Land access and feeding strategies in post-Soviet livestock husbandry: evidence from a rangeland system in Kazakhstan

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Focus on determinants of intensification

Research questions :

a) What are the determinants of land use and feeding strategies among livestock owners in Kazakhstan?

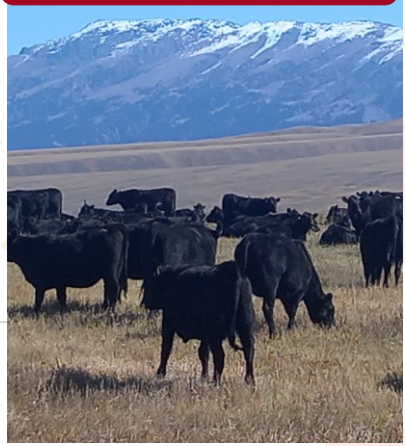
b) Among these determinants, what is the specific role of recent reform outcomes concerning land access and farm restructuring?

We define strategies providing more fodder per animal as more *intensive* & more pasture-dependent feeding strategies as *extensive*.

Produce fodder?

Purchase fodder?

Use remote pastures?



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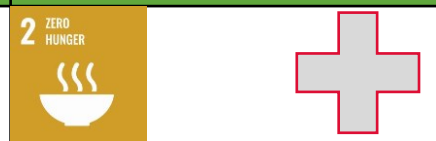
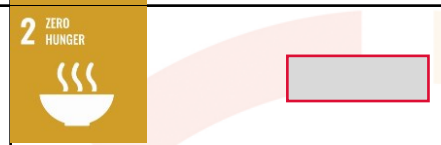
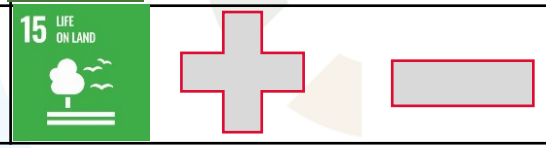
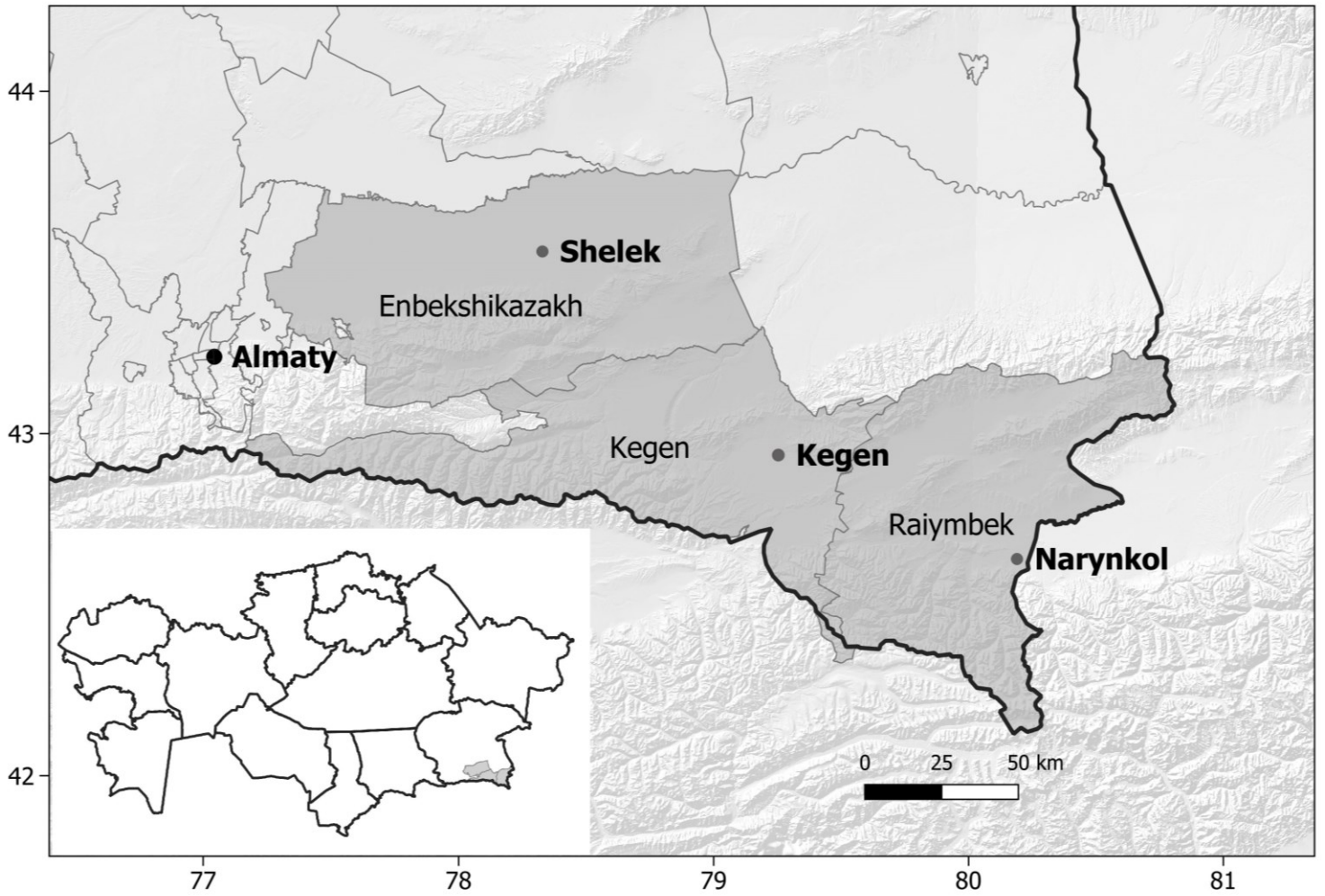
Implications of intensification (why is it interesting?)

Impact of livestock production system (metrics)	Impact on SDG (of more intensification)
Feed use efficiency (Herrero et al. 2015)	
Feed-food competition (Mottet et al. 2017)	
Water scarcity and pollution (Mekonnen and Hoekstra 2012)	
Zoonotic Disease (Gilbert et al. 2021)	
Greenhouse gas emissions (Gerber et al. 2013; Herrero et al. 2015)	
Biodiversity (Reid et al. 2010; Steinfeld et al. 2006)	

Study site & data

- South-eastern Kazakhstan
- Survey of 200 farms and 50 households



Outcome variables

Three feeding strategies explored:

1. Provide additional fodder based on the crop and hay land available.
2. Provide additional fodder through purchases.
3. Expand into new grazing areas abandoned or underused since the Soviet period, measured through indicators of livestock mobility.

For our analysis these were defined as:

Fodder availability

- Self-produced roughage (kg)
- Self-produced concentrate (kg)
- Purchased roughage (kg)
- Purchased concentrate (kg)

Livestock mobility

- Months spent on off-village pasture (0-12)
- Maximum distance moved in the year (km)
- Share of mobile cattle in total (0-100)

Model structure

Recursive multi-equation conditional mixed process modelling (cmp) (Petrick and Götz 2019, Roodman 2011).

Exogenous determinants

Natural conditions

- Precipitation, temperature, altitude

Geography

- Distance from markets
- Population density

Production factors

- Pasture access
- Access to cropland & hayland
- Access to finance

Socioeconomic characteristics household

- Labour availability
- Education of farm head
- Age of farm head

Restructuring experience

- Farm or household
- Age of farm
- Farming experience in Soviet period

Livestock holdings

Outcomes

Fodder production

Fodder purchase

Livestock mobility

Instrument pasture Access.
Points scale with increasing:

- Individualisation
- Formality & Tenure Security
- Number of areas

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Credit constraint variable

Producers are credit constrained if:

- Owner applied for a loan and was rejected or would have liked to borrow more at going interest rate than was actually obtained (**quantity rationing**).
- Refrained from borrowing because feared risk of defaulting (**risk rationing**)
- Regarded the application procedures as too complicated (**transaction cost rationing**).

(Boucher et al. 2009, Petrick et al. 2017).

Non-credit constrained producers are:

- Borrowers who received the full amount of credit for which they applied.
- Borrowers and non-borrowers who would have borrowed more had the interest rate been lower or who lacked sufficient collateral are '**price rationed**'.
- This form of rationing is not included, as considered due to welfare enhancing market forces.

(Boucher et al. 2009)

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Equation pairs

For each outcome we present structural and reduced form equation results:

- **Structural form** solves equations (1) and (2) simultaneously. Coefficients represent *direct* effects of determinant on the outcome (i.e. separated from effects mediated through livestock unit).
- **Reduced form** finds the combined net effect of livestock unit and exogenous determinants by substituting livestock equation instead of livestock in main intensity outcome equation. Contribution of herd size is unseen.

Example:

	Months on off-village pasture			
	Structural		Reduced	
	Coeff.	P	Coeff.	P
Log of livestock unit	14.46***	<0.001	-	-
Average annual precipitation	-0.02	0.700	-0.02	0.210
Distance from Almaty, km	-0.03	0.524	0.04**	0.042
Number of households in sub-district	<0.01	0.184	>-0.01	0.728
Log of cropland area (ha)	-2.02**	0.022	-0.07	0.783
Log of hayfields area (ha)	-1.87**	0.028	0.22	0.337
Credit constrained (0/1)	5.71***	0.001	1.09*	0.087
Total household members	-0.08	0.922	0.24	0.163
Categorical education index (0-2)	-0.96	0.534	0.21	0.698
Age of manager (years)	-0.08	0.809	0.17	0.313
Square of age of manager (years)	<0.01	0.920	>-0.01	0.353
Household (1) or farm (0)	7.74**	0.018	-1.58	0.141
Worked on state farm (0/1)	2.31	0.193	-0.42	0.527
Years since establishment	0.05	0.747	-0.07	0.148
District (Kegen)	-2.73	0.664	-1.84	0.444
District (Raiymbek)	7.74	0.402	-4.83	0.127
Pasture access category[a]	-	-	1.43***	<0.001
Constant	-56.62	0.012	-2.90	0.739

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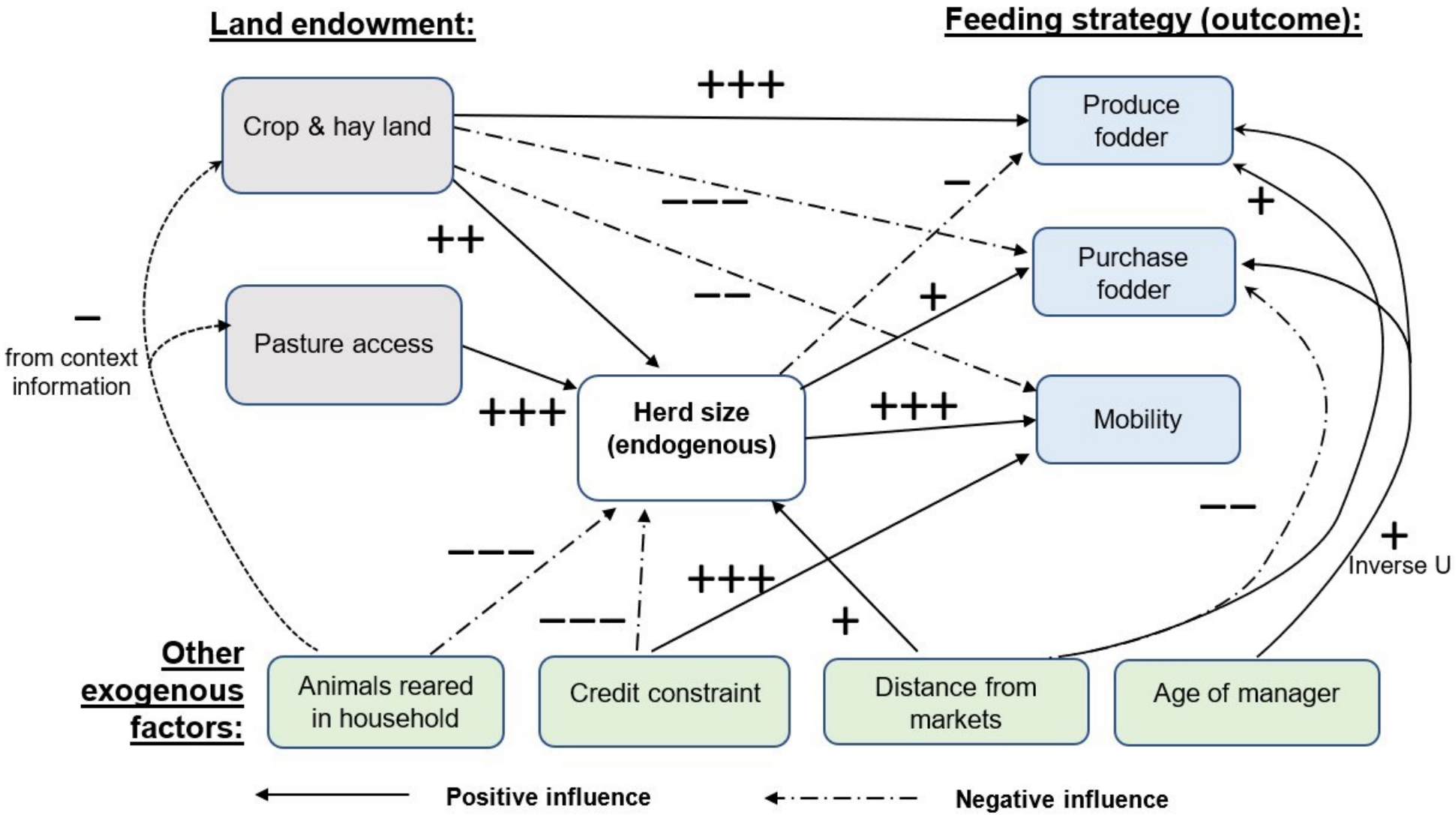
Results of all paired equation models



Key takeaways

Access to crop and hay land	Allows farmers to **produce more fodder and keep larger herds**. But as larger herds are more mobile, overall net effect of land access on mobility is null.
Credit constraints	Associated with **extensive production**, but as farmers with credit access keep fewer animals, the overall effect on mobility is neutral. **Most common constraint is risk rationing**.
Distance from markets	Compels farmers to **produce more roughage**; negative determinant for both concentrate production and purchase.
Settlement size	Negatively related to mobility indicators, suggesting **more mobile strategies in sparsely populated areas**
Restructuring	Households keep significantly fewer livestock and produce less roughage than commercial farms. **Farms established later are more mobile as these found it hard to obtain arable land**.
Precipitation; Education, labour	**Not significant**

Conclusions

- Self-produced fodder is substituted for pasture with rising herd size: this may appear obvious.
- However, some have found cultivated land area to be only weakly related to feeding intensification due to substitutability of purchased and farm-grown fodder (Staal et al. 2002).
- In our study system, substitution is difficult – and distance from Almaty is an important predictor of concentrate purchase.

Thus, at large holdings and far from markets, it may be cheaper to use pastures than either fodder procurement strategy.

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Conclusions

- Land access determines how producers feed their livestock.
- Limits to cropland access mean that **as herd size increases farmers become more mobile.**
- These mobile commercial producers **remain unspecialized.**
- **Risk rationing of credit** reflects barriers to intensification in remote areas (Godde et al. 2018).

Global context :

- This pattern differs from global intensification trends based on external input use (Davis et al. 2015).
- Similar observations in arid regions where growth in livestock production achieved through increasing animal density on pastures (Godde et al. 2018).

- But **many pastures still understocked.**
- Some pastures of much higher quality than certain fodders.
- Animals may be fattened on grain higher up the value chain.

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Policy implications

Land reform and farm restructuring:

- Land is accessed through leasehold from the state.
- Barriers to obtaining or transferring leaseholds are high (Kvartiuk and Petrick 2021). Smallholders cannot access leaseholds.
- Public pastures cover a limited area (Robinson et al. 2021).
- This has led to a **mismatch between pasture area and stocking density.**

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Recent policies promote mobility

- Kazakhstan initially focussed on intensification.
- Recent reforms focus on making pastures more easily transferable. And accessible to smallholders.
- But still fall short of landscape-level management required to foster optimal use of seasonal pastures.
- Meanwhile, reducing uncertainty through insurance, greater policy stability and better infrastructure may support a greater diversity of feeding strategies.

SDG nexus network
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Thank you!

Robinson, S and Petrick, M. (2024). Land access and feeding strategies in post-Soviet livestock husbandry: evidence from a rangeland system in Kazakhstan. *Agricultural Systems*.

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