The effects of privatization on pasture productivity in southern Kazakhstan

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Introduction

Rationale behind land privatization

Resolving the 'Tragedy of the Commons' (Hardin, 1968), policy-makers often choose **private property** + **property rights transfer** (Bowles, 2006) because it

- improves land use efficiency and ag. productivity (Binswanger et al., 1995; Deininger et al., 2001; Holden et al., 2014) through land allocation efficiency, investments, restructuring.

Positive effects of enclosure on agriculture are well documented (Adamopoulos et al., 2022; Besley et al., 2010; Chari et al., 2021; Chen et al., 2022; Dippel et al., 2020), however, **frictions in other markets** can offset land reform achievements.

Therefore, promising objectives of land reform are often achieved only partially (Deininger et al., 2023)

- especially in former Soviet countries (Kvartiuk et al., 2021; Petrick, 2021);

Land privatization and quality

(Buehler, 2022; Hou et al., 2022; W. J. Li et al., 2007) document positive effects of privatization on land quality, however, there are also negative consequences (A. Li et al., 2012; D. Li et al., 2021):

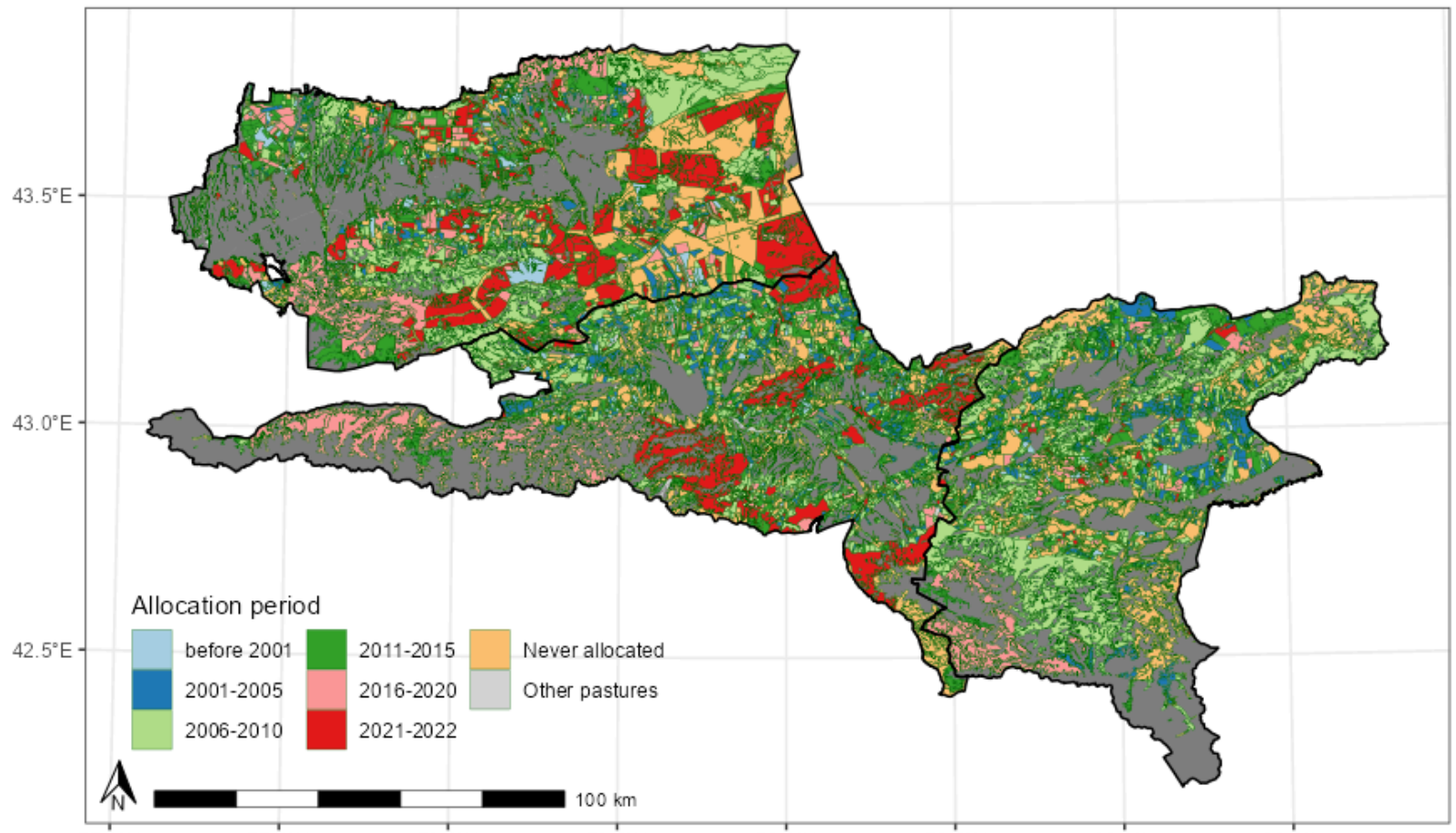
- **unequal land distribution**:
  - leaves others on limited common land (Rohde et al., 2006);
- **spillover effects**:
  - even if management improves on private parcels, it worsens elsewhere (Masami Kaneko et al., 2009);
- **fragmentation of grazing systems**:
  - reduction in livestock mobility (Galvin et al., 2008);
- 'The tragedy of enclosure' (Reid et al., 2008);

Kazakh's natural experiment

Since 1990th, Kazakhstan was implemented a redistributive land reform, cadastre, and inefficient land market institutions, which favor large producers (Kvartiuk et al., 2021).

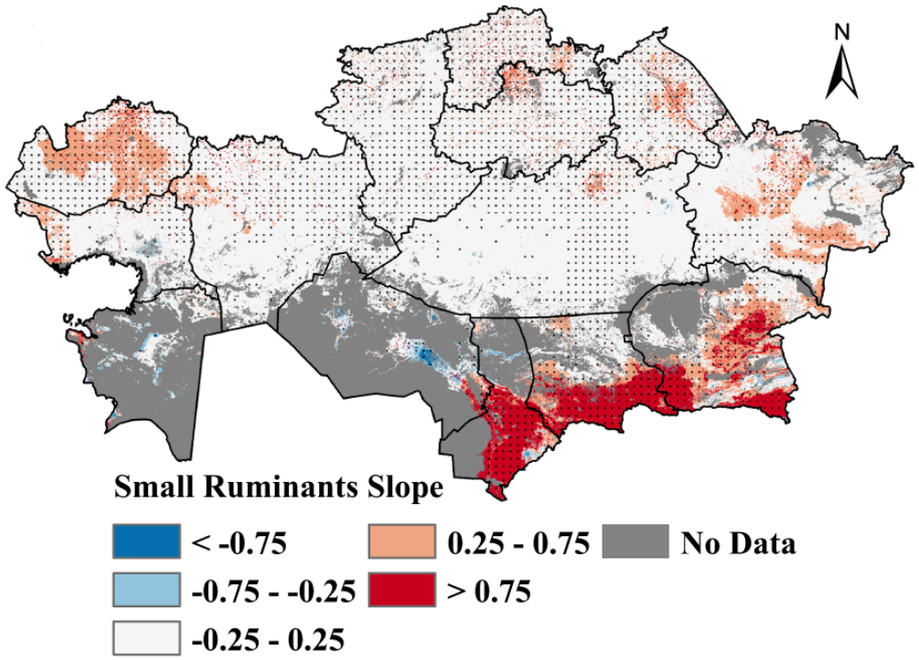
- Land reform enabled **Individual Farmers (IF)**
  - who hold ~35% of all livestock
  - privatize pastures under 49 years leases.
- Land reform left **Households (HH)** aside
  - they hold 60% of LS
  - Do not have formal rights to pastures.

Created by authors based on cadastre data aisgzk.kz

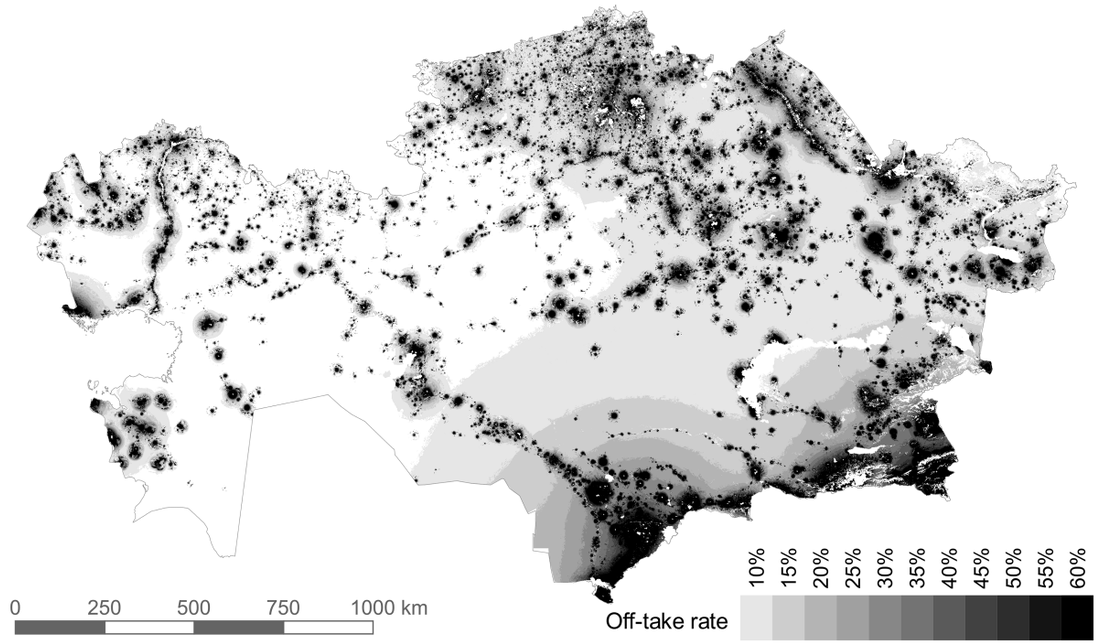


Livestock growth 2000-2020

Population growth and urban development fostered demand-driven growth of the livestock sector.



That increased pressure on pastures.



Growth of small ruminants (2000-2020) adapted from Kolluru et al. (2023)

Land reform had ambiguous consequences

- the land market is inefficient, dysfunctional, and benefiting large enterprises (Kvartiuk et al., 2021);

- ag. enterprises failed to intensify livestock production (Robinson et al., 2021), maintaining enterprise-household duality (Petrick, 2021);
  - 60% of livestock is kept by **landless households (HH)**
  - HH use **not-yet/never-allocated** or **common** land;
  - never-allocated land areas decreased;

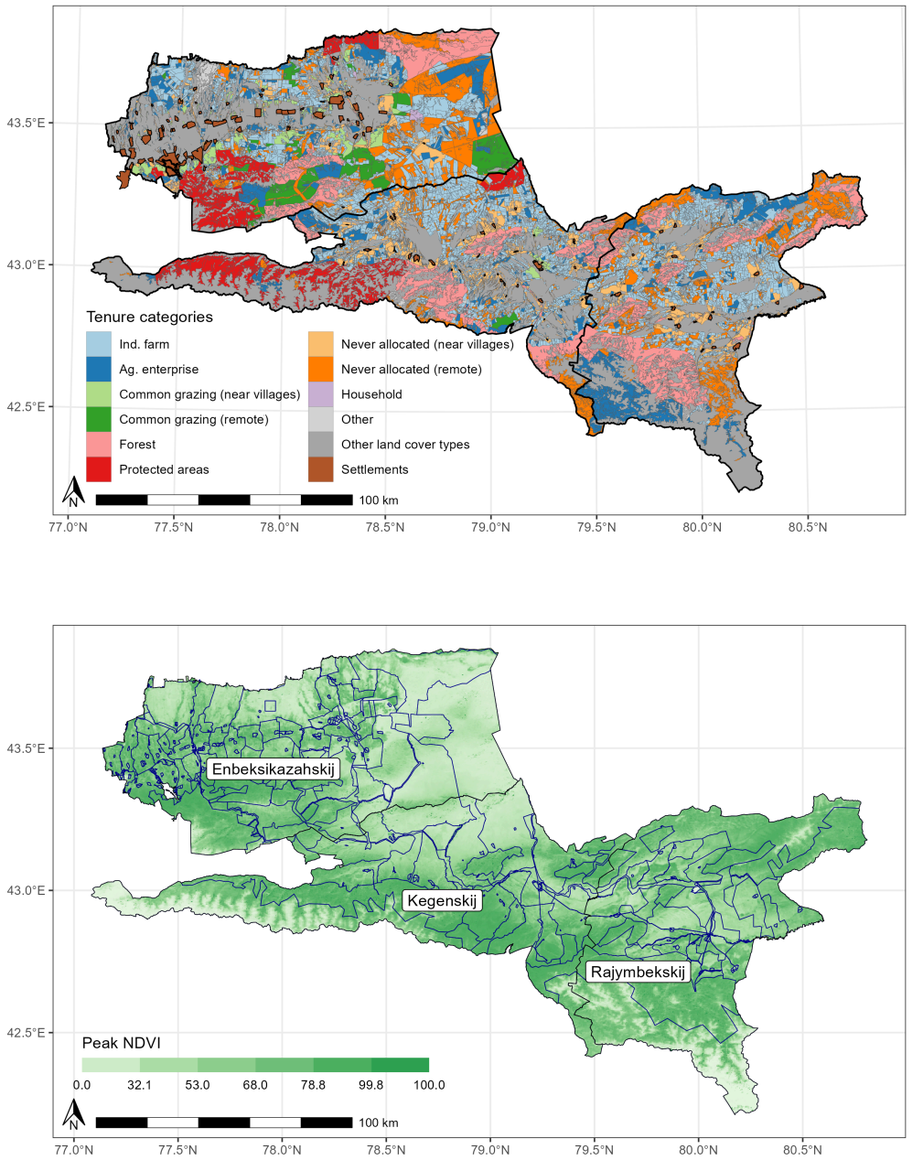
- increased pressure on the land close to settlements; remote pastures little used or abandoned (Alimaev et al., 2008; Dara et al., 2020);

Research question(s)

- What are the **effects of land privatization on pastures**?
- What are the **spillover effects of privatization**?
- How **pasture use** changes **given proximity to settlement**?
- How do the **grazing practices** adjust to accommodate the fragmented landscape?

Data and methods

Data: privatized plots boundaries



We follow 30k plots

- allocated in cadastre between 1990-2023 (top map aisgzk.kz)
- on pasture land only;
- including remaining never-allocated pastures;

Remotely sensed **peak vegetation density (NDVI) for 2000-2023** using MODIS 250m resolution MOD13Q1.061 (bottom figure).

Other remotely sensed climatic data on monthly cumulative $\mathrm{Rainfall}_{i,t}^{month}$ and solar $\mathrm{Radiation}_{i,t}^{month}$; monthly average $\mathrm{Temperature}_{i,t}^{month}$.

Identification of the ATT

Staggered absorbing treatment calls for two ways fixed effect model (TWFE) (Athey et al., 2022; de Chaisemartin et al., 2020, 2022; Goodman-Bacon, 2021)

- each plot i is observed over t years and a treatment (privatization) is suddenly applied at different time

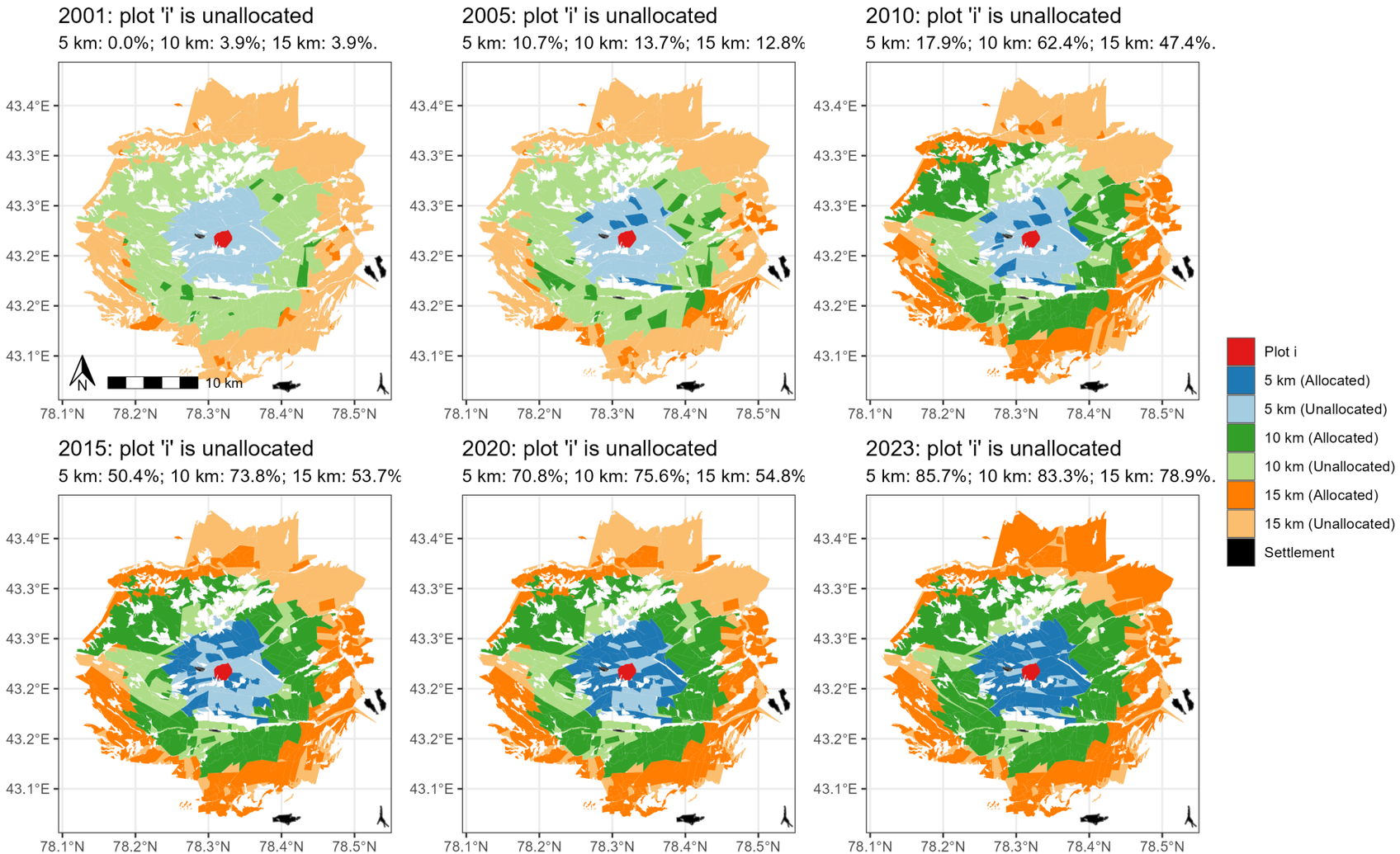
$$\log \mathrm{NDVI}_{i,t} = \tau D_{i,t} + \beta_s \boldsymbol{X}_{s,i,t} + \eta_{\cdot,t} + \eta_{i,\cdot} + \epsilon_{i,t}$$

- τ is the **Average Treatment Effect on the Treated (ATT)** ($\frac{\Delta \mathrm{NDVI}}{\Delta D} = 100(1 - e^{\tau})\% \approx 100 \cdot \tau\%$);
- Fixed effects $\eta_{\cdot,t}$ and $\eta_{i,\cdot}$.
- 72 control variables $\boldsymbol{X}_{s,i,t}$: monthly rainfall, solar radiation, temperature, monthly interaction terms.

Such TWFE model estimated using heterogeneity robust DiD estimators (overview of the cottage industry is in (Baker et al., 2022; Roth et al., 2023)):

- SA - Sun and Abraham (Sun et al., 2021); CA - Callaway and Sant'Anna (Callaway et al., 2021); IMP - imputation estimators (Borusyak et al., 2023; Gardner, 2022; Wooldridge, 2023);

Spillover examples



Identification of the spillover effects

(Butts, 2021; Clarke, 2017; Xu, 2023) show that if spillover effects are present:

- their omission leads to the OVB;
- they can be decomposed into:

$$\tau^{\text{spillovers}} \equiv \tau^{\text{direct (ATT)}} + \tau^{\text{spillover on treated}} - \tau^{\text{spillover on control}}$$

We accommodate (Xu, 2023) idea on spatial configuration in j rings around plot of interest i in time t. The resulting model is:

$$\begin{aligned} Y_{i,t} = \tau^{\text{direct}} D_{i,t} + \sum_{j=1}^{p} \tau_j^{\text{s. treated}} D_{i,t} S_{i,t,j} + \sum_{j=1}^{p} \tau_j^{\text{s. control}} (1 - D_{i,t}) S_{i,t,j} \\ + \beta \boldsymbol{X}_{i,t} + \eta_{\cdot,t} + \eta_{i,\cdot} + \epsilon_{i,t} \end{aligned}$$

where, $S_{i,t,j}$ is the share of land allocated in the ring j relative to the observation unit i at time t.

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Results

ATT of land allocation

Estimates of ATT using different estimators

	BM	SA	CS (NYT)	IMP static	IMP
Panel: A. Full sample					
ATT	-0.0030**	-0.0035***	-0.0020*	-0.0050***	-0.0034***
N obs.	565,680	565,679	565,679	534,216	534,216
N ind. FE	23,570	23,570	23,570	22,259	22,259
Panel: B. Excluding never-allocated plots					
ATT	-0.0025*	-0.0048***	-0.0013	-0.0132***	-0.0173***
N obs.	380,088	380,087	380,087	334,098	334,098
N ind. FE	15,837	15,837	15,837	13,921	13,921

Note. Estimators are BM - benchmark TWFE, SA - Sun and Abraham, 2021, CA - Callaway and Sant'Anna, 2021, and IMP imputation estimators Gardner et. al. 2022

Significance levels are: '***' p-value < 0.001, '**' p-value < 0.01, '*' p-value < 0.05, p-value < '.' 0.1, and ' ' p-value >= 0.1.

Source: own calculations.

Observations:

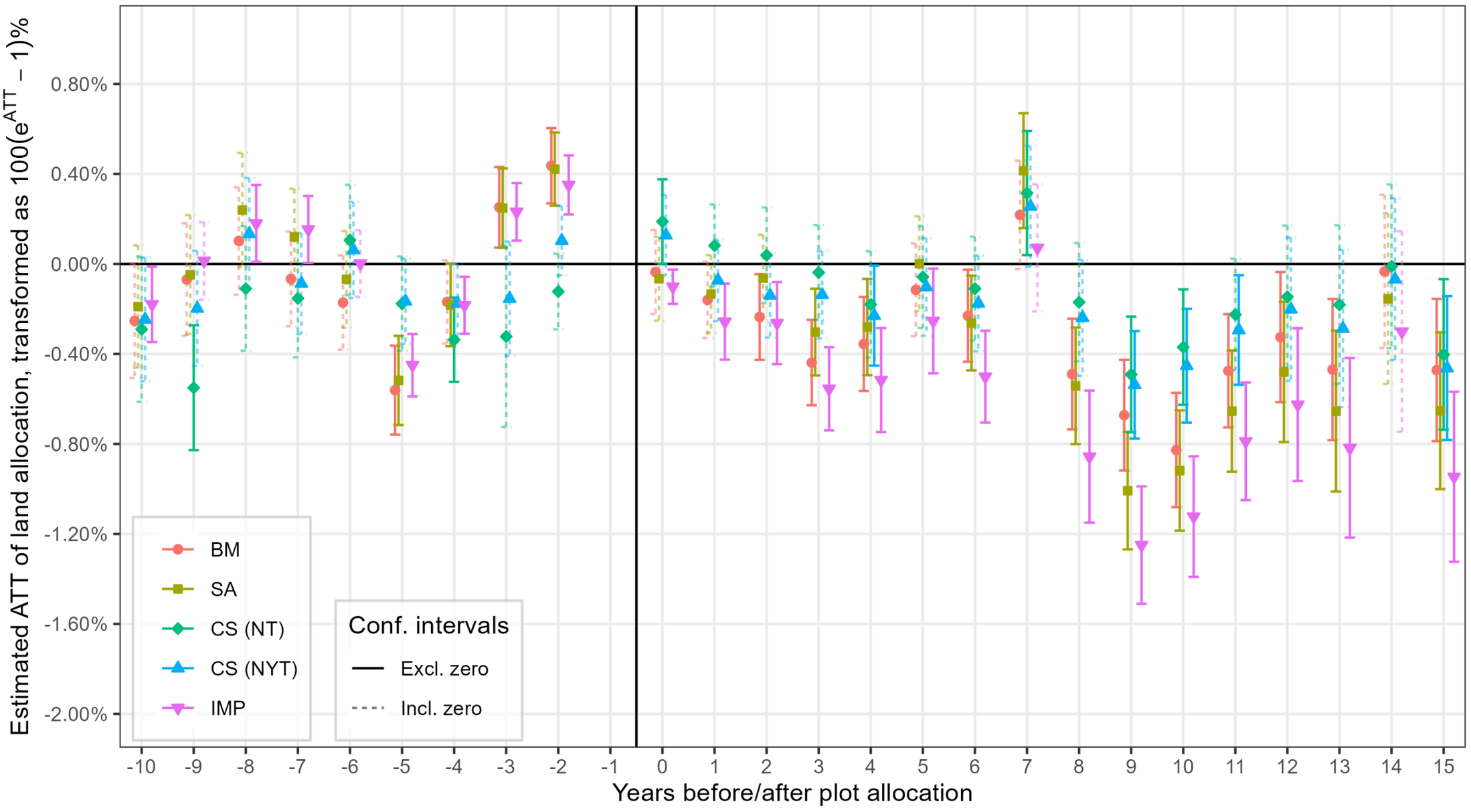
- Negative and significant ATT.
- Land allocation **reduces pastures peak vegetation by 0.2-1.7%.**

This is the equivalent to a **drought that occurs once in 10 years**

Results are also robust to:

- Alternative functional forms with fewer controls;
- Sample variation by allocation date quality;

Event-study of land allocation



ATT by tenure with sharp land use

Estimator	Ind. farm (own)	Ind. farm (rent)	Ag. ent. (own)	Ag. ent. (rent)
Panel: A. Full sample				
SA	-0.0025	-0.0060***	0.0141**	0.0042.
IMP static	-0.0026	-0.0068***	0.0167***	0.0000
IMP	-0.0003	-0.0024*	0.0003***	0.0002
N obs.	229,248	404,280	192,600	225,504

Note. Estimators are BM - benchmark TWFE, SA - Sun and Abraham, 2021, CA - Callaway and Sant'Anna, 2021, and IMP imputation estimators Gardner et. al. 2022

Significance levels are: '***' p-value < 0.001, '**' p-value < 0.01, '*' p-value < 0.05, p-value < '.' 0.1, and ' ' p-value >= 0.1.

Source: own calculations.

- The effects differ depending on tenure.
- In some tenure types privatization does not change land use

Spillover effects by tenure (SA estimator)

	Ind. farm (own)	Ind. farm (rent)	Ag. ent. (own)	Ag. ent. (rent)
Panel A. Full sample				
ATT	-0.0399***	-0.0106***	0.0167	0.0204
Spillover on allocated	-0.0062***	-0.0111***	-0.0075***	-0.0078***
Spillover on unallocated	-0.0081***	-0.0124***	-0.0074***	-0.0076***
N obs.	230,950	444,023	188,088	200,087
N ind. FE	9,623	18,501	7,837	8,337

Statistical significance levels are: '***' p-value < 0.001, '**' p-value < 0.01, '*' p-value < 0.05, p-value < '.' 0.1, and ' ' p-value >= 0.1.

Source: own calculations.

- Spillover effects are stronger than the effect of privatization.
  - They magnify the negative impact of privatization.

- Individual farmers reduce the negative effects of spillovers with fencing and enforcing enclosure.
- An irrational seed persists: enclosure causes overgrazing, instead of efficient land use (although land sales and rental is possible).

Spillover effects by village proximity

	2 km	2-5 km	5 km	5-10 km	10-more km
Panel A. Full sample					
ATT	-0.0171***	-0.0079*	-0.0124***	-0.0057.	0.0083*
Spillover on allocated	-0.0138***	-0.0126***	-0.0113***	-0.0173***	0.0008
Spillover on unallocated	-0.0172***	-0.0140***	-0.0135***	-0.0183***	0.0034.
N obs.	110,399	153,551	263,951	155,399	146,327

Statistical significance levels are: '***' p-value < 0.001, '**' p-value < 0.01, '*' p-value < 0.05, p-value < '.' 0.1, and ' ' p-value >= 0.1.

Source: own calculations.

- Competition for land is the highest within 5km from villages because of the households that use rotations to graze livestock.

Findings from the field

April 11 to 26, I spent in Kegen district, conducting semi-structured interviews with the Households and Individual farmers.

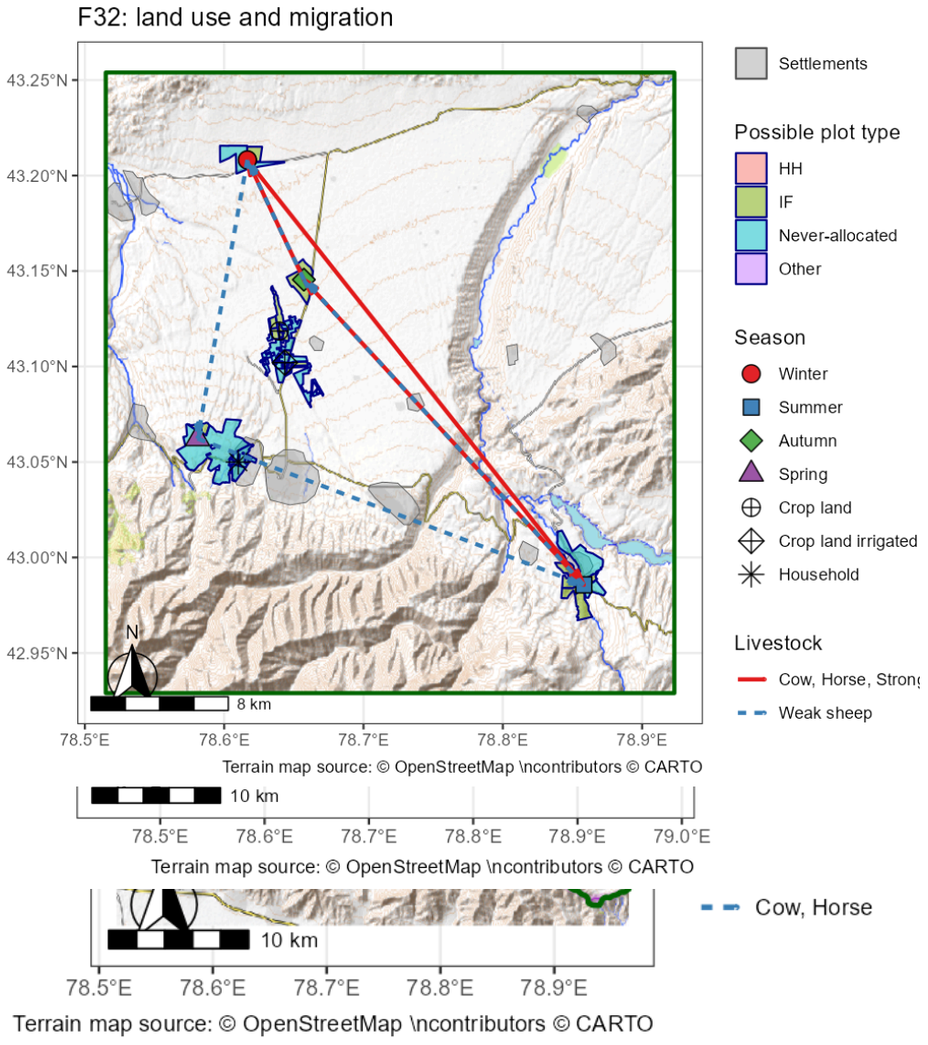
Two distinct cases emerged:

Transhumance: most IF and HH implement migratory grazing keeping livestock on different winter, spring, summer, and autumn pastures avoiding feed use.

No migration: single pastures year round.

Successful transhumance

- Land enclosure is **not a central problem** to pasture management because of diverse alternatives in accessing land **informally** (in line with Adamopoulos et al. (2022)).
  - Tenants feel secure about their informal rental rights.
  - Once enclosed, neighbors act opportunistically, requiring land monitoring, especially in proximity to villages.
  - In response, rare fencing occurs, but generally community enforces the enclosure.
- Strong collective action is a key to migration:
  - larger herd sizes are essential to take advantage of scale economy: fixed costs are required to migrate.
- Collective actions depend on **familiar relationship**, **trust**, **verbal agreements**, **neighborhoods**, and **exchange in-kind: in labor and livestock**.



No migration

Happens when **collective action fails**:

- “If I migrate, others will graze on my pastures. What my livestock will eat during winter?”
- no roads makes remote transhumance impossible;
- livelihood depends on dairy and related marketing channels (tourism) not accessible from remote pastures.

Failing collective actions are observed with **contrasting inequalities**:

- near urbanized ares, around land “grabbed” by large enterprises, and irrigated crop land.

Land use around villages

Around villages, when land availability is low:

- Land-less households organize in rotations to monitor livestock;
- They graze in a 5km radius;
- Use unoccupied land, or plots, where enclosure is not enforced by the owner.

This supports privatization spillovers finding where:

- Low availability of land elsewhere leads to more intensive private and communal land use.
- Communal enforcement of enclosure reduces spillover effects on the privatized land.

Conclusions

Land privatization leads to the **reduced vegetation** on pasture (contrary to findings elsewhere: Hou et al. (2022) Buehler (2022)).

- Fieldwork shows: the same parcel is being more regularly used once privatized (population/LS growth)

IF keep LS on the **same pastures all year round** contrary to the rational expectation of land exchange and migration.

- Field: it happens **when collective action fails**.
- It fails in the presence of external distortions.

Negative privatization spillovers exists. They exacerbate the negative effects of privatization also in village proximity

- Field: landless LS owners act opportunistically, but enclosure reduces spillovers also without fencing.

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