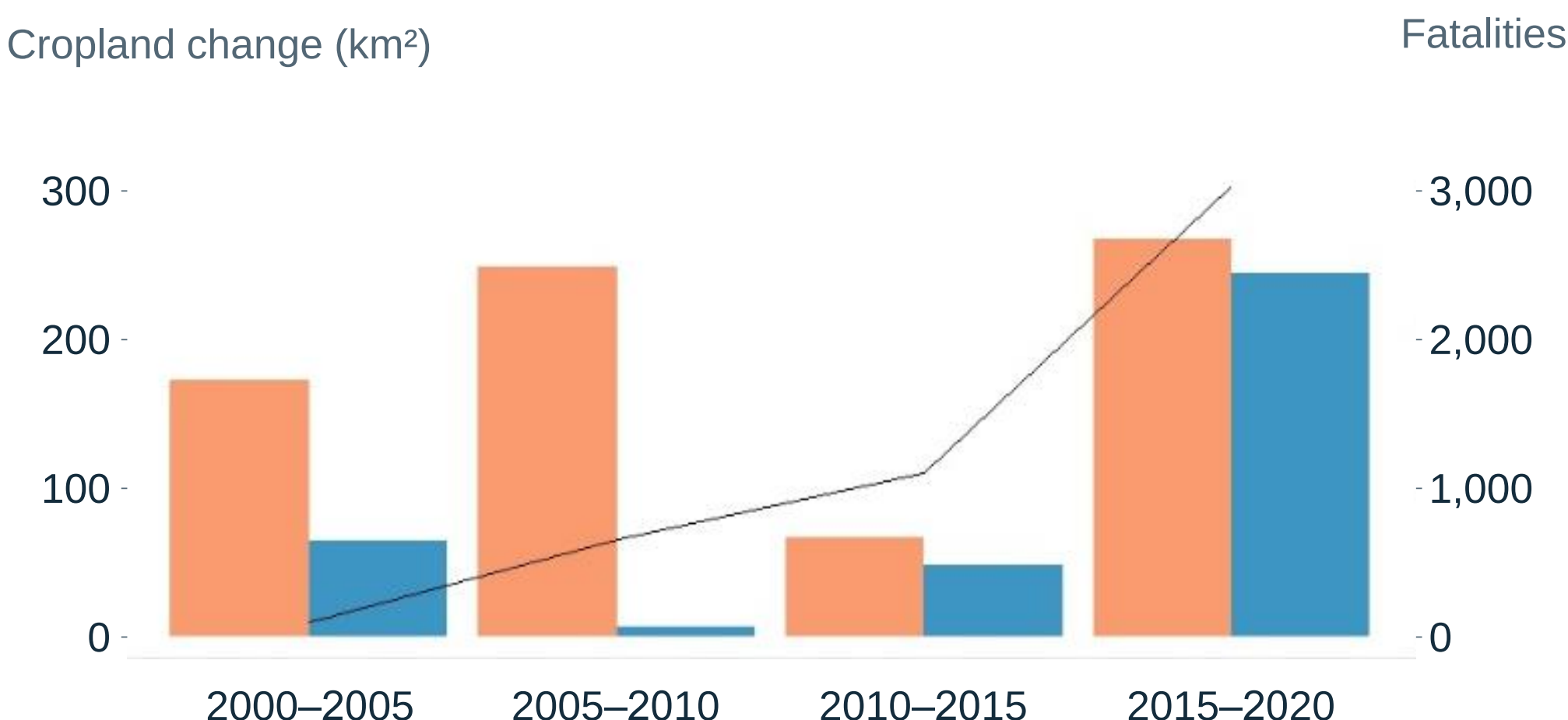
Localized cropland decline

Lower Kunduz (Panj Amu basin)



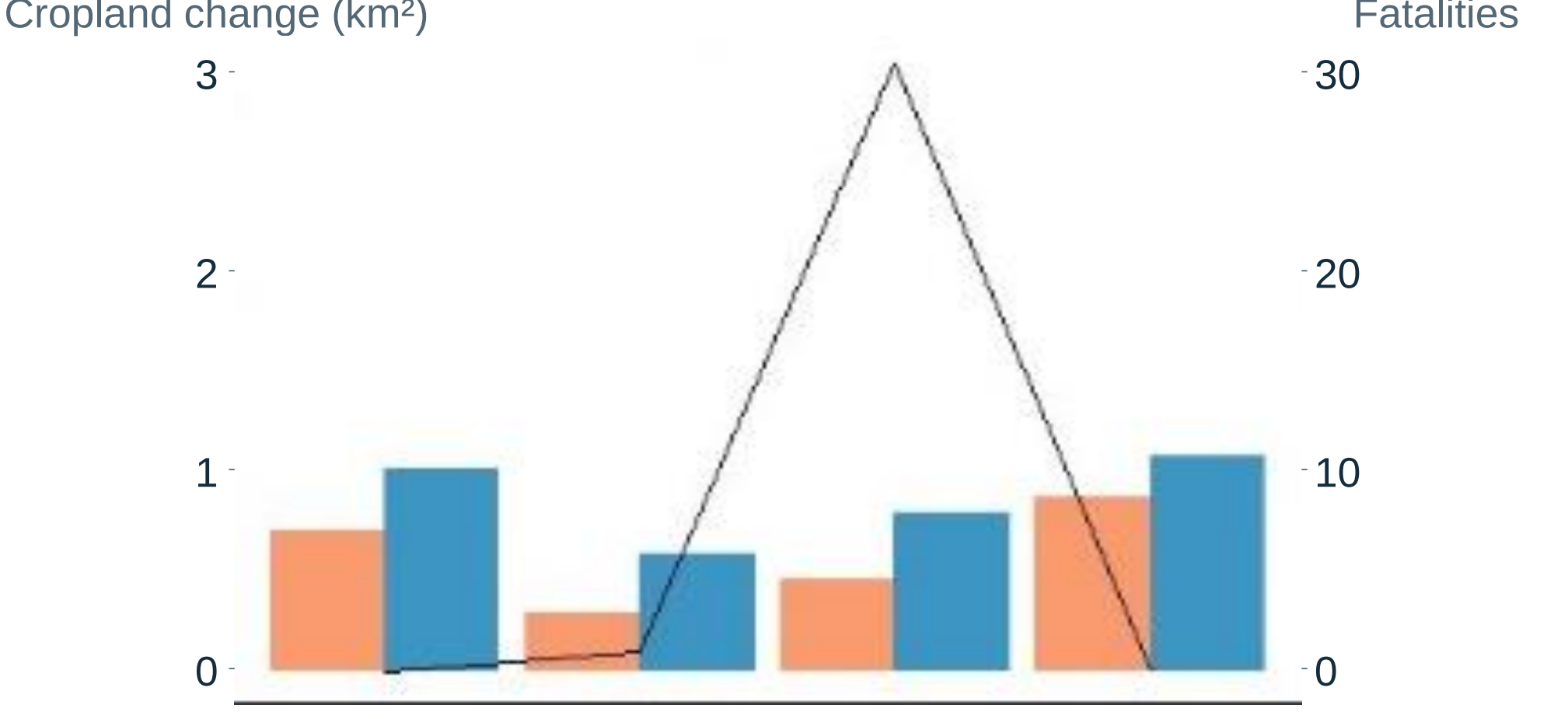
Simultaneous gains and losses

Murghab (Harirod Murghab basin)



Simultaneous gains and losses

Upper Panjsher (Kabul Indus basin)



Limited cropland change

9. Conclusion

The association between conflict and cropland change differs across river basins and sub-basins.

Controlling for sub-basin and year effects, conflict fatalities were not significantly associated with same-year net changes in irrigated cropland area.

Sub-basin patterns include expansion, simultaneous gains and losses, and localized decline.