



# Potentials and constraints for cropland expansion in the former Virgin Lands Area of Kazakhstan

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# Kazakhstan

- Country occupies one of the fertile soils (Chernozem)
- Emerging important player on world wheat and livestock markets
- Rich land-use history often driven by institutional changes (Virgin Lands Campaign, collapse of the Soviet Union, Kazakhstan-2020) with land-use legacies
- Massive agricultural land abandonment (~14 Mln ha, 1990-2010)
- The drivers of land-cover change and environmental costs of potential cropland expansion are not estimated



## Goal

***To understand potentials and constraints for cropland expansion in Kazakhstan***

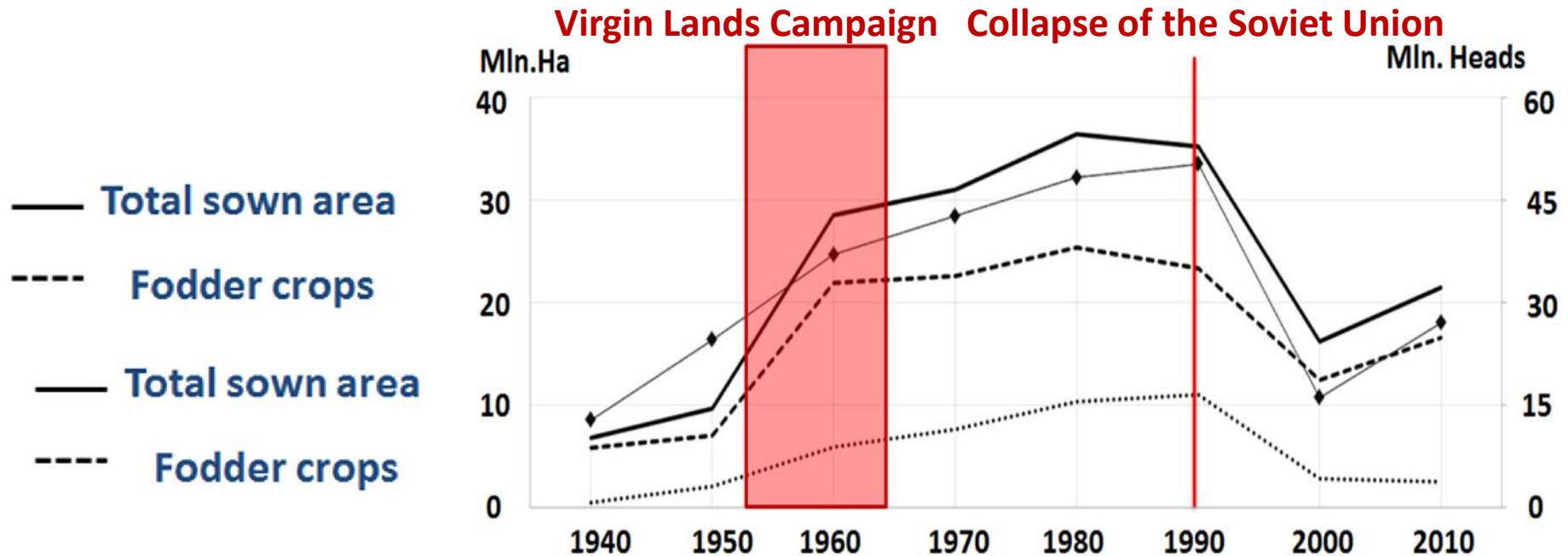


## Objective

1. Assess the dynamics and determinants of land-cover change 1954-2009
2. Estimate opportunities and environmental costs (e.g., changes in soil organic carbon stocks) for cropland expansion-potentially available croplands (PAC)



# Dynamics of land use in Kazakhstan



*Cropland expansion during VLC (1954-1963)-22 Mln ha*

*Abandonment (1990-2000) –20 Mln ha*

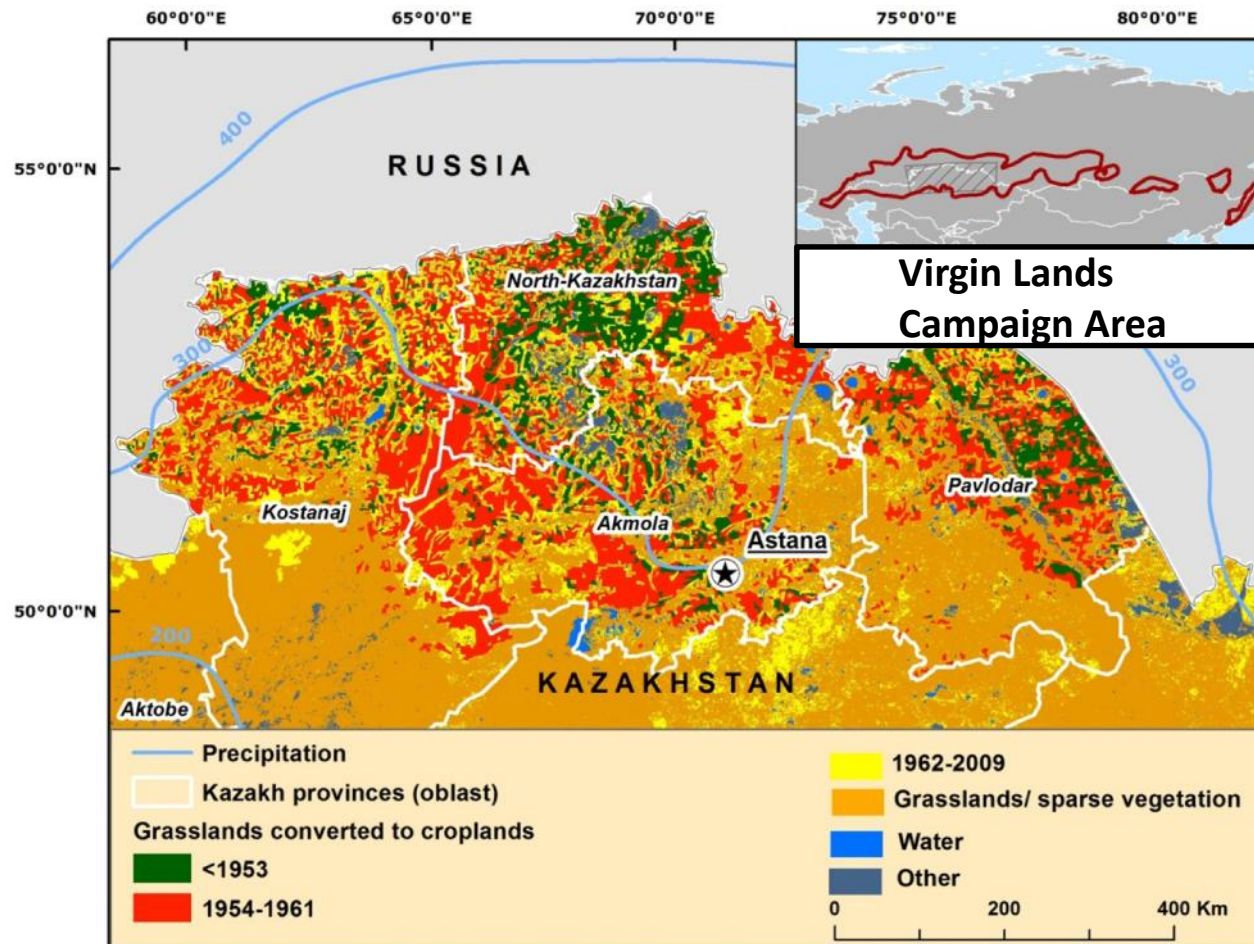
*Recultivation after 2000-6 Mln Ha*

*Potentially available croplands -14 Mln ha*





# Mapping land-cover change patterns 1954-2009



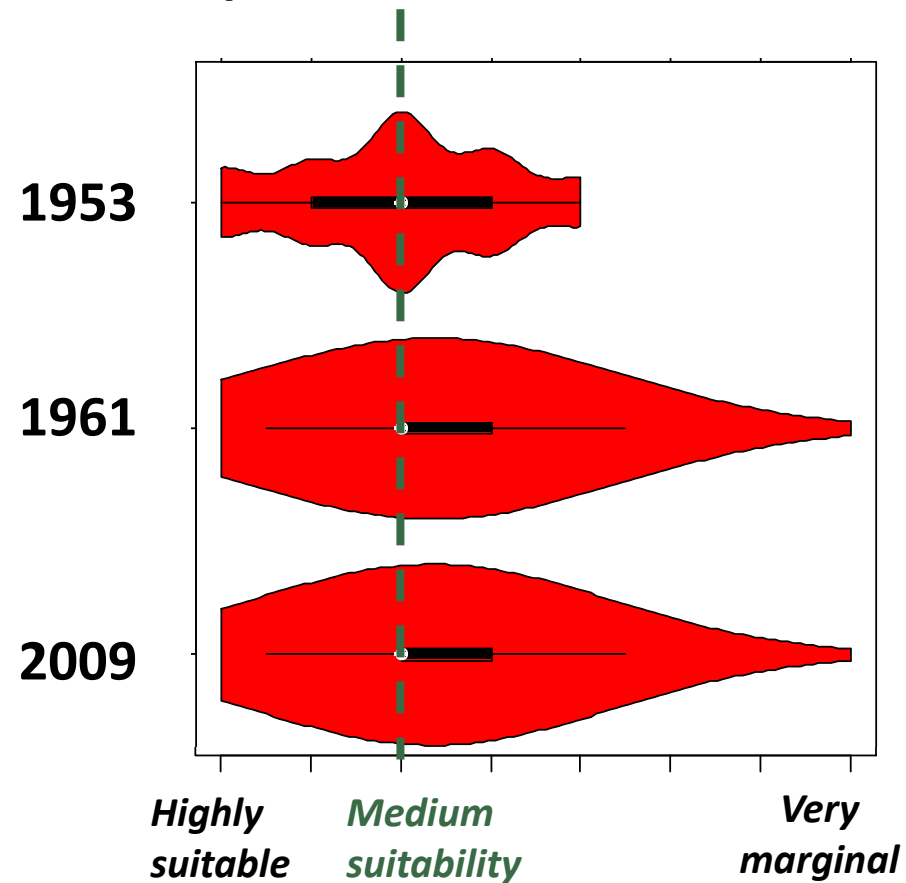
Source: Prishchepov et al., in prep.



# Change of cropland area 1953-2009

## Suitability for rain-fed wheat production

*Cropland expansion during Virgin Lands Campaign (1954-1963) and post-Campaign period (1963-1980) went at the expense of marginal lands*

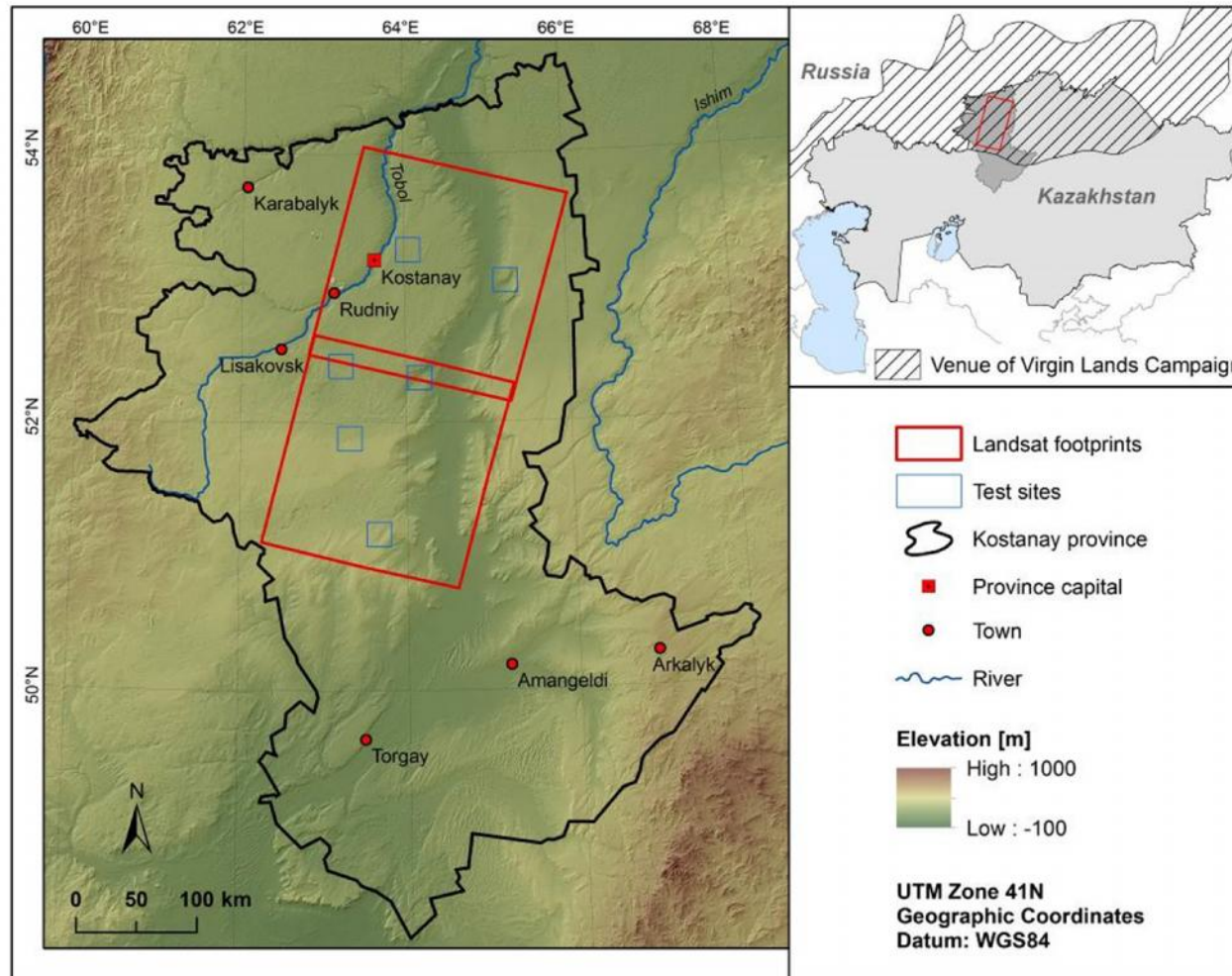


Source: FAO IIASA GAEZ



# Detailed analysis of land-cover change

## Kostanay province case study

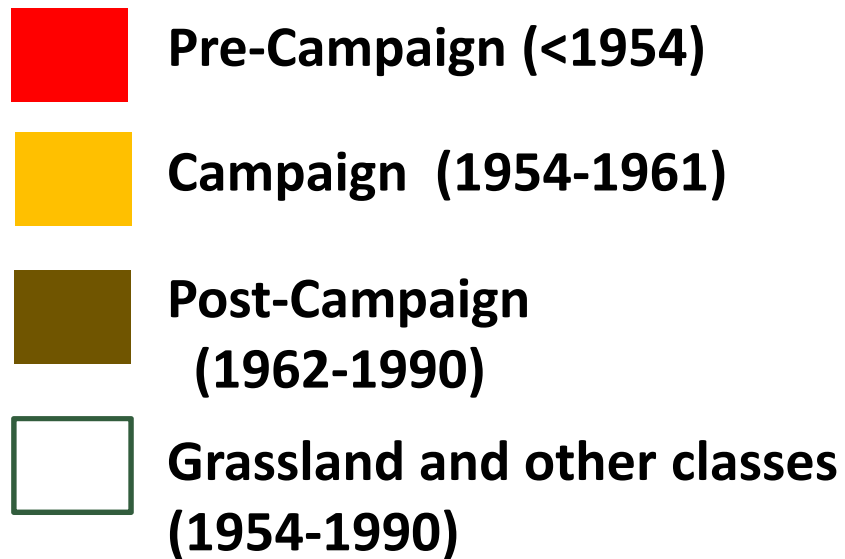


Source: Kraemer et al. (2015), *Environmental Research Letters*



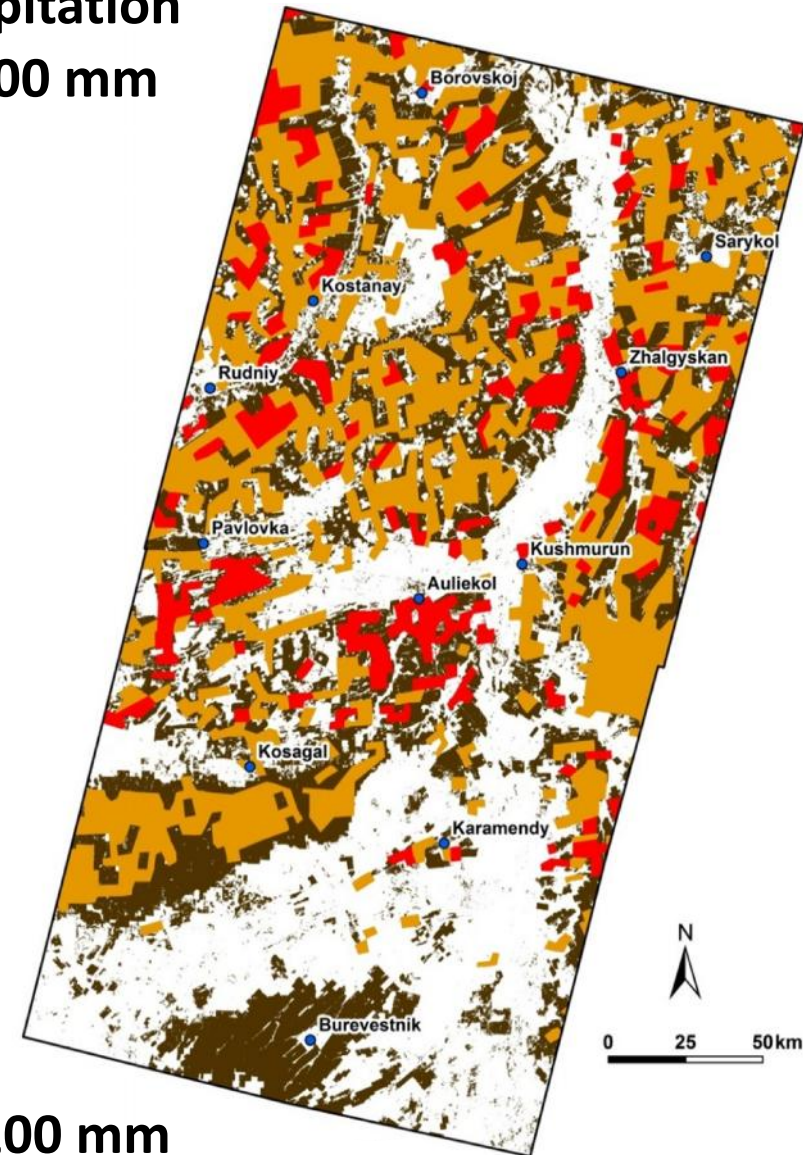


# Cropland expansion 1954-1990



Precipitation

500 mm

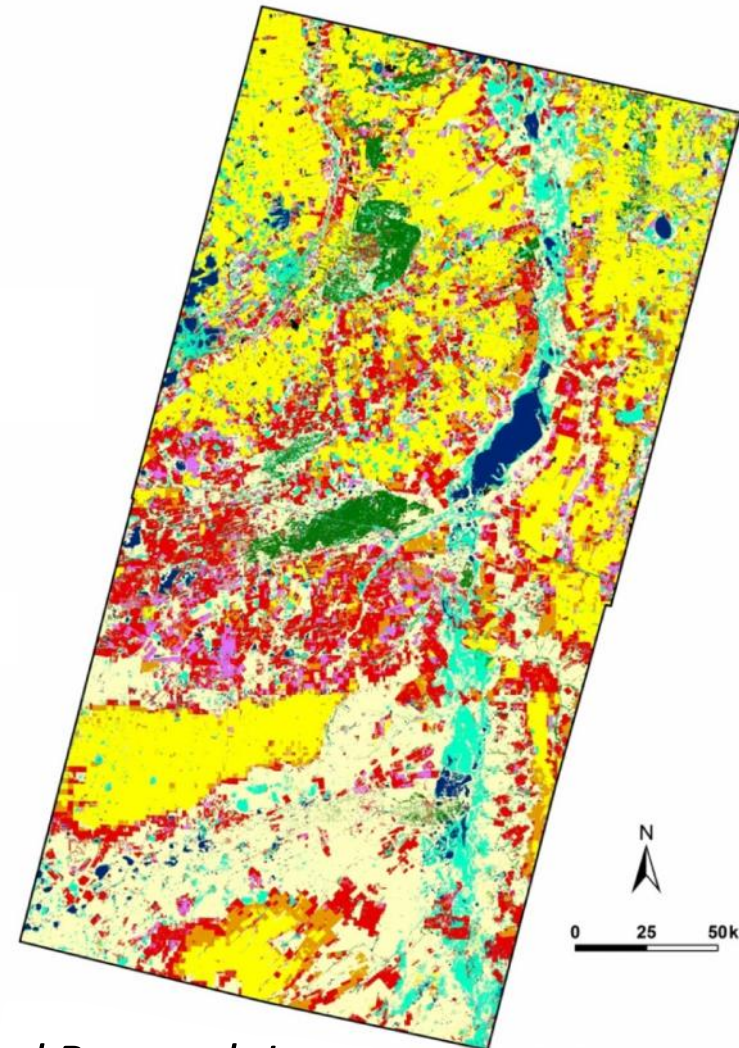


200 mm

Source: Kraemer et al. (2015), *Environmental Research Letters*

# Post-Soviet agricultural land abandonment and recultivation

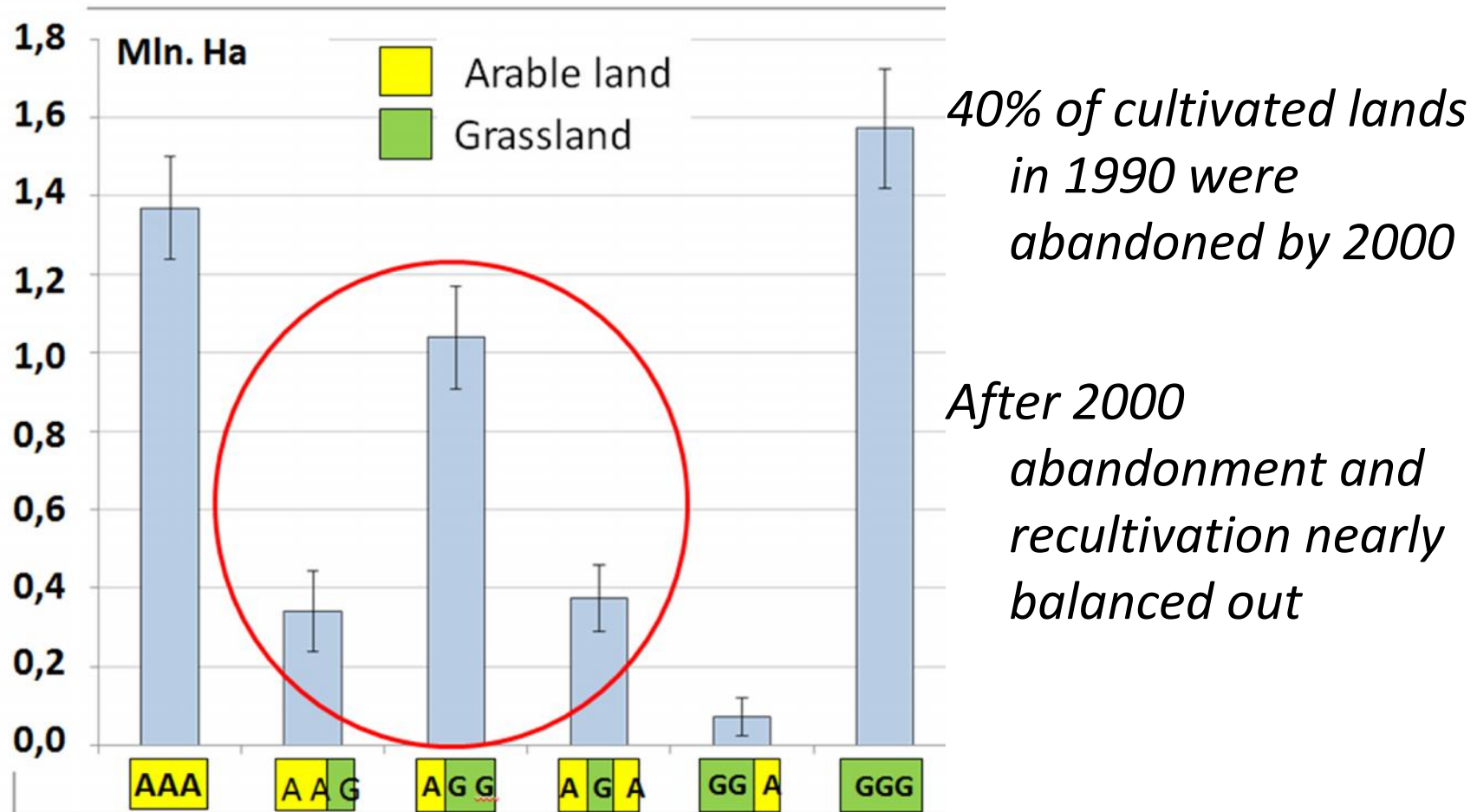
1990 / 2000 / 2010



Source: Kraemer et al. (2015), *Environmental Research Letters*



# Area estimates of land-cover change (1990/2000/2010)



Source: Kraemer et al. (2015), Environmental Research Letters



*Abandonment after 1990 and recultivation after 2000 were primarily taking place on marginal lands converted into croplands in post Campaign period (1962-1990)*

1954/1961/1990

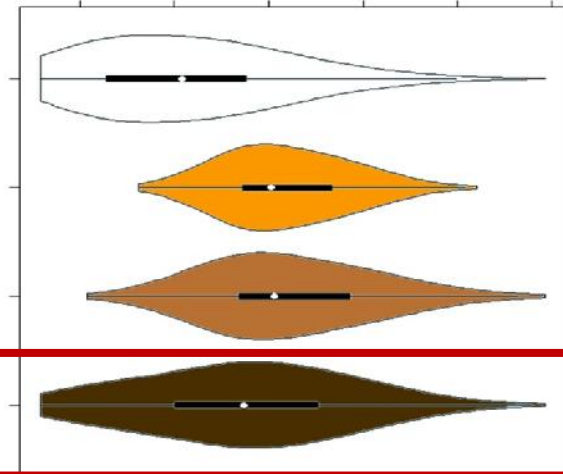
**Selyaninov Hydrothermal Coefficient (proxy for aridity)**

Never cultivated

<1954

1954-1961

1962-1990



1990/2000/ 2010

**Severe aridity**

**Not arid**

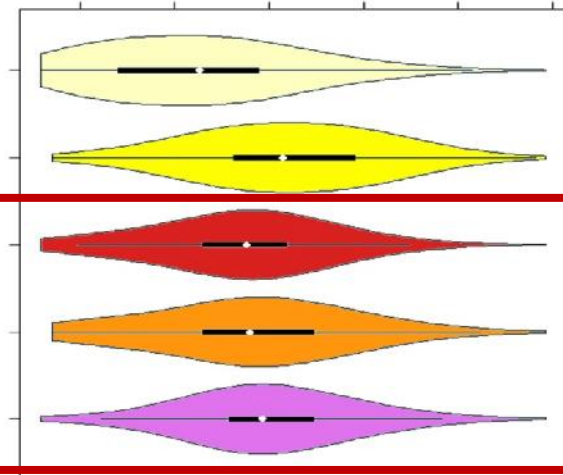
Never cultivated

Cultivated all period

Abandoned after 1990

Recultivated after 2000

Abandoned after 2000

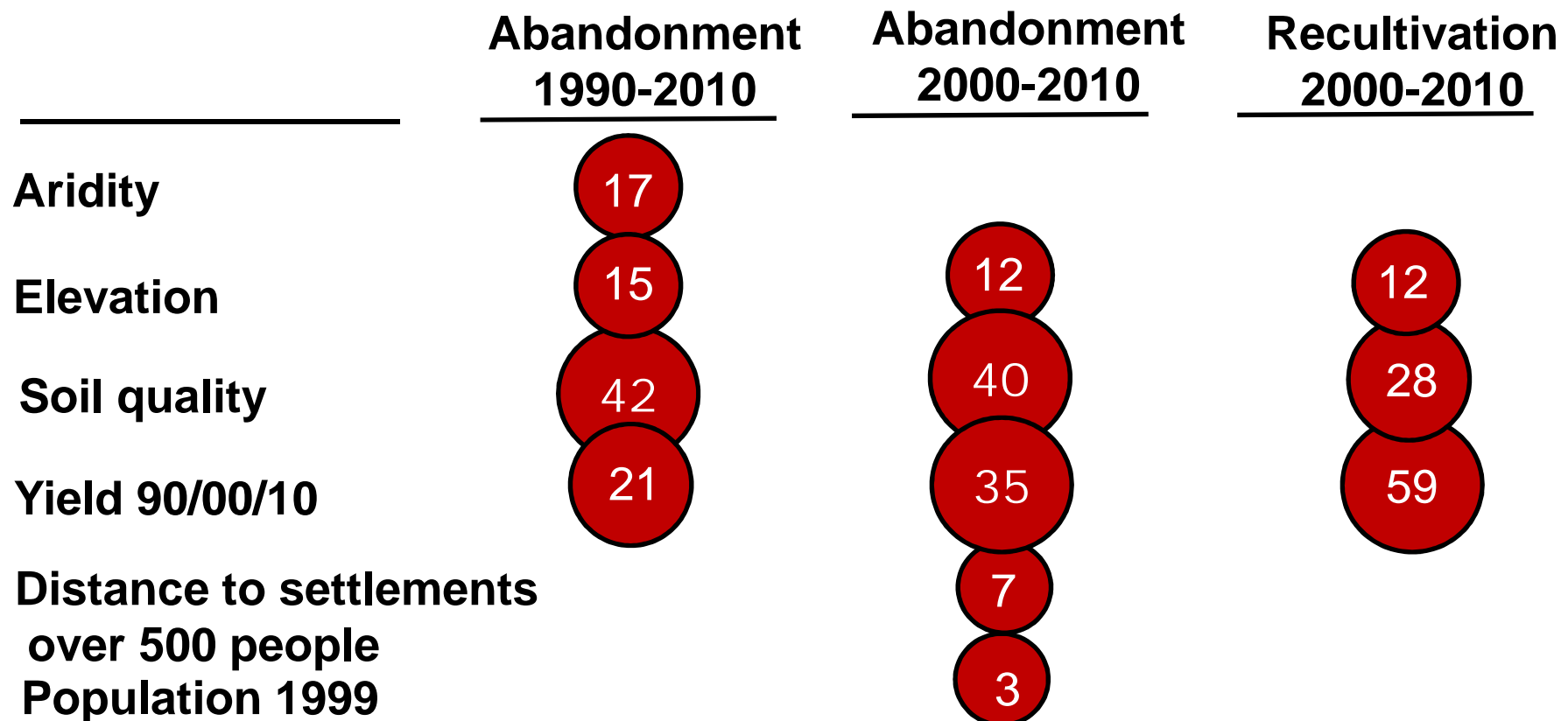


Source: Kraemer et al. (2015), Environmental Research Letters



# Drivers of abandonment/ recultivation- Kostanay

Percent of explained variance by statistically significant variables with spatially explicit logistic regression models

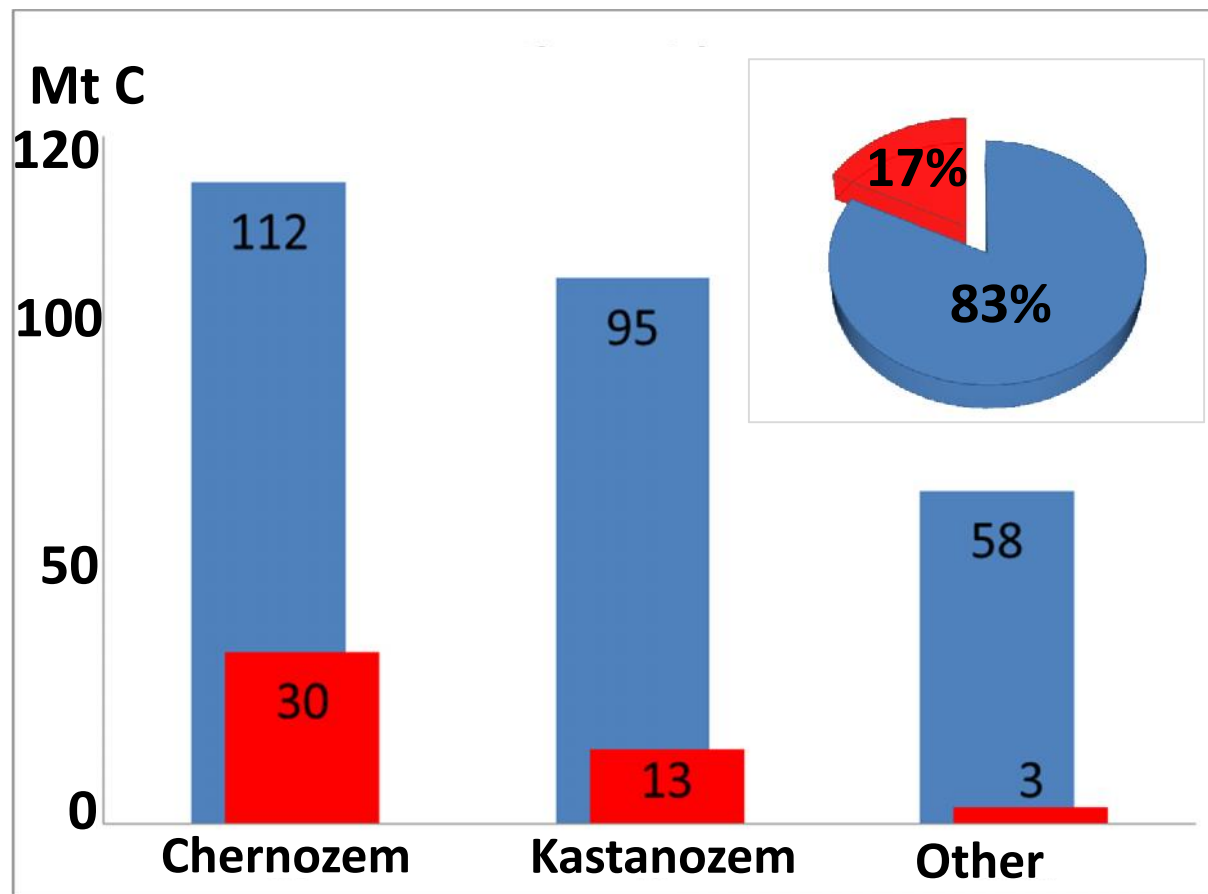


Source: Kraemer et al. (2015), *Environmental Research Letters*  
Prishchepov et al. (in prep).



# Changes in SOC stocks due to abandonment and recultivation in Kazakhstan

## Bookkeeping approach



**C Loss (2000-2015)**

**C sequestered in soils (1990-2010)**

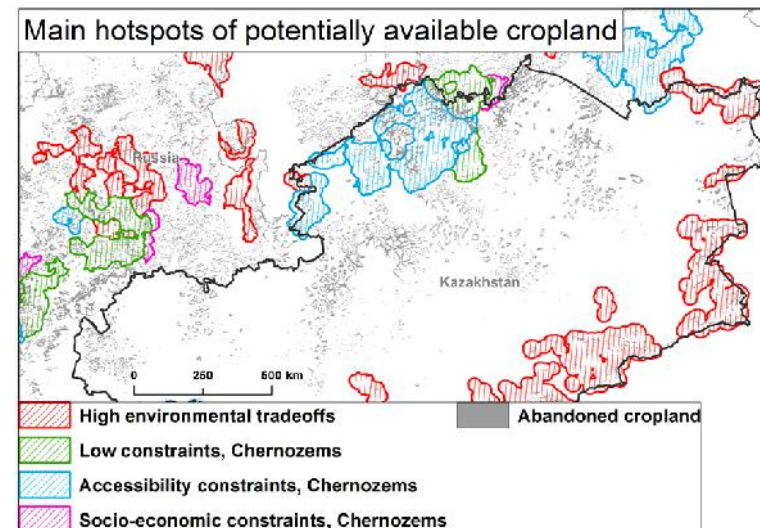
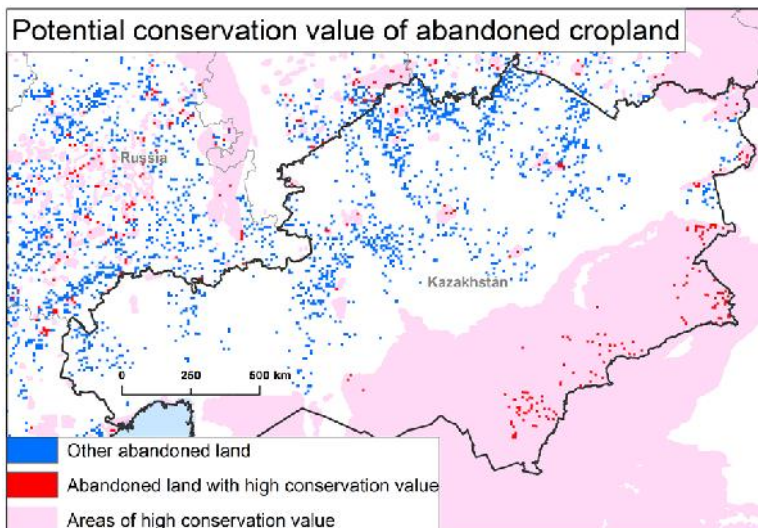
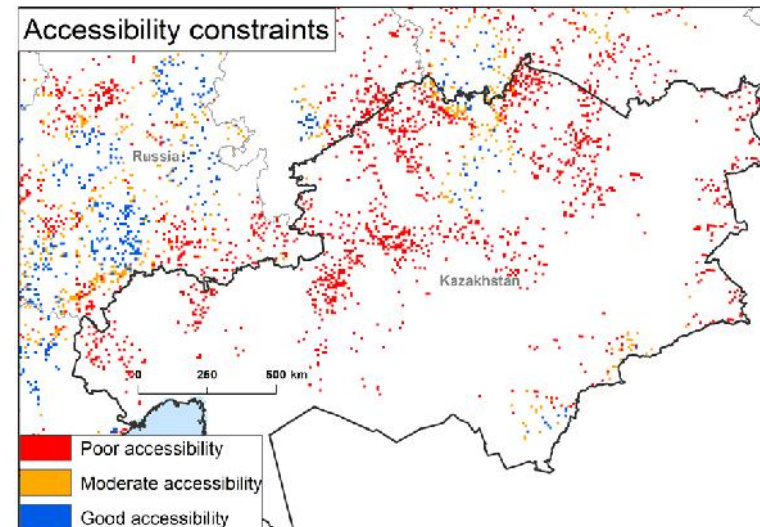
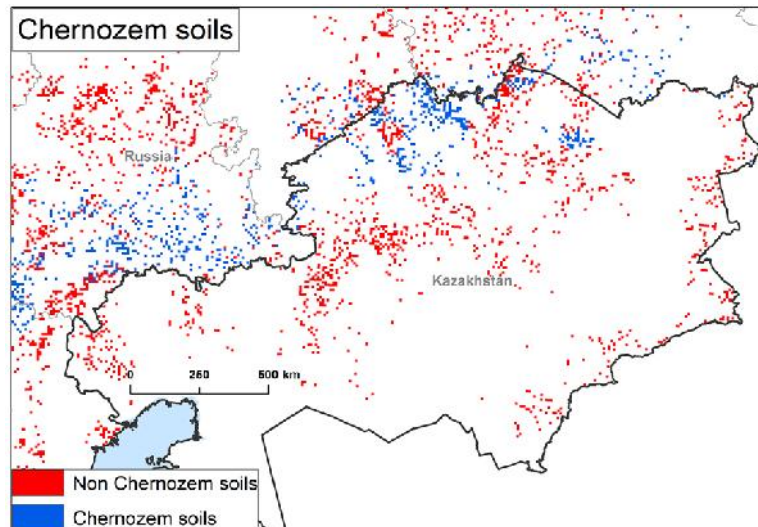
**C Sequestration-255 Mt on remaining abandoned 14 Mln ha**

**C loss due to recultivation-50 Mt on 6 Mln ha**

Source:

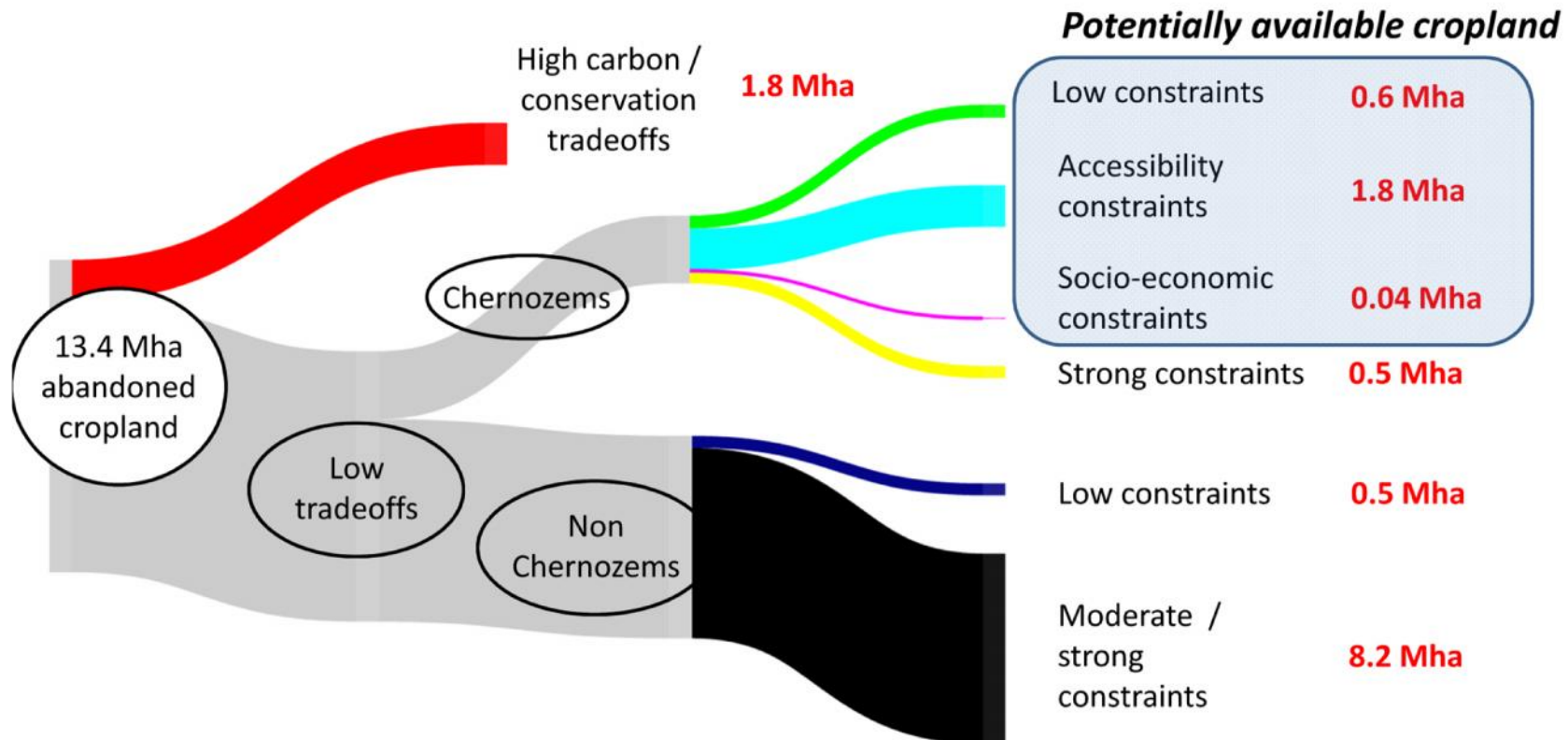
*Prishchepov et al. (in prep); Kurganova et al. (in prep)*

# Constraints for recultivation and environmental trade-offs



Source: Meyfroidt et al. (In Review), *Global Environmental Change*

# Potentially available cropland (PAC)



Source: Meyfroidt et al. (In Review), *Global Environmental Change*





## Summary

- Rapid cropland expansion (1954-1980), following massive abandonment 1990 and ongoing recultivation
- Gradual expansion on marginal lands, which later were abandoned
- Significant C sequestration in the soils on abandoned lands (255 Mt C)
- Recultivation explicitly is taking place on lands with better agro-environmental suitability (Chernozem) with high SOC losses
- PAC are limited, 1-3 out of 14 Mha of abandoned lands
- Additional constraint comes from the competition between cropland production and growing numbers of livestock after 2000 (hay cutting and grazing)

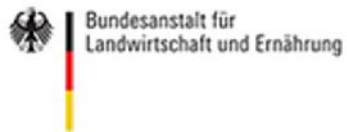


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in Transition Economies



**BALTRAK**

**UCL**



**ИНСТИТУТ СТЕПИ УРО РАН**



**Thank you!**

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